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**GROUPWARE SUPPORT FOR
OPERATIONAL MANAGEMENT**

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ABSTRACT

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The purpose of this research work is to provide *operational management framework to deal with groupware support*. Initially theoretical and empirical models about groupware and operational management are presented for the basis of the framework. Criteria for the evaluation of the support are also presented, at a later stage.

The operational management model is built on the basis of the Fayol's model, which deals with the management functions: *planning, organizing, commanding, coordinating and controlling*. The groupware model is built on the basis of the Lotus Development Corporation model, which deals with groupware functions: *communication, collaboration and coordination*. The particular models were chosen because their combination facilitates the evaluation of the functionality of the operational management with groupware use. In the empirical part of the research, operational managers were interviewed and some groupware environments were examined.

The main results of this thesis are the framework about groupware support for the operational management and the empirical models about operational management and groupware utilisation. *Criteria about interaction, information and knowledge creation* were also proved important for a holistic evaluation of the results. From the practical point of view the developed framework indicates how groupware modules could be used to facilitate the work of the operational manager.

KEYWORDS: operational management, management functions, groupware, groupware tools, Fayol's model.

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1 INTRODUCTION

The task of management is to *assist people* in organizations to achieve corporate strategic objectives. There have been management supporting information systems for decades. However, groupware support for management has not been studied widely. Known software systems usually support the interaction between the user and the system (Ellis, Gibbs and Rein 1991, 40). Groupware can additionally support *interaction between people*.

The operational manager himself/herself is an *active participant in his/her group*. Applications that support group work could also support *group management*. Groupware features could bring extra value to management by increasing the interaction between people, organizational memory and organizational knowledge. Groupware could provide an environment for people to work together and reduce the limitations that exist in the traditional organization.

Operational management is the *link between corporate mission and corporate operations*. There are a lot of studies made about strategic, project or change management. However, operational management has not been studied widely. Operational management exists in organizations in that level, where corporate objectives are transformed to specific tasks and orders. The effectiveness of middle and executive management depends on how well corporate strategic objectives are transformed to detailed tasks for operations and how operations are executed. The *quality* of available information and knowledge is a significant factor. *Information* is needed not only about strategic objectives, but also about organizational knowledge, resources, performance and corporate environment.

Operational management coordinates and controls immediate work (Vanhala, Laukkanen & Koskinen 1995, 34). "*Operational managers are responsible for monitoring the firm's daily activities*" (Laudon & Laudon 1998, 12). The work of an operational manager is also extended to other management functions. Just coordination and controlling are not enough. As a coordinator he/she has to be able to participate in operational planning and organizing functions. The differences between middle management and operational management are not always clear. In this thesis some work of the middle management is examined together with operational management. In this thesis, operational management is defined as management of the personnel, which executes immediate work. The focus of the research has been placed on the managerial functions.

The goal of groupware is to assist groups in communication, in collaboration, and in coordinating people's activities. *Groupware* can be defined as computer-based systems that support groups of people engaged in a common task by providing an interface to a shared environment. (Ellis et al. 1991, 40) *Groupware tools* are instruments, which can be used to implement groupware functions. In this thesis groupware is defined as software that *assists group to work together for achieving a shared goal*.

The aim of research is to survey the potential value of groupware for management. There are different management functions, such as *planning* and *coordination*. To find out the usability of groupware in management, the *functions of the management* must be defined first. *Detailed* specifications of management functions facilitate the evaluation of the work of the operational manager. One aim of the research is to find out, what kind of tasks operational manager has to do. The theoretical model of operational management that is used here is based on previous research in the field of management.

Since groupware could be understood in many ways, a model about groupware is considered throughout this research in order for groupware to be

categorized for the facilitation of evaluation of the groupware tools. Another aim of the research is to find out what types of groupware tools also exist and how these can be categorized. The theoretical *model of groupware* is based on previous studies about groupware.

The main objective of this research is to build a *framework*, which could be used for evaluating the needs of the operational management and the possibilities of groupware applications to support it. This evaluation had to be made with common sense and understandable criteria. The research can ultimately provide an approach to the management of requirements specification and groupware development. The main outcome of this research is a framework, where operational management and groupware functions are presented in an integrated way, where the relationships of the two previously mentioned models are defined and explained.

The *research problem* handled the following main questions and subquestions, which are discussed and exposed further in the chapters of this thesis.

1) Which are the *management functions*?

- What are the main operational management functions?
- Which are the objectives of each function?
- What tasks are included in each function?
- Which are the outcomes of each function?

2) Which are the *groupware application functions* and which are these groupware features that could support management?

- Which are the main functions of groupware?
- Which type of tools can be used in each function?
- Which of tasks can be supported with in each function and by which groupware features?

3) Can groupware *support* operational management?

- Are there any problems with the use of groupware?
- What type of groupware tools can support operational management and how?

Following these questions, the research initially presents operational management functions and groupware functions. Additional criteria to evaluate the relationships of these two models are explained.

The answers to the research questions are analyzed and evaluated with *empirical case studies*. Operational management functions are defined with six semi-structured interviews. With in this information the usability of the theoretical management model can be evaluated. The approach taken in the interviews is qualitative. The approach to application evaluation is also qualitative. Then operational management functions and groupware functions are compared. The comparison *criteria* are based on the concepts and forms of *interaction, information and knowledge creation*.

The need for interaction considers the need for synchronous or asynchronous communication, the need for one to one or one to many type of interaction and the need for formal or informal interaction. Information forms can be text, pictures, audio or video. Knowledge creation and management can be the creation or transfer of tacit and explicit knowledge. Consequently, groupware tools are also evaluated regarding their support to different types of interaction, information, knowledge creation and knowledge management.

The empirical *model about operational management* presents new information about the tasks of the operational manager. Totally twenty one (21) different tasks of the operational managers are identified and are also evaluated with evaluation criteria based on interaction, information and knowledge creation. This empirical model provides an example about the work of the operational manager. Existing *groupware tools* are categorized and evaluated with the same criteria.

A new framework for evaluating the groupware support to operational management is presented. The framework about groupware support to operational management is a synthesis of presented two empirical models. It was clearly found, that in operational management, there exists such kinds of interaction, information and knowledge management, which can be supported with groupware environment. The demands of the work of the operational management and the support of the groupware tools, for these demands, are presented. Single groupware tools are integrated to groupware modules. The support of these modules to operational management is presented and proved with the evaluation criteria.

The second chapter of the thesis presents a theoretical model of operational management based on the literature study. Theoretical model is needed for empirical research about operational manager's work. The third chapter presents a theoretical model of groupware functions, which is build with literature study. This model is needed for the evaluation of groupware tools. These evaluation criteria are presented in fourth chapter.

The understanding of manager's work is needed for the evaluation of the groupware support for managerial tasks. An empirical research about the work of operational manager is reported in fifth chapter. Operational tasks are presented to give an overview about the daily routines of operational manager. In sixth chapter, groupware tools are evaluated. The seventh chapter collects up the previous chapters and presents a framework about groupware support to operational management. In last chapter, the results of this research are discussed. The last chapter includes also the summary of the thesis.

2 THE FUNCTIONAL MODEL OF OPERATIONAL MANAGEMENT

Managerial work, roles and decisions vary on different levels of the organization. Managers have different information needs (Laudon & Laudon 1998, 12). The mission of the organization has to be transformed into strategic objectives to guide management (Kotler 1999, 90). The task of the operational management is to execute strategic objectives with the resources of the organization. The work of people and groups, and the support of this work in the spirit of the organization strategy, is essential for organization (Vanhala et al. 1995, 117). Managerial work includes five different functions: 1) *planning*, 2) *organizing*, 3) *commanding*, 4) *coordinating* and 5) *control* (Fayol 1987, 9). In this chapter operational management is examined with these functions. The purpose of the chapter is to provide scientific base for the examination of operational management. Objectives, tasks and outcomes of each of the functions are examined and presented. Also manager's working roles are examined to get more detailed description about operational management. Management can be divided in different functions, but these functions should not be examined separately.

2.1 Operational Planning Function

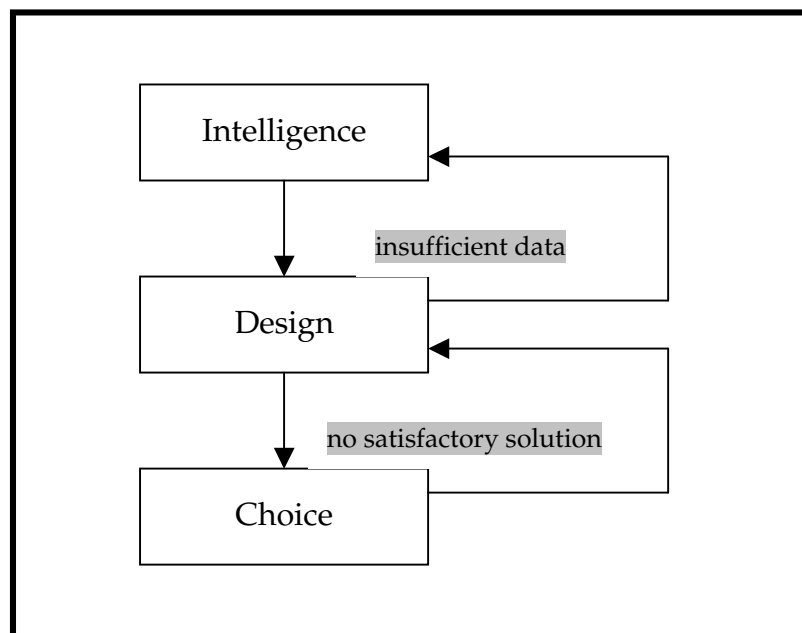
Planning is setting objectives for actions and making decisions about methods (Vanhala et al. 1995, 30). Planning and decision-making should not be considered as separate activities (Minzberg 1980, 37). Planning is defining what is wanted to accomplish (Fayol 1987, 5). In this thesis operational planning is seen as transforming operational objectives to operational plan of action. Planning includes information searching, making decision and designing an operational plan of action.

Planning is based on the strategic objectives of the organization (Oakland 1993, 70). While planning operational actions, manager should have access to the strategic decisions of the organization. Operational planning cannot be in

conflict with the objectives of the organization and operational manager has to be aware about the strategy of the organization. All sub plans should be a part of the organization strategy (Fayol 1987, 22). This alone is not enough to start operational planning. The objective of the management is to "make sense" of the situations faced by the organization and formulate action plans to solve organizational problems (Laudon & Laudon1998, 12). Manager has to see the essential part of actions needed. Manager has to compromise between the objectives of the organization and the needs of the people (Nurmi 2000, 15). As a responsible for the organization performance, manager has to transform and execute objectives of the organization to the actions and tasks for the subordinates (Nurmi 2000, 15). The plan of action rests 1) *on the resources of the firm*, 2) *on the nature and importance of work in progress*, and 3) *on future trends* (Fayol 1987, 15). The objective of operational planning is to make a plan of action, which is in harmony with strategic objectives, and can also be realized and accomplished by the members of the organization. Operational planning should take into account organization structure, command guidelines, coordination mechanisms and control function.

Simon's model depicts human decision-making as a three-stage process: intelligence, design and choice (Galliers 1987, 20). Planning tasks can be seen chronologically: 1) *finding out the objectives, possibilities and possible threads of the organization*, 2) *making decision how to proceed* and 3) *planning the details and objectives for other management functions*. Simon's model is presented in the picture 1.

For the basis of the planning manager has to gain needed information. Manager begins planning with the search of information. He has to gather information about objectives, environment and organization resources. Manager needs and receives information in different forms and uses this information as a basis for decision (Nurmi 2000, 16). The search of information continues after planning. Manager needs information while controlling the tasks of the subordinates. Information is needed from the middle and top management. Manager also has to be aware of his/her own resources. Manager has to discuss about the plans with employees (Juuti 1989, 201).



Picture 1. Human decision-making process (Ahituv & Neumann 1987, 20).

The most important task of the management is decision-making. Decision-making can be seen as a line between planning preparation and planning implementation (Nissinen 1998, 56). More information may be needed before decision-making. Manager needs information in different forms. Decision-making for operational control determines how to carry out the specific tasks set forth by strategic and middle management decision-makers. Manager has to determine, which units in the organization will carry out the tasks. Manager establishes criteria for completion, resource utilization and evaluating

outcomes. All of this requires a decision about operational control. (Laudon & Laudon 1998, 129). Operational manager will make decisions about personnel and controlling. Manager has to make a decision how to proceed and he/she has to decide general methodology to be employed during operations. Decision includes the methods how to achieve the operational objectives of the organization.

Plan of action has to include the overall results, results of major stages, execution of the plan, and a general layout of timing (Fayol 1987, 15). After decision-making manager has to make a more detailed plan about the subordinate's tasks. Also organization structure for communication and control functions has to be planned. Operational plan of action is the base for other management functions. The structure of the organization, coordination, commanding lines and controlling are based on the operational plan of action. The planning process has an influence on all the managerial activities (Fayol 1987, 23)

The plan is a picture about the future. Events appear progressively less distinct as they become more distant from the present. It is the basic means for guiding the organization over a managerially defined period. The outcome of the plan is the only thing that finally determines its true value. There are certain characteristics of plans, which appear crucial to their success. One such characteristic is a plan's unity. A plan must also have continuity. Only one basic plan can be put into operation at same time. A basic plan must often be divided into several parts. The plan should be flexible. (Fayol 1987, 15 - 16)

Outcome of the planning is the base for other functions of the management. Plan allows the manager to design the structure of the organization, and formulate tasks for subordinates. Plan also allows manager to design coordination, which may include communication and "check points" for coordination and control. Controlling can also be planned on the basis of operational plan. Control sensors are needed for gathering information.

Operational manager's working area has a large influence to what kinds of plans are needed.

It takes some time before new manager is able to do planning (Fayol 1987, 25). Organizational memory can be used to support manager training and decision-making. *"Good specimen plans should be made generally available (from past history of the firm, published sources, trade associations, universities, or consultants). Experience and general discussion should help single out those plans to be used as examples."* (Fayol 1987, 26) There is also a need for trading ideas with other managers. In order for a good plan to be compiled, the personnel in charge should be skilled in the art of handling personnel and have experience and ability to generate creative ideas (Fayol 1987, 24). Subordinates objectives and ideas have an influence on the objectives of the organization (Nurmi 2000, 15). Something new can be learned from the methods adopted by others. Experience from recent plans and recognition of mistakes made, will make new plans more useful. Also personnel experience will grow. Everything going on in the firm will combine to managerial abilities. (Fayol 1987, 17, 23)

2.2 Organizing the Work

Organization is the establishment of the formal structure of authority through which the work of subdivisions are arranged, defined and coordinated for the defined objective (Minzberg 1980, 9). To organize is primarily to set out human organization and the expected flow of communications (Fayol 1987, 27). Organizing can also be seen as arranging people's collaboration to achieving organization objectives (Nurmi 2000, 25). In this thesis operational organizing is seen as setting up human organization and communication lines to achieve operational objectives. Organizing includes also arranging information flows. Because operational manager is on the lowest level of the management, there is no need to create lines of authority. It is more important to create information flows for collaboration.

Manager has to create the lines of authority and responsibility along which the orders flow to start the work (Fayol 1987, 5). For operational manager it is more

important to create lines of communication. The objective of organizing is to arrange people and resources effectively for achieving the objectives of the organization. Manager allocates his/her resources. Superior is responsible for the efficiency of his resources (Nurmi 2000, 22). Manager's objective is to make a form, which allows organization to work for achieving operational objectives. Organizing should include setting up lines of communication.

Selection of employees in order to build up organization is important and difficult task (Fayol 1987, 33). Organizing tasks are setting the flow of materials, training employees and scheduling. Manager has to schedule his own time (Mintzberg 1980, 86). Information analyze has to be organized to help the evaluation of alternative solutions (Nissinen 1998, 56). Management has to arrange efficient personnel selection (Fayol 1987, 27) for current situation, which is defined in the operational plan of action. If organization does not have the personnel needed available, also staffing may be needed. Manager has to set up guiding authority and establish the lines of communication to and from this authority throughout the organization (Fayol 1987, 27).

The outcome of the organizing is the structure of the organization and communication lines that supports other functions of the management to achieve operational objectives, which are established in operational plan of action. On operational level this may be reforming groups and working schedules. This may also include the selection of supporting communication equipment.

Managers must re-create the organization from time to time (Laudon & Laudon 1998, 12). The general form of an organization depends on the number of employees, the level and motivation of those employees, and the nature of the work to be done. When the number of levels in organization is reduced, the chain of communication is shortened. This reduces delays in orders from strategic level to operations. (Fayol 1987, 30, 33) Organization will also change on the operational level. There is always a need for rearranging duties and communications.

2.3 Commanding Function

Commanding is about sharing information and giving orders to workers about tasks. Commanding can also be seen as the continuous task of making decisions and embodying them in specific and general orders and instructions (Minzberg 1980, 9). In this thesis operational commanding is seen as establishing the operational objectives and tasks for subordinates. Commanding contains also routine management. Commanding can be seen as a continuous function. Subordinates need information and guiding during their work. Commanding has to be interactive. Subordinates must have a chance to make questions or suggestions.

The objective of the operational commanding is to get the organization started to work. *“An organization, having been formed, must be set going – and this is the mission of command”* (Fayol 1987, 49). Manager cannot give strategic objectives straight to the subordinates. Objectives have to be interpreted. Most of this work is done during planning. Manager transmits interpreted information to subordinates (Nurmi 2000, 17). Manager has to make subordinates to understand the value of each subordinates work. This means that tasks have to be exemplified and explained.

In a conference attended by manager’s staff and assistants, the manager may explain a program and ask for each person’s ideas. Manager may also make decisions, make sure that his orders are understood and make certain that each person knows the part he is to play in the implementation of the decision made. Such conferences, when they are well planned and carefully controlled, will save managers and subordinates time. Conferences are a key component of command. Reports are also important tools. It is the manager’s responsibility to know all that goes on. Oral and written reports are needed in order to ensure proper supervision and control. (Fayol 1987, 53 – 54)

Outcome is a clear interpretation about operational plan of action and organization structure. Each subordinate’s work, objectives and available resources have to be clarified for everyone related to current task. After the

establishment of the operational plan of action, subordinates should be able to start their work.

Manager can study his/her immediate subordinates and succeed in knowing what he can expect from each of them and what degree of confidence he/she can place in them (Fayol 1987, 50). As a commander manager also needs negotiation skills. Commanding has to be clear enough. Subordinates have to understand their tasks clearly. There is always a need for questions and interaction during commanding.

2.4 Coordinating Operational Work

Coordination is harmonizing the work of different factors. On operational level, even single workers work has to be coordinated. In coordination theory, the common problems have to do with coordination: How can objectives be subdivided into actions? How can actions be assigned to people? How can resources be allocated among different actors? How can information be shared among different actors to help achieving the objectives? (Malone & Crowston 1990, 376) In this thesis operational coordination function is seen as following-up and stepping into employers work. Coordination contains also scheduling work and resources. Coordination has to be planned in operational plan of action.

“The successful complementation of a pre-defined business process depends on the coordination of the people in completing a set of structured tasks in a particular sequence and within expected time constraints” (Lotus Development Corporation 1995, 31). Coordination objective is to harmonize people and the work of the department so, that the waiting and harmful simultaneous work is minimized. Work and the outcome have to be in harmony with the strategy of the organization.

To coordinate is to harmonize all the activities of a concern so as to facilitate its successful functioning. Coordination involves: 1) *determining the sequencing and timing of activities so that they properly mesh;* 2) *allocating to things and actions their*

rightful proportions of resources, time and priority; 3) adapting means to ends. Coordinating means keeping the secondary considerations behind the principal ones. Scheduling can be used as a tool for coordination. Working schedules of the various departments are constantly attuned to circumstances. Each department must work in harmony with the others. (Fayol 1987, 45) Examples of coordination processes can be: ordering activities, allocating resources, and synchronizing activities (Malone & Crowston 1990, 382).

One method for keeping the personnel functioning well and for making the execution of their duties easier is a conference of departmental heads. Conferences can be used to coordinate workflow. The objective of a conference of departmental heads is to inform management about the running of the concern, to clarify the types of cooperation expected between various departments, and to utilize the presence of departmental managers for solving various problems of common interest. (Fayol 1987, 46) Manager has to solve conflicts (Juuti 1989, 201). Manager is a liaison between different departments (Nurmi 2000, 15-16).

The outcome of the coordination is harmonized work. Resources are allocated and activities are synchronized. Coordination can usually be noticed when it is absent. For successful coordination, manager has to be aware of his resources and status of the performance of the duties. To be able to coordinate manager needs feedback from subordinates.

2.5 Controlling Operational Work

Control function provides information or feedback so that manager can keep all functions on track (Oakland 1993, 29). Controlling is to make sure that organization is working by the operational plan of action. In this thesis operational controlling is seen as monitoring operational work. In this thesis controlling is seen more related to controlling the work than controlling people. Controlling is closely related with quality control. Controlling has to be planned.

To control is to be concerned with general management, whose objective is to see that results match the established plans and whose activities are designed to contribute to the smooth working of each department (Fayol 1987, 58). One of controlling objectives is also to learn from work. The results of controlling have to be reported.

Operational control includes checking on-going performance against the plan and taking corrective actions when necessary (Kottler 1999, 118). Control is supervising, controlling and evaluating the work. Control consists of verifying whether everything occurs in conformity with the plan adopted. Control involves monitoring for weaknesses, errors, and drifts from the assigned path. Control touches on everything: things, people, actions and timing. (Fayol 1987, 57)

Manager looks for operations that are going wrong, problems in need for attention, and subordinates who require encouragement or criticism. Manager maintains continuing control over the allocation of resources by insisting that he/she authorizes all significant decisions before they are implemented. The tour provides the manager an opportunity to observe activity without prearrangement. Monitoring is continually seeking information that enables manager to understand what is taking place in his/her organization (Minzberg 1980, 62, 67 and 87). The various stages must be controlled (Oakland 1993, 53). Manager has to analyze and report organizations work. Reporting is keeping those, to whom the executive is responsible, informed as to what is going on (Minzberg 1989, 9).

The outcome of the control is an organization, which is heading for its objectives. Manager also transmits information out to his/her organization's environment (Minzberg 1980, 75). Reports may be used in learning and may be stored to organizational memory. The effectiveness of an organization depends on the extent to which each person and department perform their role and move towards the common goals and objectives (Oakland 1993, 29).

Controlling function is important for checking the quality of the process and outcome. Operational manager should also be the quality control manager. The control of quality can only take place at the point of operation or production. The act of inspection is not quality control. Quality control is an activity, which helps to achieve and maintain the quality of a product, process, or service. It includes monitoring. (Oakland 1993, 15)

2.6 Group Management

Group work can be seen essential in operational management. In specialized organization, group work is needed to support coordination. Group work can be used to increase horizontal interaction. Group work can also be used in idea generation. Group work is sharing knowledge and it is needed in organizational learning. (Nurmi 2000, 70) Integration of individual's knowledge to collective level typically takes place in a group. There are many organizational situations in which individuals with specialized knowledge must integrate their knowledge in a group to realize its value. (Okhuysen & Eisenhardt 2002, 1)

Group work doesn't solve problems by itself. Group work can be used also wrongly. Group work cannot solve problems made by poor organizing or commanding. Successful group work needs also knowledge on group working itself. (Nurmi 2000, 71) Operational manager should be seen as an active member of his group. Manager's effort is vital. Manager should be able to select tools, which support the cooperation of the group.

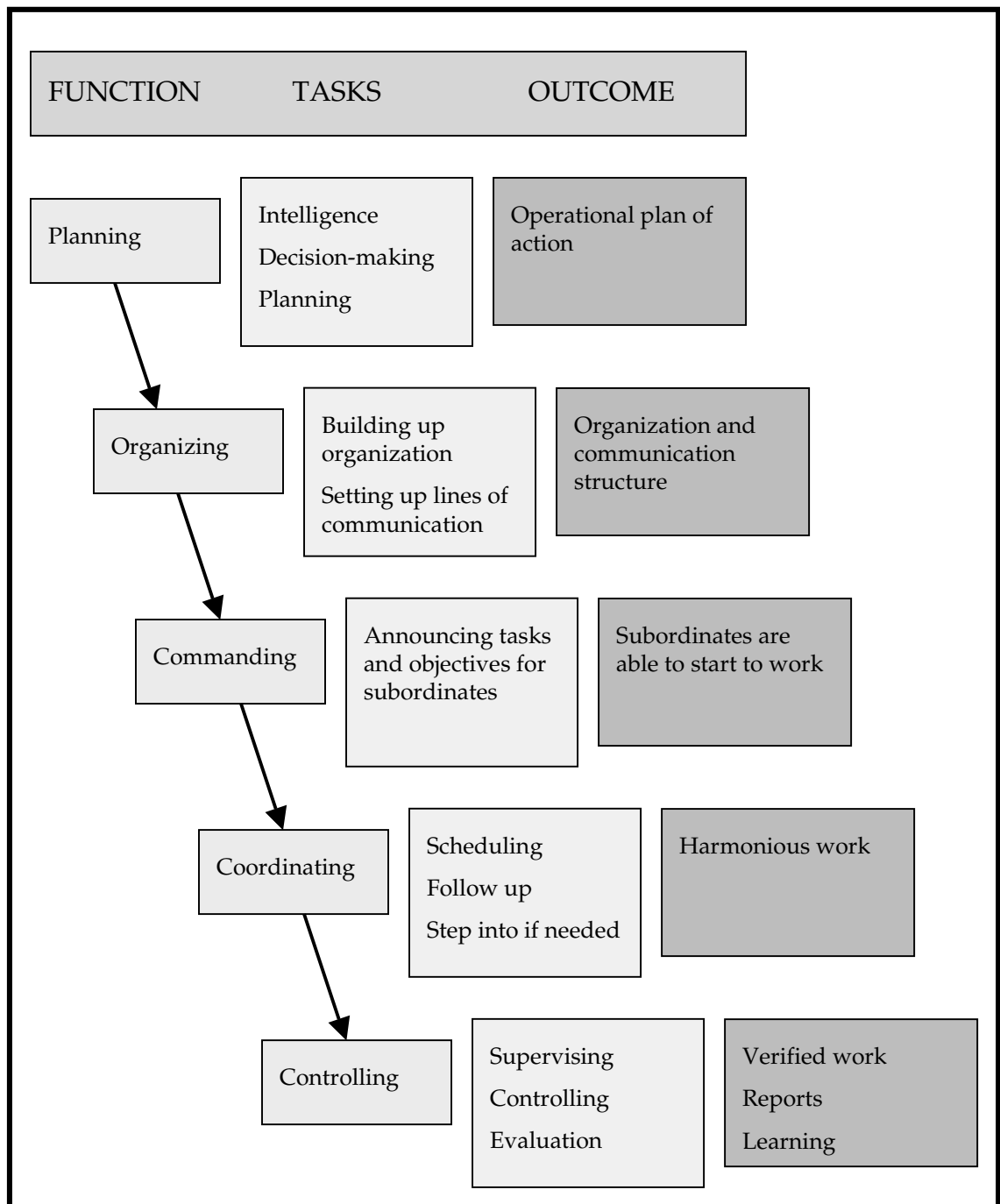
2.7 Summary of the Chapter

Operational management can be examined with Fayol's management functions. Operational management model is illustrated in the picture 2. Operational management can be divided into five different functions and examined with these functions. Each function includes different tasks and different outcomes.

Different functions should not be examined separately. Planning is the base for other management functions and should be based on previous experience. All organization work should concentrate on strategic objectives. Operational manager has to plan management supporting tasks, such as reporting and control. Controlling cannot be considered as productive work. It is supporting work for measuring the actions of the organization. Managers should reduce all supporting work and concentrate on productive work. It is a paradox, but every supportive action consumes resources, which could and should be used for productive work. If manager gets support with supporting activities, he can focus more on productive work.

Managerial work in operational level focuses on details. Operational manager needs very detailed information while planning. Also commanding for subordinates has to be detailed. Group work is needed in operational management. Group has knowledge, which may help manager. Subordinates and other managers may have planning experience and new ideas. Every group member may be seen as a sensor for controlling and coordination. Also interaction during every phase will reduce misunderstanding and conflicts.

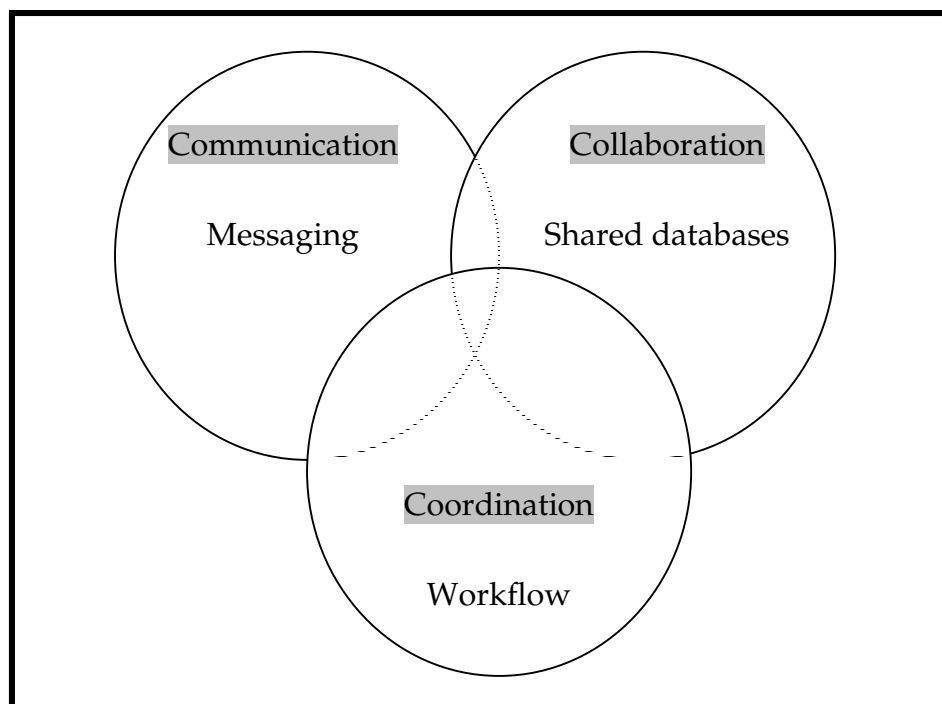
Conferences are very useful mode for group work. They can be used to support every management function. Conferences are needed especially for the allocation of organizations resources to operational objectives. Even informal meetings without clear objective can be used to solve daily problems. Managers have a need for supporting tools or environment. Idealistic environment would provide tools that support every management functions.



Picture 2. The model about operational management.

3 THE MODEL ABOUT GROUPWARE FUNCTIONS

Groupware has its roots in three distinct application areas: electronic messaging, information management, and workflow/process automation. Information and knowledge are shared in support of three functions: communication, collaboration, and coordination. This Lotus Development Corporation's groupware model is presented in the picture 3. Groupware system should support all these different modes of group work. (Lotus Development Corporation 1995, 9-11) This chapter is a description about groupware functions. Each groupware function is defined and examined. Groupware functions and tools are presented. Also the support of the groupware for organizational memory is introduced.



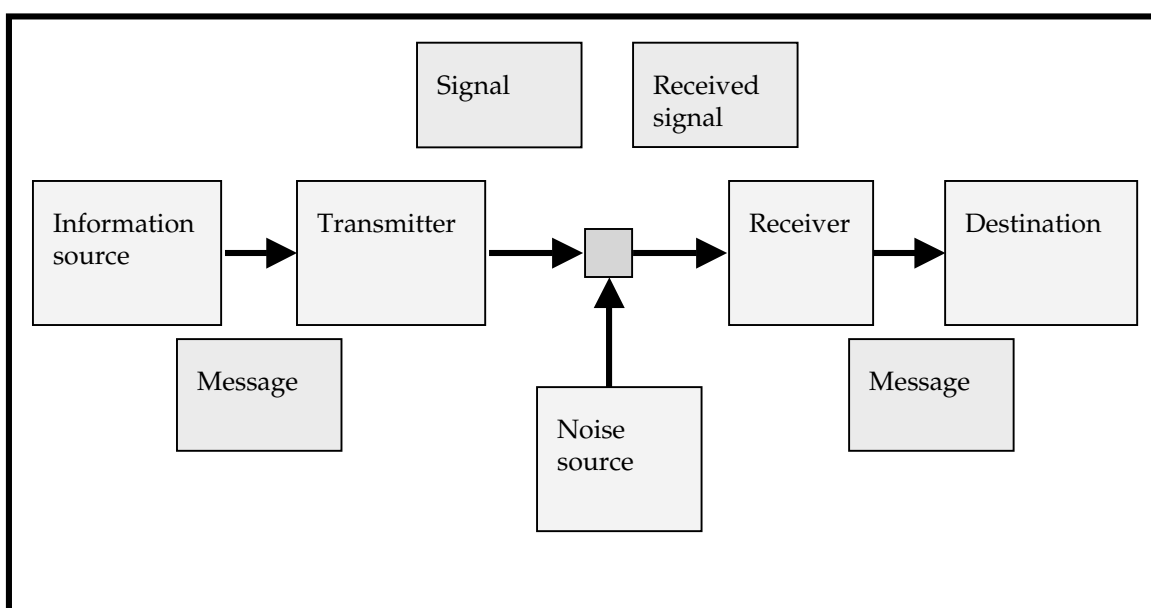
Picture 3. The category of the groupware functions (Lotus Development Corporation 1995, 31).

3.1 Communication Function

"Communication is the transmission of knowledge" (Lotus Development Corporation 1995, 13). Shannon's mathematical theory of communication presents communication with five different parts: 1) *information source*, 2)

transmitter, 3) channel, 4) receiver, and 5) destination. Shannon's theory is presented in the picture 4.

Information source produces message. Message is sent with transmitter. The channel is merely the medium used to transmit the message to receiver. In the channel message is exposed to noise. Receiver reconstructs the message for destination. (Sloane & Wyner 1993, 6-7)



Picture 4. The communication model (Sloane & Wyner 1993, 7).

In this thesis groupware communication function is seen as sending and receiving information and knowledge in different forms via different media. Communication can occur between individuals or groups. It can also be synchronous or asynchronous. In communication, all basic elements of Shannon's theory are needed. Groupware communication tools provide a channel between communicators.

People communicate in many ways: in formal meetings and presentations, through interoffice memos, over the telephone, and in informal hallway meetings. Information takes form of both verbal and visual communication. Electronic messaging is an effective tool for notification and supports communication. (Lotus Development Corporation 1995, 10, 13)

Variables such as time, place and number of participants determine the most appropriate communication system in any given situation. When the combinations of time, place and number of participants increase, complexity is introduced. Electronic messaging supports different-time and different-place information sharing. (Lotus Development Corporation 1995, 13-14)

Electronic messaging is the store-and-forward transport of electronic objects among people. The design point of electronic messaging is the asynchronous transmission of messages from one place to another. Messages can contain different kinds of information, and they can be delivered to individuals or groups. Messaging supports different-time, and different-place information sharing. Electronic messaging should support also different forms of messages, like text, pictures, files etc. (Lotus Development Corporation 1995, 14)

Email is an effective medium for one-to-one and one-to-many forms of communication. Due to the lack of structure and volume of information being pushed, it appears that many-to-many communication quickly becomes unmanageable in this environment. As a store and forward transport, messaging is effective for information delivery. In order to resolve the information management problem, other technologies should be used. Email is effective in supporting unstructured communication, but it fails with more complex level of interaction. Specially, many-to-many communication becomes quickly unmanageable. Email could be quite useful in certain situations, for example manager may have need for occasional interaction. (Lotus Development Corporation 1995, 17)

The information lens is an intelligent system for information sharing and coordination. It bases on semi-structured message types and rules for processing messages. Semi-structured message types are used to add metadata like time, topic and persons involved with message. The information lens helps people to filter, sort, and prioritize messages that are already addressed to them. It also helps people to find useful messages they would not otherwise have received. (Malone, Grant, Lai, Rao & Rosenblitt, 1989)

Computers can serve communications in a variety of ways. Real time computer conferencing allows group to interact synchronously physically dispersed. Computer conferencing can also be asynchronous like newsgroups. The most familiar examples of teleconferencing are conference calls and video conferencing. Workstation-based interfaces make the process more accessible. Desktop conferencing system uses the workstation as the conference interface and also runs applications shared by the participants. (Ellis et al. 1991, 42-43)

Chat systems provide synchronous and text-based discussions between multiple users. Unlike email and computer conferencing, each sentence that is typed is immediately observable for the users, which facilitates rapid turn taking in discussions. (ter Hofte 1998, 11) Chat discussions are informal and messages are not usually stored. Chat is very useful for simple and fast conversations. If specialists are available, needed information can be transferred quite fast. Other participants may also follow the conversation without necessity to participate.

Some message systems have become the resting place for corporate information. As a result, the new ways to manage, manipulate and automate the use or information has been explored. Increased volume of information can have a negative impact on individual productivity. In response to this, features such as rules, filters and hierarchical folders have been implemented to assist with email information management. (Lotus Development Corporation 1995, 15-16)

3.2 Collaboration Function

Collaboration relies on a shared space. Shared space serves as a touchstone for the act of collaboration. Shared spaces are the collaborative tools that provide a context in which the whole of the relationship is greater than the sum of the individual participants' expertise. (Lotus Development Corporation 1995, 19) In this thesis groupware collaboration function is seen as shared space or shared tool, which allows group to work together. Group members have an access to other member's information and knowledge. Collaboration should not be

examined alone without supporting communication. Awareness is important in communication. You need to know who has done what work, who is dealing with whose work now, what other participants can see and so on. (Ambe & Monk 1997)

Shared databases differ from message systems. Shared databases house knowledge in one place. They make knowledge viewable through a common structure and provide a record of what has transpired. This facilitates common understanding and awareness. Activities such as problem solving, brainstorming, identifying and locating data that has been created by others are all forms of collaboration. As in communication, one of the most important contributions of technology in collaboration is the elimination of the constraints of time and space. (Lotus Development Corporation 1995, 19, 21)

Shared databases facilitate collaborative interaction by providing a virtual common workspace with a group-centered interface, which allows participants to share information, knowledge and ideas. Users are allowed to retrieve or ignore information at their own discretion. Shared databases also support knowledge management. Where a shared view is provided, multiple forms of presentation are important, because people need to view information by date, by author, by document type, etc. End users should also be able to customize and modify information. (Lotus Development Corporation 1995, 21)

Groups communicate, share information, generate ideas, organize ideas, make decisions, and so on. Electronic meeting systems try to make group meetings more productive. Technology is designed to improve group effectiveness, efficiency, and satisfaction. Electronic meeting system can be used for example idea generation and group memory. (Nunamaker, Dennis, Valacich, Vogel, George 1991) One of the simple electronic meeting systems is an electronic voting system. It provides a rapid, anonymous and accurate way of voting. Other parts of the meeting process can benefit from computer support. Anonymity may facilitate proposing bold ideas and giving honest opinions about ideas. Meeting support systems can facilitate viewing and manipulating

electronic documents. Similarly, the systems may allow the generation of electronic documents. (ter Hofte 1998, 12-13)

Technologies like videoconferencing enable people to collaborate across dispersed geographical areas. (Romano, Chen & Nunamaker 2002, 1) A media space is a system that uses integrated video, audio, and computes to allow individuals and groups to work together despite being distributed without leaving their offices (Mantei, Baecker, Sellen, Buxton & Milligan 1991, 203). Audio conferencing and videoconferencing systems (multimedia conferencing systems) allow humans, who are geographically separated, to interact with different types of media over distance (ter Hofte 1998, 27-28).

Computer conferencing systems allow users to send a message to a uniquely identified place in cyberspace devoted to discussion about a particular topic. Messages, which are sent with computer conferencing systems can be read by other users at a later time. Apart from showing the temporal order of posted messages, some computer conferencing systems support and exploit additional relations between messages. Systems can also support different types of messages or documents and pictures. (ter Hofte 1998, 10-11)

Reference publishing systems are considered as groupware because they facilitate information sharing. Information is published electronically by a provider and read by many users. This represents a one-to-many broadcast of information. (Lotus Development Corporation 1995, 23)

Bulletin boards and computer conferencing systems are used to provide a much more coherent, common view of group interaction. Electronic conferencing systems (discussion databases, public forums) facilitate asynchronous collaboration by introducing a measure of structure, that passively facilitates the process of sharing, organizing and navigating information through an interactive electronic space (Lotus Development Corporation 1995, 10, 22).

Shared whiteboard systems are designed to support drawing sketches during discussions. Other people can refer or propose modifications to such drawings.

Systems are useful specially when the participants are not in the same room. Some systems allow users to have a different view on the shared workspace, if they wish. Shared whiteboards allow multiple users to draw, type and gesture in the shared workspace simultaneously. (ter Hofte 1998, 15-16)

Problem solving work comprises such general-purpose tasks as brainstorming to generate ideas, structuring those ideas, and evaluating them (Lotus Development Corporation 1995, 22). Group decision support systems provide computer-based facilities for the exploration of unstructured problems in a group setting. The goal of the group decision system is to improve the productivity of decision-making meetings, either by speeding up the decision-making process or by improving the quality of the resulting decisions. (Ellis et al. 1991, 42)

A flexible, shared database at the core of a groupware system provides the platform on which a wide range of applications can be developed. This may vary from simple discussion databases to rich knowledge bases that support, for example, customer assistance systems and responses to questions. Shared databases and shared views are essential for common work. If groups have incorporated collaborative technologies into their environment, they are able to effectively minimize the number of face-to-face meetings that would otherwise be necessary to exchange information and ideas (Lotus Development Corporation 1995, 19, 21-22).

Workspace awareness has made shared spaces more usable. Workspace awareness provides workers with a perspective on the current state of collaborative work. Problems with the workspace awareness can occur if the latest information remains inside the individual's environment. This will cause that workspaces do not provide awareness of the most recent changers to the information. (Hayashi, Hazama, Nomura, Yamada & Gudmundson 1999, 100)

3.3 Coordination Function

The coordination is the integration of individual work towards shared objective (Ellis et al. 1991, 43). An example about coordination is a workflow system. Workflow can be defined as: *The Automation of a business process, in whole or part during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules.* Workflow normally comprises a number of logical steps, each of which is known as an activity. Automating the actual work will increase efficiency. (Allen 2000, 15-16) Workflow system can be based simply on forms, which are routed from person to person. This kind of workflow leaves each person in the group on their own, with no overview of the process (Lotus Development Corporation 1995, 11). The domain of workflow has been to focus on highly structured business processes. Coordination is very active from a systems perspective. (Lotus Development Corporation 1995, 31) In this thesis groupware coordination function is seen as function, which helps to integrate and schedule individuals work to group objectives. Coordination tool provides possibilities for manager to follow up group's work and step into if needed.

Many business activities are much more structured in nature. The organization defines specific policies about how report is to be routed through an organization. Most real work involves a combination of highly structured processes and tasks where the process is fussy and the rules, routes and roles are dynamically defined as the work is being done. (Lotus Development Corporation 1995, 31-32)

Databases suffer from the passive nature of conventional database technologies. Each participant is responsible for finding information and scheduling their actions. This creates the need for coordinate use of messaging and databases. Coordination is supported by communication and collaboration. (Lotus Development Corporation 1995, 10, 30)

Workflow can be based on messaging model. Workflow automation is typically associated with the automatic routing of documents. Route-based workflow

automation generally uses messaging system to route documents to the next person, who must take an action. Routing based workflow is powerful because it matches the model of routing thesis: the document is acted upon and set to the next person for further action. There might be problems while document becomes unavailable to anyone other than the person in whose inbox it resides. (Lotus Development Corporation 1995, 36)

Another workflow model is the shared database. In this model, users consult a tracking database to check the status of specific documents. The shared database model has three advantages. First, triggers can be used to start action without any specific user activity. Second, documents are available for others while the workflow proceeds. Third, model makes the management of workflow much easier. (Lotus Development Corporation 1995, 37)

The use of email may cause problems with version control and document management problem. Shared databases lacks the notification capability when needed. The coordinated use of messaging and shared databases in a fourth generation email system (attachments, rich text and hypertext links) resolves both of these problems. The document is not transferred physically. Only a link with email is sent. Messaging and shared database technologies have each become the foundation for workflow automation systems. Workflow systems that support both models, as well as supporting the less structured collaborative functions, will be most successful. (Lotus Development Corporation 1995, 34-35, 39)

Workflow management systems coordinate actions by users to help a group to achieve particular goals. Systems enforce the right actions at the right time by the right user, based on a model of a cooperation task, which is embedded in the workflow system. Systems can track the state of a particular workflow and will suggest certain actions by certain users at certain times, while providing relevant information needed for particular actions. (ter Hofte 1998, 12)

Workflow tool would support operational manager while coordinating and controlling group's work.

Scheduling a meeting with a group is one of the group tasks, which might benefit from computer support. Finding free time in several personal schedules seems a task that can be done more efficiently with a groupware system. System may allow users to align their electronic calendars and schedule a meeting. Some systems have a function to find free time. (ter Hofte 1998, 26) Shared calendar would also support operational manager while planning, organizing and coordinating group's work.

Creating documents (authoring) is a common task which computers help people to accomplish. Many documents, like reports, result from cooperation between two or more persons. Co-authoring systems are designed to support multiple users in their joint effort to create a document. Co-authoring system can be created with combining a conventional editor and a messaging system or an application sharing system. (ter Hofte 1998, 16-17)

Complete coordination includes support for informal conversations that allow people to gather the information they need to get their jobs done, especially when these conversations happen in the context of a more structured process (Lotus Development Corporation 1995, 32). Collaborative workflow focuses on groups working together towards common goals. Effective use of collaborative workflow to support group working is now considered a vital element in the success of organizations. (Allen 2000, 23)

3.4 Organizational Memory as a Groupware Function

Organizational memory is an instance of collective memory. Stein (1995) defines organizational memory: "*Organizational memory is the means by which knowledge from the past is brought to bear on present activities, thus resulting in higher or lower levels of organizational effectiveness*". Activities referred to the definition include decision-making, organizing, leading, controlling, communicating, planning, motivating, and so on. (Stein 1995, 20, 23) In this thesis the computer supported organization memory is examined with other groupware functions. Groupware memory is electronic memory that can be supported with computers. In this

thesis groupware memory is defined as group's shared memory, which is supported with groupware tools.

In general, the processes of organizational memory can have a significant effect on the functioning of the organization. Organizational memory is relevant to management practice. It provides information that enables an organization to function effectively. Organizational memory is essential for planning, communication, decision-making, processing information and learning in organizations. The processes of memory include acquisition/learning, retention, maintenance and retrieval. (Stein 1995)

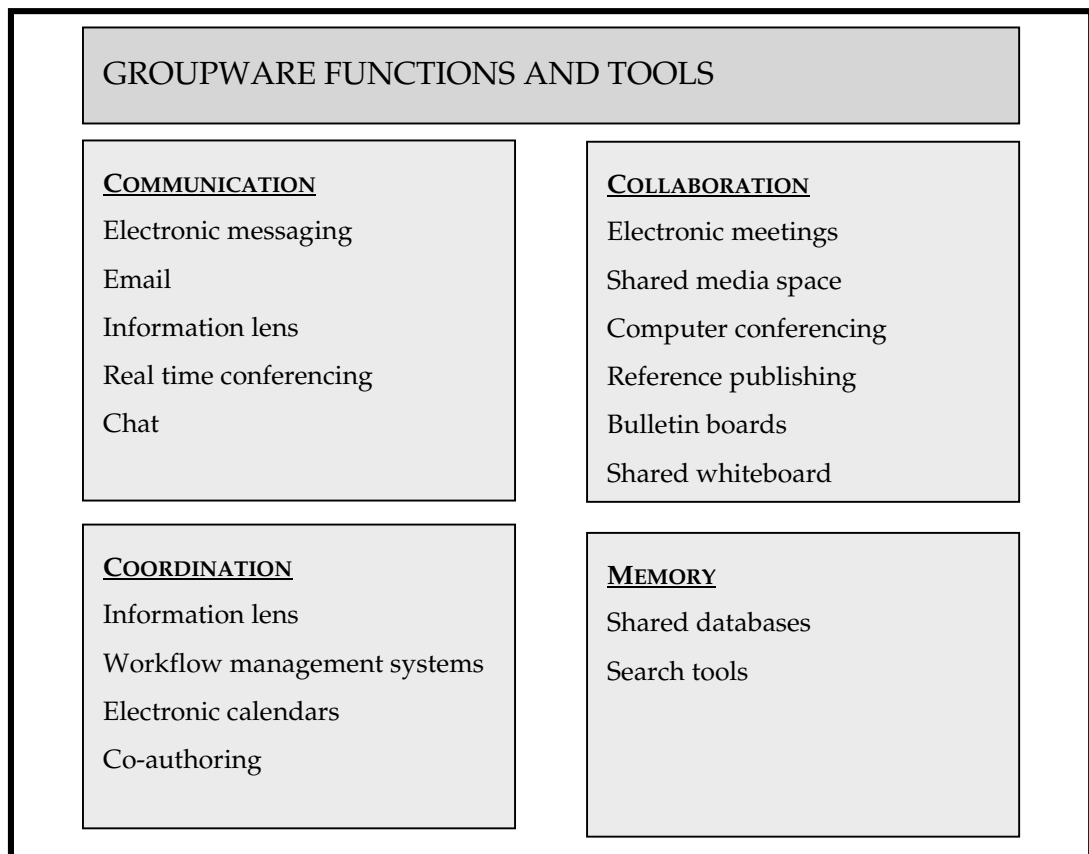
Different kinds of databases can be used to provide organizational memory. Answer Garden is an example about computer supported organizational memory. It supports organizational memory in two ways: by making recorded knowledge retrievable and by making individuals with knowledge accessible. Users seek answers to commonly asked questions through a set of diagnostic questions or other retrieval mechanisms. (Ackerman 1994).

The issue of capturing organizational memory is to store the existing flow of interaction between the members in organization and to transform it to organizational memory. Groupware can provide the medium for interaction and create a record of semi-structured documents. (Conklin 1992, 135)

Organizational memory is affected, when organization changes. When experts leave, the cost to the organization is even greater, because it takes years of education, training and experience to make new one. Organizational memory can benefit the organization in several ways. Organizational memory can help managers to maintain strategic direction. Also cycling through old solutions to new problems can be avoided because that what was done before can be remembered. Organizational memory can provide newcomers with access to the expertise of those who preceded them and also facilitate organizational learning. (Stein 1995, 20, 24, 32-33)

3.5 Summary of the Chapter

Groupware can be examined with Lotus' model. Like management functions, differences in groupware functions are not always clear. Support for organization memory is important factor and should be included to groupware model. The model of groupware functions is presented in picture the 5. Some groupware tools can be categorized to several functions. Specially, communication and collaboration tools have similar features. Collaboration is quite useless without communication. Groupware tools are made to support the kind of work, which is essential to operational management.



Picture 5. The category of the groupware functions and tools.

The increased volume of information can have a negative impact on individual's productivity (Lotus Development Corporation 1995, 16). Thus, more time is spent on not operational work. If groupware is used to support operational management, it should not have disruptive features. All groupware tools may not be useful for every situation.

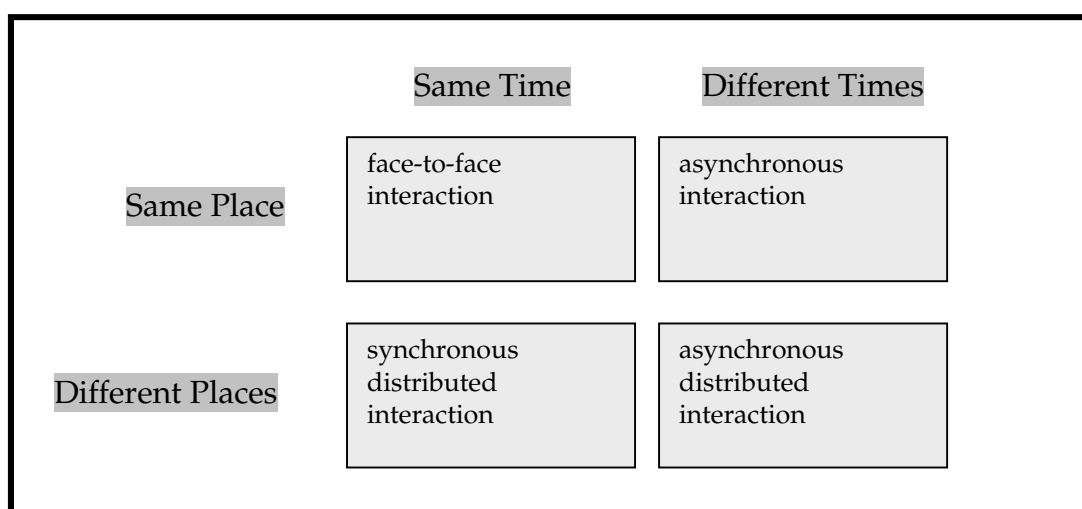
4 CRITERIA FOR THE EVALUATION OF THE FUNCTIONS

The purpose of this thesis is to evaluate possibilities of groupware to support operational management. For the evaluation, there has to be common criteria for the operational management and groupware. Demands of operational management and groupware support have to be examined together with the same criteria. The purpose of this chapter is to present criteria for management and groupware evaluation. The criteria are divided with three categories: 1) *forms of interaction*, 2) *forms of information*, and 3) *forms of knowledge transformation*. These categories are defined and presented.

4.1 Forms of Interaction

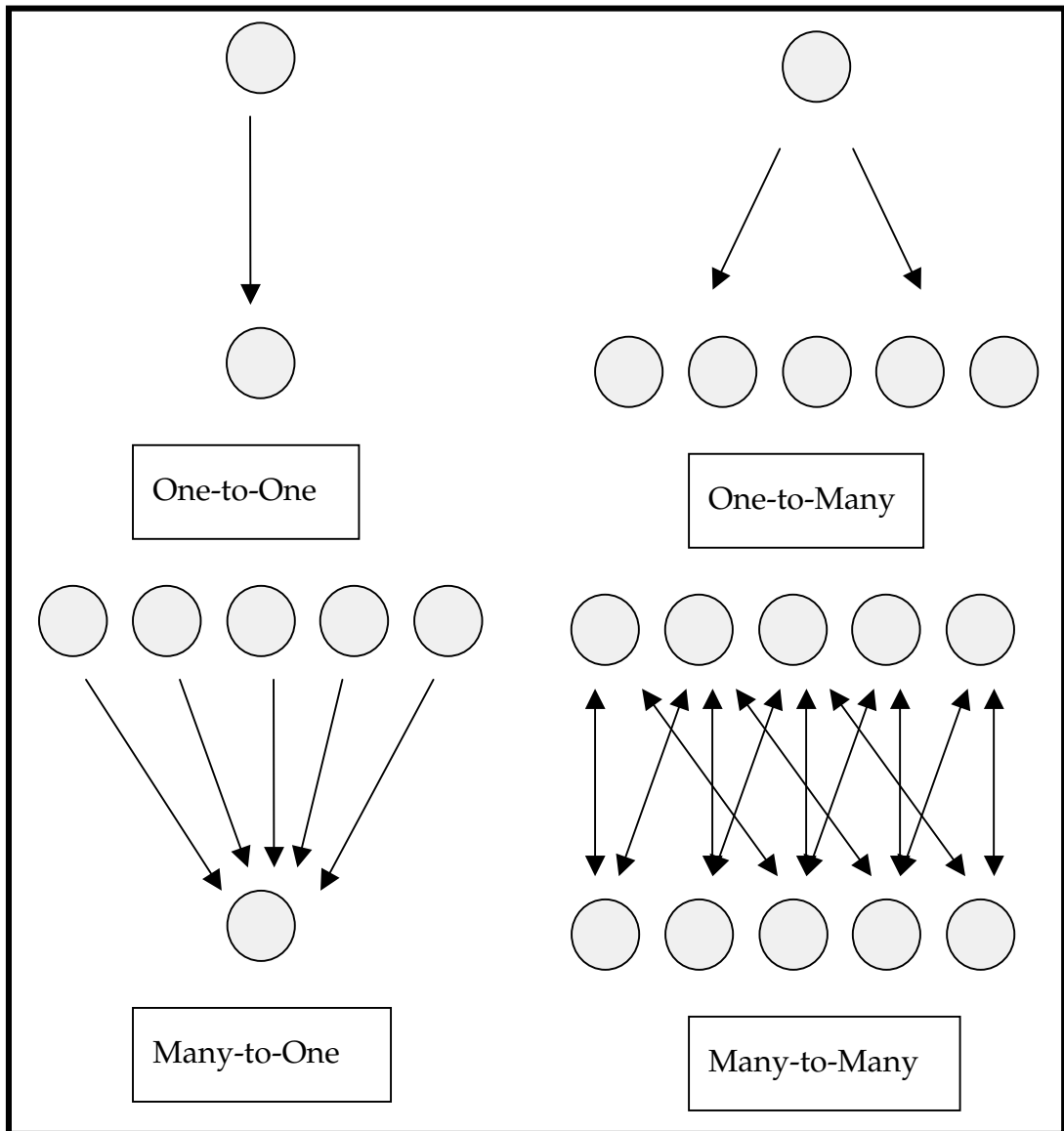
Interaction can be examined with different models or categories. The first category presented, is based on location of the participants and the time when interaction occurs. Group may be distributed over many locations. Communication and collaboration can be real time interaction or asynchronous. These time and space considerations are used to make four different categories of interaction. These categories are presented in the picture 6. This time-space taxonomy helps us to examine the nature of the operational management in different types of interaction situations. This taxonomy helps us to evaluate the possibilities of groupware to support these different types of interaction. (Ellis et al. 1991, 41)

The second category presented, is based on the number of participants and direction of the interaction. This category is illustrated in picture 7. Interaction is very easy to manage, when there are only two participants. Used communication tool may be very simple. When interaction occurs in many to many form of interaction, the email, for example, is no longer useful.



Picture 6. The time-space taxonomy (Ellis et al. 1991, 41).

The third category presented, is based on the degree of planning the meeting and interaction. Meetings inside group can be formal or informal. In formal meetings the objective of the meeting is planned. Presentations and communications are usually prepared. There is a chairman, who is responsible for the success of the meeting. Discussion and interactions are more structured. Informal meetings occur occasionally. There are not planned objectives and discussion is spontaneous. Still informal meetings can be very important for manager to get needed information unintentionally. Informal and formal meetings create different kinds of demands for the groupware.



Picture 7. Forms of interaction (Lotus Development Corporation 1995, 14).

4.2 Forms of Information

Information has different characteristics on different levels of management. On operational level information has to be more accuracy, detailed, present and quantitative. Characteristics of information in different levels of management are presented in the picture 8. (Galliers 1987, 5) One approach for evaluation of operational management and groupware is to examine the forms of information. Information may be examined with different attributes like timeliness and type of information.

Timeliness is not a single attribute, but a class of attributes related to the time factor in information update and retrieval. When event occurs, it might also take a while until the user gets the report detailing this event. When delay of reporting is very short, the system can be described as a real time system. Another useful timeliness attribute is frequency of reports. Some reports are needed daily or weekly. On operational management level, most reports are needed more frequency than on strategic level. Also information is needed faster than on the strategic level. (Ahituv & Neumann 1987, 34)

Management activity	Strategic planning	Management control	Operational control
Information characteristic			
Accuracy	Low		High
Level of detail	Aggregated		Detailed
Time horizon	Future		Present
Updating requirement	Infrequent		Frequent
Source	External		Internal
Scope	Wide		Narrow
Type	Qualitative		Quantitative
Age	Older		Current

Picture 8. Characteristics of effective information in relation to different levels of management activity (Galliers 1987, 5).

Type of information can be very useful attribute for the evaluation of groupware. Information can be categorized with following attributes: video,

image, audio, and text. This category can be used to evaluate the usability of groupware. Some functions of the operational management may have special need for certain type of information.

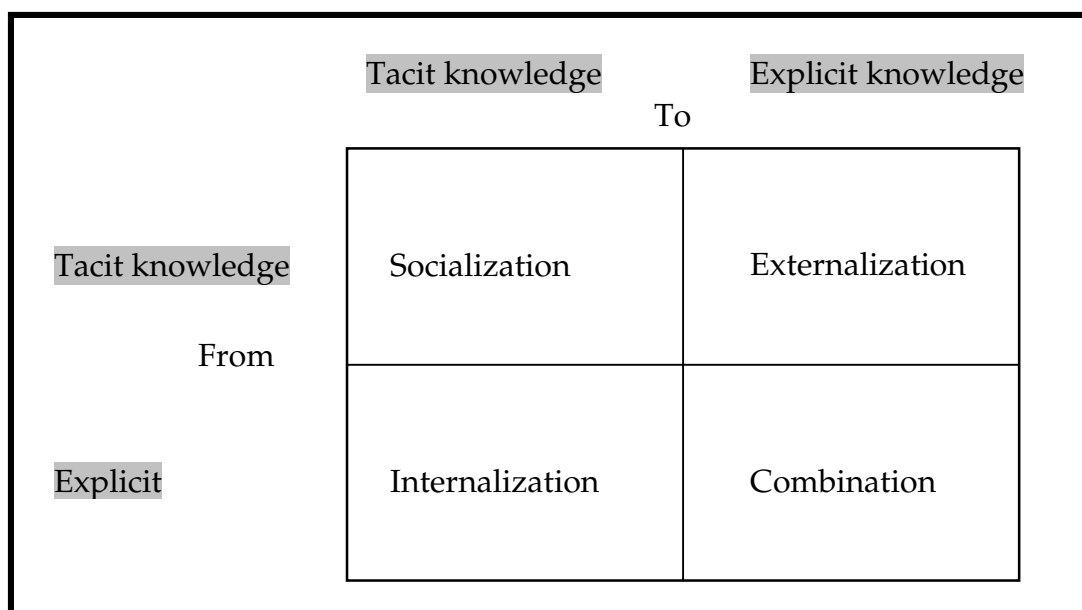
4.3 Forms of Knowledge Transformation

Knowledge can be defined as "*justified true belief*". Information is a flow of messages, while knowledge is created and organized by the flow of information, anchored on the commitment and beliefs of its holder. (Nonaka 1994, 15) Knowledge can be seen as information that has meaning. Knowledge includes both the experience and understanding of the people in the organization and the information artifacts, such as documents and reports. Effective knowledge management typically requires appropriate combination of organizational, social, and managerial initiatives. (Marwick 2001, 814).

One dimension to knowledge creation process can be drawn from a distinction between two types of knowledge – "*tacit knowledge*" and "*explicit knowledge*". Knowledge creation results from interaction of personnel's tacit and explicit knowledge. Tacit knowledge has a personal quality, which makes it hard to formalize and communicate. Tacit knowledge is what the knower knows, which is derived from experience and embodies beliefs and values. Tacit knowledge is actionable knowledge, and therefore the most valuable. Tacit knowledge is the most important basis for the generation of new knowledge. Explicit knowledge refers to knowledge that is transmittable in formal, systematic language. Explicit knowledge is represented by some artifact, such as document or a video, which has typically been created with the goal of communicating with another person. Both forms are important for organizational effectiveness. (Marwick 2001, 814. & Nonaka 1994, 15-16)

Knowledge is created with individuals. Knowledge creation at the individual level involves continuous interaction with the external world. The organization supports creative individuals or provides a context for such individuals to create knowledge. Social interaction between individuals provides the expansion of knowledge. This means conversation with and between tacit and

explicit knowledge. The assumption that knowledge is created through transformation between tacit and explicit knowledge allows us to postulate four different modes of knowledge conversation: 1) *from tacit knowledge to tacit knowledge (socialization)*, 2) *from explicit knowledge to explicit knowledge (combination)*, 3) *from tacit knowledge to explicit knowledge (externalization)*, and 4) *from explicit knowledge to tacit knowledge (internalization)*. This knowledge creation model is presented in picture 9. (Nonaka 1994, 17-19)



Picture 9. Modes of the Knowledge Creation (Nonaka 1994, 19).

Socialization includes the shared formation and communication of tacit knowledge between people. Knowledge sharing is often done without ever producing explicit knowledge. A typical activity in which tacit knowledge sharing can take place is a team meeting, where experiences are discussed. By its nature, tacit knowledge is difficult to convert into explicit knowledge. In collaboration with others, some part of a person's tacit knowledge may be captured in explicit form. Typical activities in externalization are dialogs among group members or responding to questions. Explicit knowledge can be shared in meetings, via documents, emails or through education and training. A typical activity in combination might be to put a document into a shared database. In order to act on information, individuals have to understand and internalize it, which involves creating their own tacit knowledge. A typical activity in

internalization would be to read and study documents from a number of different databases. (Marwick 2001, 814)

Modes of knowledge creation can be used to examine demands of operational management. On operational management level, there could be a large need for tacit knowledge. From the point of organizational learning, there is also a need to capture this tacit knowledge. Model can also be used to evaluate groupware tools support for knowledge creation process.

4.4 Summary of the Chapter

In this chapter, three different approaches to operational management and groupware evaluation are presented. The evaluation criteria can be seen more overlapping than exclusionary. Different approaches can be used together. These criteria are needed, when demands of operational management are connected with the possibilities of groupware. These criteria will help to evaluate the true usability and support of certain groupware tool to certain operational management task.

Forms of interaction are useful criteria for the operational management and groupware. Time-space taxonomy is very clear and useful model for evaluation. Forms of information are connected with forms of interaction. Need for real time information, can create need for synchronous interaction. Type of information is a clear and simple criterion for groupware evaluation. Model about forms of knowledge transformation gives an approach for deeper examination of the work of the operational management.

These criteria were gathered for this research. Same criteria have been used in previous research, but not together. These criteria enables to make an evaluation both to operational management needs and groupware support for interaction, information and knowledge. The use of several criteria enables more wide approach to the problem and more reliable conclusions. The evaluation criteria focus on subjects, which are important in the work of the operational manager.

5 OPERATIONAL MANAGEMENT TASKS

This chapter is based on the interviews about operational management. The research process of the interviews is reported. Also the results of the empirical research are presented in this chapter.

5.1 Interview Process

Operational managers interviews were made during April 2003 in Central Finland (Jyväskylä and Tikkakoski). Author of the research interviewed six different operational managers. Managers were from four different organizations and their responsible areas distinct from each other. Managers' operational areas were: *sales, warehouse, transportation, maintenance, guarding and training*. Examined managerial scenarios were: 1) *execution of ¼ year period sales plan*, 2) *Easter week arrangements in a warehouse*, 3) *planning, organizing and executing new delivery area transportation arrangement*, 4) *joint fire and rescue exercise between different authorities*, 5) *setting up security guarding for large industrial area* and 6) *air force company's training exercise*. Managers were operational managers, but the managerial level was not always clear and some manager's tasks or positions may be seen also as middle management tasks or positions. Managers' working experience varied from two months to over 15 years. All four organizations were large, nationwide organizations.

Interviews objectives were to find out: 1) *what kind of tasks operational managers carry out*, 2) *what kind of interaction there exists while executing these tasks*, 3) *what kind of information is managed while executing these tasks* and 4) *what kind of knowledge is managed and created while executing these tasks*. Interviews questions based on the research problems, operational management model and evaluation criteria.

Interviews started with preparing interviews. The purpose of the preparing interviews was to prepare interviewer and interviewees for the actual interview. During preparing interviews, the research was presented to managers and there was a discussion about suitable managerial scenario to be

examined. Also some background information was gathered. Preparing interviews questions are presented in appendix 1.

After a week the actual interviews were held. Interviews were semi-structured and themes based on Fayol's model (planning, organizing, commanding, coordinating and controlling). Interview questions can be seen as guidance for individual story about managerial scenario. Interviewers role was essential to find out needed information. Operational managers were supposed to tell about their managerial tasks, existing interaction, managed information and knowledge related to these tasks. Interviews were made in Finnish and translated interviews questions are presented in appendix 1. One managerial scenario was chosen for the basis of the each interview. All the main themes (scenario and functions) were discussed in the same order. However, the actual interview questions were directive. Interviewees were allowed to talk freely if they wanted. If some question were answered already, these questions were not asked again. When needed, extra questions were also made to found out needed details.

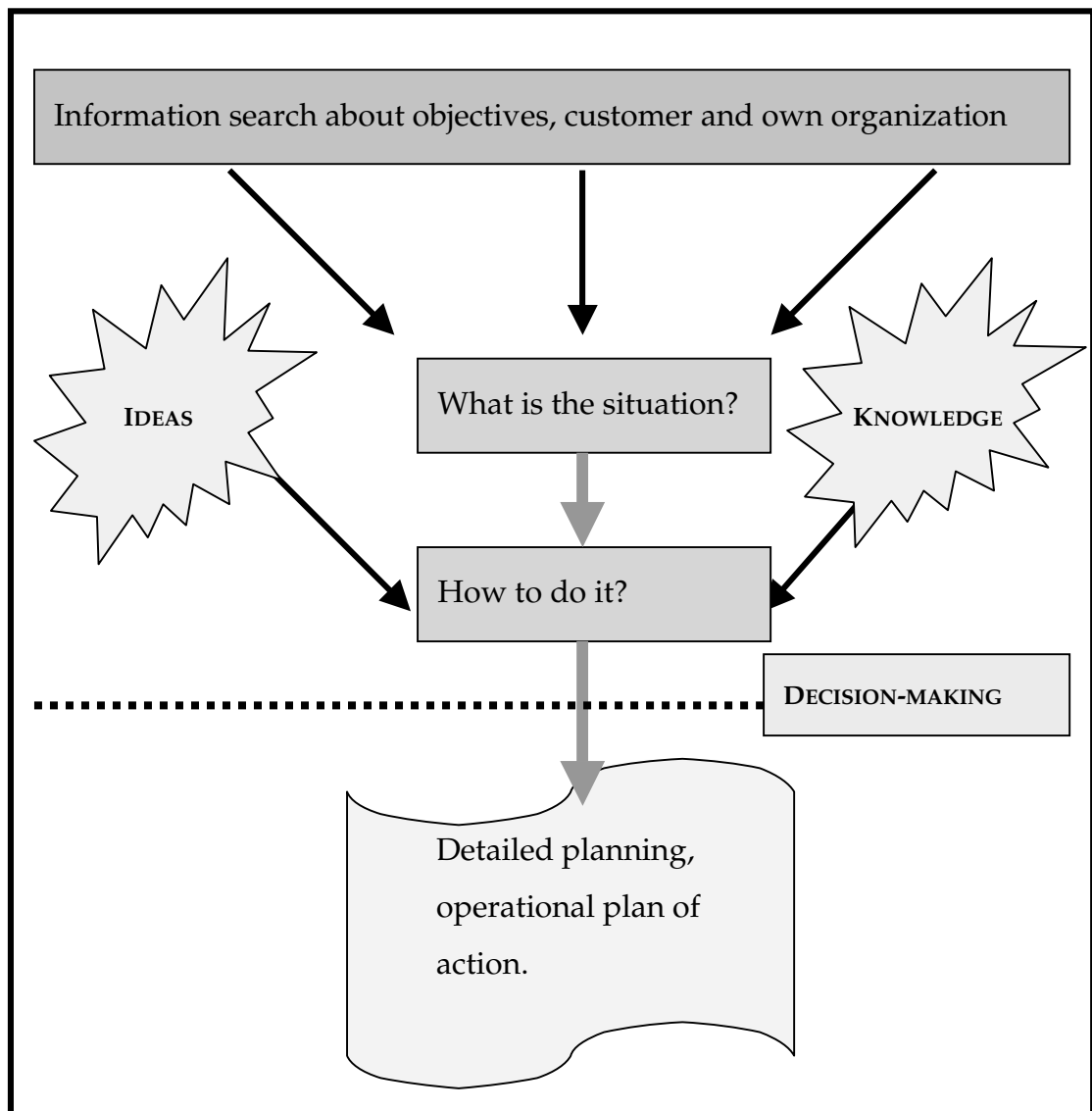
Managerial tasks were analyzed with following evaluation criteria: interaction, information and knowledge. Tasks were categorized with Fayol's model. The outcome of the interviews is an empirical model about the tasks of the operational manager. In this chapter the results of the interviews analysis are presented. The evaluation between different scenarios or manages is made and the tasks are presented. In the summary, empirical findings are reflected with theoretical model.

Used research method was useful for this situation due the available information and research objectives. There was not enough information about operational management tasks to make a structured enquiry for the managers. However, theme interview would not have been so successful to find out needed detailed information.

5.2 Operational Planning Tasks

Planning tasks were quite similar between different operational managers. Though, some managers had different emphasizes. However, in operational planning, five different tasks were distinguished: 1) *search for information*, 2) *search for knowledge*, 3) *idea generation*, 4) *decision-making* and 5) *making operational plan of action*. These tasks are illustrated in picture 10.

Operational manager starts his/her planning with searching information. Manager needs information about contracts concerning the task, information about client(s) and information about the situation of his/her own organization. Some information is given with the task, but there is always need to search for information before decision-making. After manager has enough information about what he/she is supposed to do, manager has to plan how to do it. During this phase manager uses his/her own knowledge and ideas, but manager usually needs or could use more knowledge and ideas from his superior, colleagues or subordinates. If idea generation and decision-making are done in a group, manager will gain synergy from his/her superiors, colleagues and subordinates ideas and knowledge. During decision-making all gained information and ideas are processed with gained and maintained knowledge to produce decision for planning the operational plan of action. Last phase of planning is making the operational plan of action. Plan is usually made in formal form and it is stored in organization's database. Though these different tasks and phases can be separated, the actual planning does not proceed so idealistic. Information is also searched and ideas needed during detailed planning.



Picture 10. The planning function of the operational management.

The interaction during the planning phase depends on operational manager's way to work. When manager works as an individual, he/she has less need for interaction, than manager who works more as a group leader. During the search of information, manager meets people and uses organizations databases. The interaction during the search of information does not have to be synchronous. Manager may leave requests and receive information later. Usually there is no need for physical meetings. Manager receives information from several persons like superiors and colleagues. The direction of interaction is usually from many to one. Needed information is usually formal.

The interaction during knowledge search and idea generation is more multiform. The need for synchronous interaction and physical meetings increases. However, physical meetings between dispersed colleagues may not be possible to arrange. Interaction is much more informal and occurs between wider number of participants. The direction of interaction should be from many to many. During the moment of decision-making, manager should have all the needed information, ideas and knowledge available. In the matter of group decision-making, the interaction should be synchronous and formal. The direction of interaction should be from many to many. After decision-making, manager has to produce operational plan of action. During more detailed planning, there is still need for more information, ideas and knowledge. However, the need for interaction is no longer synchronous and direction changes from one to one and many to one. The nature of interaction can be formal or informal.

The objective of the search of information is to gain the awareness about operational task and organizations situation. The form of needed information can be real time or non real time. Information can usually be found from documents, which include text and pictures. The knowledge cannot be completely categorized with the information criteria. Knowledge cannot be seen in a real time form. However, explicit knowledge may have the form of text, picture or video. Audio can be used in socialization when tacit knowledge is shared.

During idea generation, the change of ideas occurs in real time and the form of the information can be text, audio or pictures. On group decision-making, the used information is non real time and usually in the form of text or pictures. If idea generation and decision-making occur in different places, video would be an effective media to support these tasks. While making the operational plan of action, manager uses real time and non real time information in a form of text, audio and pictures.

During planning, manager has to create and manage knowledge. Manager can search explicit knowledge from organization's databases, but he/she needs also tacit knowledge from his/her superiors, colleagues and subordinates. While searching knowledge, knowledge is also transformed to another form. The forms of knowledge creation are socialization, combination and internalization. The outcomes of idea generation are input for decision-making. Explicit and tacit knowledge is used in a group to create new knowledge. The outcome may also be new ideas, when a number of people share their experiences. The forms of knowledge creation during idea generation are socialization and internalization. When operational manager produces operational plan of action, the tacit knowledge is transformed to explicit form. During the decision-making, you can say that knowledge is more used than created. The operational plan of action includes information about the task, but also knowledge how to do it. Tacit knowledge is transformed to explicit form. The form of knowledge creation is externalization.

During the whole operational planning process, the manager executes different tasks, which include interaction between different persons, different kind of information management and knowledge creation and management. The need for organizational memory can be easily identified. Computer supported organization memory can provide important information and knowledge for operational manager. Operational manager needs also support for multiform communication for gaining needed information and knowledge. In the picture 10, the tasks and different phases were presented in chronological order. However, tasks and phases are overlapping and for example the information search continues after decision-making. Still the main phases and milestones of the planning function can be identified and they exist in planning.

5.3 Organizing

The tasks of the organizing function changed most between different operational managers. Some managers had no organizing tasks and some other had to set up an organization even for planning and another for operations. Selected scenarios had also a huge influence to this function. However, two different organizing tasks could be identified: 1) *setting up organization and* 2) *setting up communication lines for the organization*. Usually operational manager's resources are limited and he/she has to use existing organization. Operational manager's organizing tasks, which concern mostly personnel, are quite small-scaled. The more important thing is to set up needed communication lines. In some scenarios, there were no need to set up new communication lines, but some operational managers had to create a new communication structure. Setting up communication lines includes providing communication tools, making communication procedures and training for the usage of new communication equipment. Sometimes operational manager has to set up a new organization and communication for planning phase. However, these cases are uncommon in routine operational management.

Operational organization should be planned during the planning phase and it has to be published for subordinates. Setting up communication lines can be seen as organizing task. Manager has to choose and provide suitable communication tools. Communication has to be planned and ordered. Sometimes subordinates have to be trained or familiarized with equipment and procedures. Setting up communication can be seen as a task, that enables interaction, information management and knowledge creation and management during operations.

Operational manager has to communicate with his subordinates during the organizing task. The need and the form of interaction during organizing were hard to be identified. There was not a clear need for synchronous interaction and direction of interaction was from many to one. Interaction nature can be formal or informal. Manager needs information and knowledge for planning

the organization and communication lines. Information is needed about available resources. Information should be real time. Information about resources can be text or pictures.

Knowledge is used while planning and specially while training the use of communication lines. Explicit and tacit knowledge are used to evaluate possibilities and making decisions about organization and communication lines. The forms of knowledge creation are socialization and internalization.

Operational manager needs feedback about how the organization is operating. Organizing tasks could also be seen as planning, commanding and controlling tasks. However, organizing can be separated from other management functions. Groupware tools would be very useful for operational management due to provide flexible communication lines.

5.4 Commanding Tasks

The sorting of commanding tasks was not easy or clear thing to do. Commanding is very closely related to coordination and control functions. However, some commanding tasks could be identified. The first and important commanding task is to publish the operational plan of action and procedures. Manager presents the plan and allocates tasks and resource for subordinates. Manager has a need to get instant feedback about the plan and tasks. Other tasks are familiarization or training for the work. These tasks are usually executed when there exists a new task or a new employee. Manager has to also gather feedback. This feedback is needed as information for coordination and controlling functions. Commanding continues after operational plan of action has been published. Manager will receive questions about work and he/she has to make decision routinely. Commanding tasks can be categorized as follows: 1) *publishing operational plan of action and working procedures*, 2) *allocating tasks and resources to subordinates*, 3) *familiarize and train subordinates*, 4) *gather feedback from subordinates* and 5) *routine management (provide information, advise or resources to subordinates, when needed)*.

The form of existing interaction during commanding was influenced by the limitations of personnel working schedules. In shift work, it was not possible to gather all the subordinates for common meeting. There was identified a need to have synchronous interaction, but it was not always possible to arrange. Specially, in shift work, operational managers were forced to asynchronous interaction during all commanding tasks. However, for example, training and familiarization were not possible to arrange in different time and different space. When publishing the plan and allocating tasks, the direction of communication was from manager to subordinates and from subordinates to manager. During the training there was a need to share knowledge between subordinates. In training, many to many kind of interaction should be supported. Feedback came from subordinates to manager. When subordinate approached manager with some detailed question or problem, the direction of interaction was from one to one. The interaction has to be quite formal during commanding, because for example the law sets rules for working hours etc. When receiving feedback and committing routine management, additionally interaction may be informal.

Operational plan of action may be dynamic, but still the information is not real time updated. Operational plan of action and procedures are usually documents, which include text and pictures. If the plan of action is published in a meeting, the feedback about procedures and plan is audio, informal and not usually stored. If there is a need for dispersed synchronous meetings, video conferencing could be used. Tasks and resources should be allocated at the same time, when operational plan of action is published.

Training and familiarization were arranged at the same time and in same place. Because it was not possible to have all the subordinates at the training same time, there was a need to arrange training several times. There can be seen a need for asynchronous familiarization. Procedures can support training and familiarization, but video would be very effective media for this purpose. For example the training occasions could be recorded for future use.

Real time information may be managed when manager receives feedback or provides advises or information to subordinates. However, feedback may also be non real time. The information type of feedback and routine management may be text, audio, picture or even video.

Commanding function handles information and knowledge. The training and familiarization are mostly about tacit knowledge creation. Individual receive and create own knowledge about their work. After training subordinates should be able to start the work. The forms of knowledge creation during training are socialization and internalization. Operational managers' and workers' tacit and explicit knowledge is shared and transformed to individual tacit knowledge. Operational manager handles knowledge also when doing routine management. Subordinates receive and create tacit knowledge for single and occasional purposes.

The nature of the commanding differs from other operational management functions. There is a need for physical meetings, but still these meetings are hard to arrange. Manager should arrange meetings and on the other hand he/she should get rid of them. Operational manger's colleagues and subordinates are dispersed in time and space. The need for asynchronous interaction was identified. Some managers had already started to use groupware tools, like email, to support commanding.

5.5 Coordinating Tasks

Coordination tasks were quit similar between different managers and different scenarios. However, there was seen conflict between coordination demands and coordination actions. Some task needed to be coordinated during the execution. Still managers had no chance to do it. This problem was solved with distributing responsibility to subordinates. Subordinates were supposed to inform manager, if something unexpected occurred.

Coordinating function has to be planned in operational plan of action. Still there exist tasks, which may not be planned in advance. Manager has to coordinate

resources and tasks. Resources, like personnel, equipment, facilities and tasks, have to be coordinated. Operational manager is responsible about making the working schedules for personnel. Sometimes other resources like equipment and the usage of facilities has to be coordinated too.

Besides resources tasks have to be coordinated. Usually this is a very important management area for operational managers. Operational objectives are split to smaller tasks and these tasks have to be done in particular order. The planning of coordination is important, but not adequate alone. Operational manager have to follow up the work and handle exceptions. Usually managers receive announcements, when unexpected incidents occur. Exception handling can be reallocation or new prioritization of tasks. Exception handling could also be seen as a commanding task. All exceptions are not reported and operational manager has to follow up the work. This monitoring task is closely related to control function. In coordination function following tasks could be identified: 1) *scheduling resources*, 2) *scheduling tasks*, 3) *follow up work* and 4) *exception handling*.

Interaction between operational manager and subordinates, during scheduling, can be asynchronous. Follow up occurs both at same and different times. Exception handling on operational level is usually urgent and interaction has to be synchronous. Follow up and exception handling, can be executed in different places. However, sometimes follow up can occur in same place with subordinates. The direction of interaction changes a lot between different tasks. Resources scheduling, like making working shifts, has an influence to all personnel. This creates a demand for a many to many communication. Sometimes shifts are changed and operational manager should be able to find a "free" person for work. Tasks scheduling has to be very coordinated and it has to be done by one person. The direction of interaction during tasks scheduling is from manager to subordinates. Both tasks and resources have to be scheduled formally. There is no room for misunderstandings.

The direction of interaction during follow up task is from subordinates to operational manager. Follow up was not usually planned and the nature of it was informal. Exception handling occurs in unexpected situations. Operational managers try to block exceptions in advance, but it is not possible in all situations. When the need of interaction occurs unexpected, the nature of interaction is informal. The direction of interaction depends on circumstances. If incident has an influence on only one person, the interaction occurs from one to one. However, exception handling may occur also between several persons and direction of interaction may be from many to many.

When tasks and resources are scheduled, the used information is usually non real time. Tasks are already planned and organization is already created. Operational manager will commit scheduling on the basis of existing information. However, some real time information could be used, like subordinates wishes about working shifts. The outcomes of scheduling are for example working shifts and task list. These documents include text and diagrams.

The information concerning follow up have to be real time or it is not useful. If coordination information is old, it cannot be used. Follow up should be planned, but usually it was just "chit-chat" between manager and subordinates. Exception handling information has to be real time. Something unexpected has occurred and operational manager needs information for decision-making. Usually exception handling was done in phone, but it could be supported with different kind of media. For example real time video and audio would provide better understanding about the situation.

Operational manager needs knowledge to execute all coordination tasks successfully. Scheduling is a demanding task and manager should be able to exploit both tacit and explicit knowledge. Follow up and exception handling is based on operational managers tacit knowledge. The forms of knowledge creation during coordination tasks are socialization and internalization. Manager should be able to exploit his/her previous experience and theoretical

knowledge. Also subordinates play important role. Exception handling was based on subordinate's knowledge too.

Coordination handles always several persons and tasks. Scheduling can be supported with shared coordination tools. Unexpected incidents cannot be taken care with automation, but exception handling can be supported with communication tools and organizational memory.

5.6 Controlling Tasks

Controlling objectives and tasks did not differ a lot between different operational scenarios. When tasks were executed, it was easier to control quantity than quality. Quality control based on the feedback from customers. Quantity was easier to monitor and verify immediately, when the work was done. The evaluation of the work was usually done, but tasks and outcomes varied a lot. Learning from work occurred, but usually it was not planned or formal.

The objective of controlling is to check out the quality and quantity of executed work. Executed work is evaluated with the objectives established in the operational plan of action. Evaluation process can be used to support organizational learning. Operational manager has to monitor subordinates working hours and also the quantity and quality of work, personnel, equipment and facilities. Operational manager has to evaluate the work and completed tasks. Operational manager writes reports about his/her work. In some organizations evaluation meetings were used as an input for learning from work. Identified controlling tasks were: 1) *monitoring resources*, 2) *monitoring work*, 3) *evaluating the work*, 4) *writing reports*, and 5) *learning from the work*.

Interaction during controlling occurs between subordinates and manager. Reporting is usually done for superiors. Most of the interaction during controlling tasks does not have to occur at same time or in same place. Only learning would gain benefits from synchronous interaction and meetings. However, the direction of interaction during controlling differs more. While

monitoring, the operational manager receives information from his/her subordinates. The direction is from many to one. During evaluation and learning interaction should be from many to many. Reporting is usually done alone, but reports are provided to many users. Interaction is mostly formal, but monitoring and learning are not necessary planned and informal interaction can also exist.

During controlling, all forms of information are useful. Also reporting could be done by phone or video. However, reports were usually made as text documents. The need of real time information is more important in coordination than in controlling.

Evaluation and learning is not possible before there is information and experiences about how the work has been done. During monitoring there does not exist new knowledge creation. Knowledge creation exists, when the work is examined and evaluated. During reporting and learning tasks, some knowledge is transferred to explicit form. During reporting and learning, tacit knowledge was used to create new tacit and explicit knowledge. In evaluation and learning meetings, experiences were shared and the form of knowledge creation was socialization. When reports were made from work and learning, these documents were stored to organization's databases. Different kind of memos captured some tacit knowledge to explicit form and this can be seen as an example about externalization. When reports are stored to organization's databases for future use, the base for combination is created. And if saved documents are used in future planning, it can be seen as an example about internalization.

Different kind of information is needed for monitoring. Some of this information flow may be automated. Specially, the control of quantity could be supported. Outcomes of controlling function should be stored to organization memory for future use. Different kind of databases would be very useful for these purposes. Some things that are not currently controlled could be

supported with groupware. For example subordinates personnel evaluations could be supported and used to monitor the quality of committed tasks.

5.7 Summary of the Chapter

Fayol's model presents five different management functions. These functions can be identified from the work of the operational managers. Totally 21 different tasks were identified categorized. Another approach to examine operational management could be dividing tasks chronologically: 1) *planning*, 2) *execution and* 3) *evaluation*. Same function and tasks could still be identified, but the operational management work would be presented in different order.

In theoretical model (page 23) planning contained intelligence, decision-making and planning. On the basis of empirical study, intelligence was specified and divided to search for information, search for knowledge and idea generation. The outcome of planning was the operational plan of action, which was usually documented. Planning function does not differ a lot between different managers or scenarios. Some managers used less other people's support and made planning by themselves. This kind of planning cannot be supported with groupware. Manager has to notice and identify the benefits of group work in planning, before he/she can start using any supporting groupware. As a result of individual planning, also knowledge search and idea generation usually fails.

Organizing tasks and outcome was similar with theoretical model. However, organizing tasks differed mostly between different managers. Some managers had to reorganize and create communication lines all the time, and others had no organizing tasks.

Commanding tasks expanded during empirical study. Commanding tasks were hard to separate and categorize. Commanding methods and routines differed a lot between managers and scenarios. It is hard to identify any concrete outcome from this function. However, five different tasks were identified and presented. Considering further conclusions, these tasks are extensive enough.

Coordination is related closely to commanding and controlling. These three functions can be seen as “executive” functions. Coordination tasks were same in theoretical model and in empirical study. Scheduling was divided to: 1) *scheduling resources* and 2) *scheduling tasks*. Coordination tasks were similar between different scenarios, but used methods differed.

Controlling function was specified during empirical study. Operational manager did not usually interfere subordinates work and better word for supervising is monitoring. Reporting and learning were identified as controlling tasks. Controlling functions were quite similar between different managers. Controlling occurs during the execution of operational scenarios, but it also continues afterwards. The empirical research concentrated more on the hard issues.

The separation of commanding, coordination and control was not a simple task. The models about planning, organizing and coordinating were more complete than commanding and controlling. Specially commanding can be presented differently. In operational management, there is a lot of different kind of interaction, usage of different kind of information and usage of different kind of knowledge. Operational management tasks and existing interaction, information and knowledge management are presented in tables 1 – 4. By supporting these tasks can the work of operational manager can be supported.

Task	Same time	Different time	Same place	Different place
Information search		X		X
Knowledge search	X	X	X	X
Idea generation	X	X	X	X
Decision-making	X			
Making operational action plan		X		
Set up organization		X		X
Set up communication lines		X		X
Publish operational action plan	X	X	X	X
Allocate tasks & resources		X		X
Training & familiarization	X	X	X	X
Gather feedback		X		X
Routine management		X		X
Scheduling resources		X		X
Scheduling tasks		X		X
Follow up	X	X	X	X
Exception handling	X			X
Monitor resources		X		X
Monitor tasks		X		X
Evaluate work		X		X
Report		X		X
Organizational learning	X	X	X	X

Table 1. The forms of the existing interaction.

Task	One to One	One to Many	Many to One	Many to Many	Formal	Informal
Information search			X		X	
Knowledge search				X		X
Idea generation	X	X		X		X
Decision-making				X	X	
Making operational action plan	X	X			X	X
Set up organization			X		X	X
Set up communication lines			X		X	
Publish operational action plan		X	X		X	
Allocate tasks & resources		X	X		X	
Training & familiarization		X		X	X	
Gather feedback			X		X	X
Routine management	X	X			X	X
Scheduling resources				X	X	
Scheduling tasks		X			X	
Follow up			X			X
Exception handling	X			X		X
Monitor resources			X		X	X
Monitor tasks			X		X	X
Evaluate work				X	X	
Report		X			X	
Organizational learning				X	X	X

Table 2. The forms of existing interaction.

Task	Real Time	Non Real Time	Text	Audio	Picture	Video
Information search	X	X	X		X	
Knowledge search		X	X	X	X	X
Idea generation	X		X	X	X	X
Decision-making		X	X		X	X
Making operational action plan		X	X	X	X	
Set up organization	X		X		X	
Set up communication lines		X	X		X	
Publish operational action plan		X	X	X	X	X
Allocate tasks & resources		X	X	X	X	X
Training & familiarization		X	X	X	X	X
Gather feedback	X	X	X	X		X
Routine management	X	X	X	X	X	X
Scheduling resources	X	X	X		X	
Scheduling tasks		X	X		X	
Follow up	X		X	X		
Exception handling	X		X	X	X	X
Monitor resources		X	X	X	X	X
Monitor tasks		X	X	X	X	X
Evaluate work		X	X	X	X	X
Report		X	X	X	X	X
Organizational learning		X	X	X	X	X

Table 3. The forms of existing information.

Task	Socialization	Combination	Externalization	Internalization
Information search				
Knowledge search	X	X		X
Idea generation	X			X
Decision-making	X			
Making operational action plan			X	
Set up organization	X			X
Set up communication lines	X			X
Publish operational action plan				
Allocate tasks & resources				
Training & familiarization	X			X
Gather feedback				
Routine management	X			
Scheduling resources	X			X
Scheduling tasks	X			X
Follow up	X			X
Exception handling	X			X
Monitor resources				
Monitor tasks				
Evaluate work	X			X
Report		X	X	
Organizational learning	X	X	X	X

Table 4. The forms of knowledge creation.

6 GROUPWARE TOOLS

This chapter is based on the groupware environments evaluation. Environments were evaluated during April and May 2003. Four different groupware environments were chosen in which to study the existence of groupware tools: Made, BSCW, Generation and Novell GroupWise. These environments were chosen since they are environments, which allow people to work together with several different tools and supporting features.

Evaluations objectives were to find out: 1) *what kind of groupware tools there exists*, 2) *what kind of interaction can be supported*, 3) *what kind of information can be supported* 4) *what kind of knowledge creation can be supported*. First different groupware tools were identified from environments. Tools were categorized as communication, collaboration, coordination or organization memory tools. After tools were categorized, their features were identified and evaluated. The result of the evaluation is presented in this chapter. Used research method differed to the one used with operational management. This is a consequence of the Lotus Notes groupware model, which was more detailed and useful for the research than the Fayol's management model.

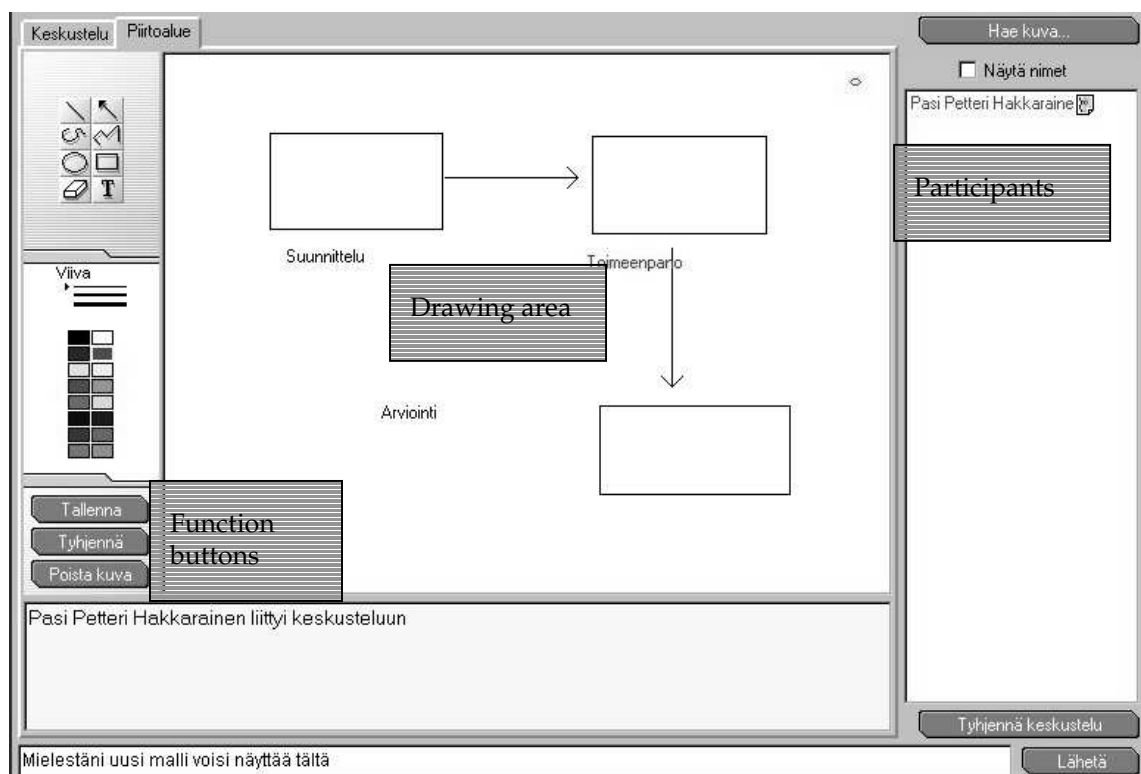
6.1 Communication Tools

Communication was supported in all environments. The basic communication tools were chat, message systems and email. Other common tool was bulletin board. Some environments provided a possibility to conferencing with video and audio. Totally five different communication tools were identified and categorized: 1) *chat*, 2) *messages*, 3) *email*, 4) *bulletin board* and 5) *video conferencing*.

Chat is traditionally considered as text tool. However, new chat tools provide also a medium to share pictures and drawings. An example about chat tool is presented in picture 11. New chat tool maintains the old chat features like support to fast and informal communication. Besides that, users can also share

drawings and are allowed to save them. Members are allowed to have text-based conversation and they can illustrate their thoughts with drawings.

Electronic messaging and email are quite close to each other. Email was more popular. Email can be sent to anyone who has an email address. Messages can be sent inside the environment. Message systems can also be supported with semi-structure and metadata. Email and messaging features were quite similar in different environments. User could send text to several receivers. Message could include hyperlinks to other documents, pictures or video and audio clips. Email could also include attachments like documents or pictures. Usually environment provides an address book or a tool to search addresses.



Picture 11. An example about chat tool that supports pictures and drawings.

Bulletin board is a simple way to share information. However, usually the sender cannot receive feedback from receivers. Video conferencing was supported in some groupware environments. Electronic meetings may also be seen collaboration tools, but in this thesis, meeting is seen as communication between people. People send and receive messages through different media.

For example video conferencing cannot necessarily be seen as a shared space for collaboration. If video conferencing is supported with other tools, like shared software or shared media space, it could be seen more as a collaboration tool.

All groupware tools support interaction in different places. Online meetings can include synchronous communication like chat, video and text-based conferencing (Marwick 2001, 817). Chat and video conferencing are suitable tools for synchronous interaction. Synchronous message tools support many different types of communication. For example carrying out work, for discussing non-work topics, for negotiating availability and so on. (Handel & Herbsleb 2002, 1) Messaging, email and specially bulletin boards are for asynchronous interaction. Message systems can easily support also structured messaging. Messages can include metadata and messages may be categorized. Messaging can also be used for formal interaction. The nature of video conferencing may differ and conferencing can be formal or informal.

Communication tools are suitable for one to one interaction. Only bulletin board is more useful in many to many type of interaction. In many to many type of interaction, participants should be aware about other participants' actions. While using asynchronous communication tools like email or messaging, users are not aware, what kinds of answers or questions other users have received. Awareness of individual and group activities is critical to successful collaboration (Dourish & Bellotti 1992, 107).

Synchronous communication tools are suitable for group communication. Chat and video conferencing can be used in many to many type of interaction. Email and messaging are more suitable for one to many or many to one interaction. Bulletin board is asynchronous tool, but still useful for many to many type of interaction, in case if everyone is allowed to leave messages. Usually this kind of bulletin board can be seen as a discussion forum.

All communication tools can be used to change non real time information. Synchronous communication tools like chat and video conferencing can also be used for sharing real time information. Message systems, email and bulleting

boards can support hyperlinks to other documents or files, which may be pictures or video. Usually email and messages may include attachments of different kinds of documents. Message systems and email may be used for sharing non real time audio, picture or video files. New chat tools can support drawings. Video conferencing is a suitable tool for sharing different kind of real time or non real time information. If group member is directed to interact with others, knowledge integration will be improved. Interactions that are not directly related to knowledge integration can still be effective. (Okhuysen & Eisenhardt 2002, 371, 382)

The most typical way in which tacit knowledge is built and shared is in face-to-face meetings and shared experiences, often informal, which in information technology plays a minimal role. However, meetings and other interpersonal interactions can be supported with groupware tools. Text-based chat is believed to be capable of supporting a group of people in knowledge sharing in a conversational mode. Online discussion databases are potential tools to capture tacit knowledge. Chat and other real time interactions within teams allow fairly informal and even freewheeling discussion. These tools could be effective for externalization. (Marwick 2001, 817, 819)

Synchronous tools, like chat and video conferencing, could be used for socialization. Combination is the easiest to support with groupware and most communication tools are suitable for it. The capture of tacit knowledge to explicit form is a hard task. With new chat tools, the participant is allowed to save drawings and this feature supports externalization. Externalization can also be supported with structured messaging. Video conferencing can be used for different kinds of meetings. Video conferencing can also be used for all kinds of knowledge creation.

All communication tools could be used to support operational management. Manager commits a lot of different kinds of interaction all the time. Telephone and email were the most used communication tools, but a need for multiform communication tools was identified. Besides interaction, manager has a need to

search and share knowledge and information. These tasks can be supported with groupware communication tools. Physical meetings were important, but also hard to arrange. Communication tools can also support dispersed and asynchronous interaction.

6.2 Collaborative Tools

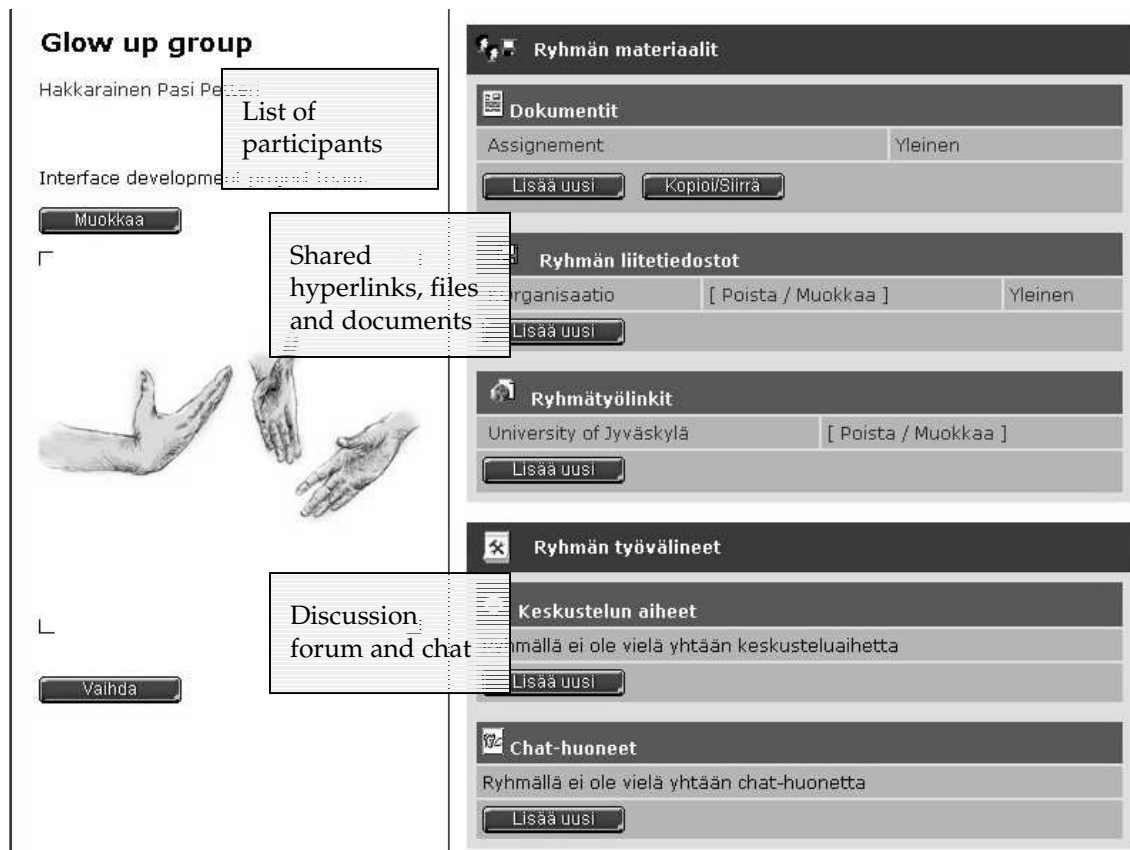
All environments provided a chance for collaboration with other users. Collaboration is based on shared media space or shared tool, which allows group to work together. The basic collaboration tool was a shared media space with supporting features. Most environments provided a mixture of discussion forum and shared multimedia space. A typical collaboration tool was a discussion space, where user was allowed to start a topic or conversation about a subject. Participants were allowed to comment the topic, but they also were allowed to send hyperlinks or files. After groupware evaluation, three different collaboration tools were distinguished: 1) *discussion forums*, 2) *shared software*, 3) *shared media spaces*. All these allow people to work together with a shared tool or in a shared space.

Discussion forums are used for sharing information and knowledge and to asynchronous interaction. Participants can make statements, comments or present questions and answers to these questions. Usually hyperlinks and files can be added to the discussions. This feature has changed traditional discussion forums, like news groups to dynamic multimedia databases. Nowadays discussion forums are usually a combination of shared database and group discussion.

Shared software was uncommon. However, some shared software were identified such as whiteboards. Also some shared software were embedded to other tools like shared media spaces.

Shared media space has features from discussion forum and it usually provides shared databases and shared software like whiteboards and communications tools. Shared media spaces can be seen as a combination of several tools. All

media space tools do not have to be groupware tools. An example about media space is presented in picture 12. Shared media space enables people to share documents, files and hyperlinks. Media space provides also communication tools for group members.



Picture 12. An example about shared media space.

All groupware tools support interaction in different places. Groupware collaboration tools enable both synchronous and asynchronous interaction. However, discussion forums are suitable for asynchronous interaction and shared software are more useful for same time interaction. In discussion forum, messages are not usually directed to certain participant. Another feature is, that you cannot predict if someone answers your question or not and when your question will be answered.

While using shared software, it is good to get instant feedback about your work. On the other hand it is useful to be aware of other people actions

Workspace awareness is essential to support dynamic collaboration (Hayashi et al. 1999, 100). Shared media spaces can be used at same or different times. For example in picture 12, media space users can communicate synchronously with chat tool and other features or tools support asynchronous interaction. Collaboration tools are built to support many to many type of interaction. All kinds of messages or files can be read by several participants. The interaction cannot be planned in forward. This lack of predictability can turn the interaction to more informal form. However, formal interaction may occur, but it is not usually supported with the features of the environment. Formal interaction is usually guided by the rules, which have no support from the environment.

Discussion forums and shared media spaces typically support different types of information. The basic type of information is text, but both tools support attachments and hyperlinks. Shared software is usually meant for certain situations. Shared software can support different types of information or not. Asynchronous interaction tools support non real time information. Shared tools can be used at same time and they can support also real time information. Because discussion forums are not suitable for synchronous interaction, they do not support real time information. However, real time information, like video, can be linked to discussion forums. As a conclusion about collaboration tools support to information, you can say they support multiform information.

Collaboration systems and other groupware systems can support socialization and externalization in some extent. Shared experiences are important factors for the formation and sharing tacit knowledge. Groupware can provide a virtual space, where participants can share experiences. Also newsgroups and similar forums could be used in externalization. The key of knowledge creation lies in the mobilization and conversion of tacit knowledge. Explicit knowledge is represented by artifact, such as document or a video. (Marwick 2001, 814, 817, 819) Discussion forums and shared media spaces support multiform interaction and information. These features enable these collaboration tools to support widely knowledge creation and management. Collaboration tools support the

basic elements of knowledge creation like sharing experiences and sharing explicit knowledge. Shared software may have some limitations. Still you can say that shared software always support socialization.

Collaboration tools have features, which would be useful in operational management. Collaboration tools provide a shared space for group to share information, ideas and knowledge. Both synchronous and asynchronous interaction can be supported. Operational manager has several needs, which can be satisfied with collaboration tools.

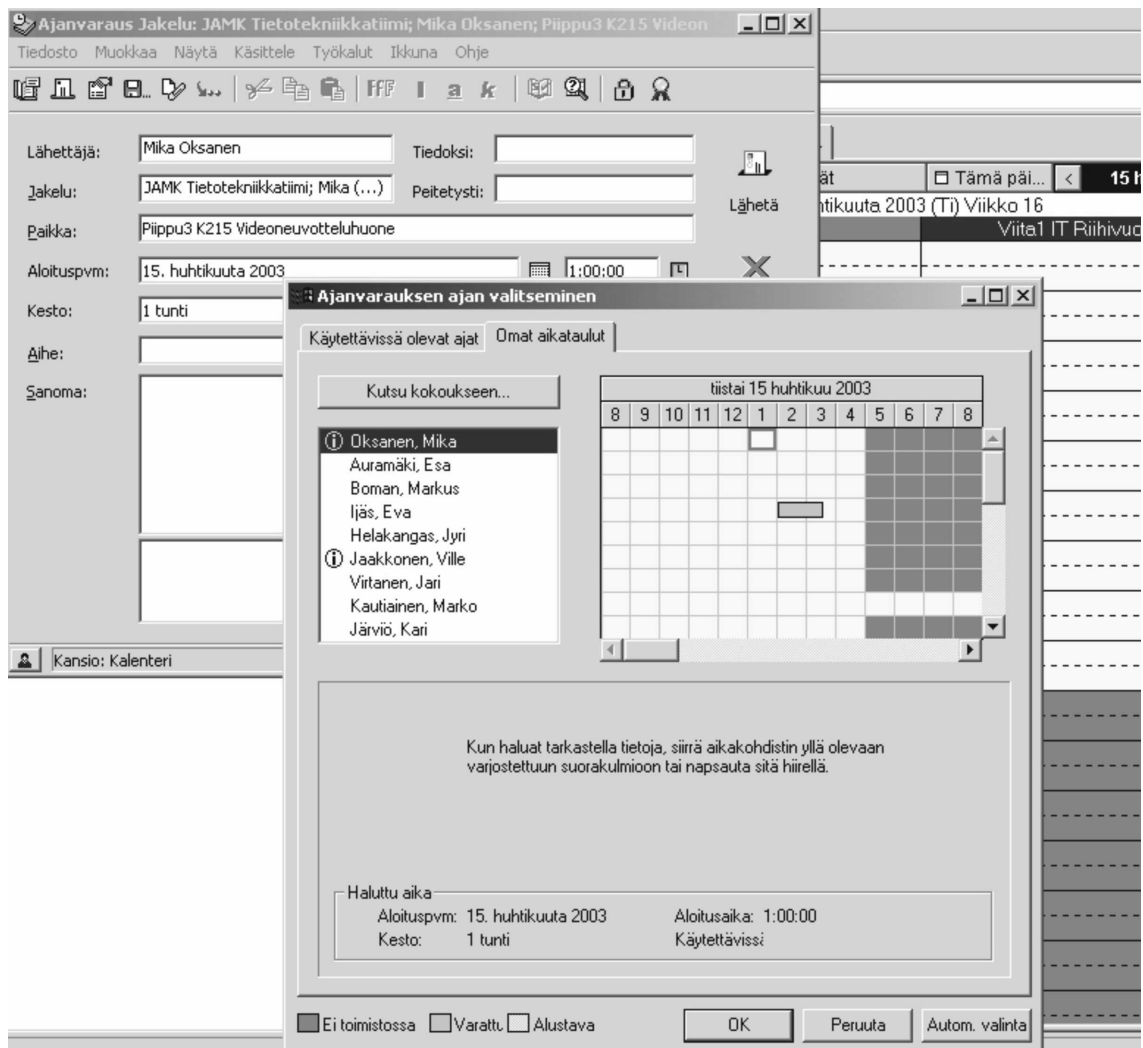
6.3 Coordination Tools

The most common coordination tool was a shared calendar. Shared calendar provides an access to other group members' schedules. One calendar included also a possibility to allocate facilities. User was allowed to search a free time for group members and also a free place for a meeting. An example about scheduling with shared calendar is presented in picture 13. User is allowed to search a free time and a free space for a meeting. After a successful search user can send a message about a meeting to participants. Participants can confirm the invitation and summoner receives the feedback if the meeting was accepted or not.

Another useful coordination tool was a structured messaging for task allocation. Superior was able to send a message concerning about certain task. Subordinate was allowed to accept the task. When the task was confirmed, the status of message was changed. Also after the task was done, subordinate was supposed to change the status of the task and manager received information about it.

During the groupware environment evaluation two different coordination tools were identified: 1) *shared calendar* and 2) *task allocator*. These tools can be seen as coordination tools, because they help manager to integrate and schedule individual's work. Shared calendar provides needed information for

coordination. Task allocator provides feedback about current status of defined task. Actual workflow tools were not identified.



Picture 13. An example about scheduling task, that is done with shared calendar.

Both coordination tools support interaction in different places. While using coordination tools there is usually no need for synchronous interaction. Both shared calendar and task allocator were more useful for asynchronous interaction. User can leave a message and receive an answer later. Shared group calendar provides a possibility for many to many type of interaction. Task allocator was used for allocating tasks to one or several persons. Coordination tools supported formal interaction. This is presumable, because operational manager's scheduling tasks are formal.

For scheduling group meetings, the needed information about individual's schedules has to be real time. Adequate human behavior with group work requires that group members are aware of the overall situation (You & Pekkola 2001, 71). A manager can scan the shared calendar and obtain a general awareness of his/her subordinates (Tullio, Goucks, Mynatt, & Nquyen 2002, 17). However, the information about individual's schedules depends on how they update their own timetable to electronic calendar. The type of information in shared calendar is text or numbers and it is presented in tables. Task allocating is for asynchronous interaction and real time information cannot be reliably transferred with it. Evaluated tool allowed user to type text message and attach files to message.

Groupware coordination tools are useful for scheduling tasks. These tools allow manager to schedule personnel and facilities. Manager can also receive feedback and follow up the current status of a certain task. However, there exist a need for more advanced coordination tools like actual workflow tools. Some routine task could be managed with workflow tools. Manager should be able to establish a task list and checkpoints. With this kind of workflow tool manager could guide and follow the progress of planned tasks. For exception handling, coordination tools are not useful. Coordination tools are more suitable for planning, and following up tasks. Coordination tools are not very useful for knowledge creation.

6.4 Groupware Memory Tools

One advantageous feature of groupware tools is that they enable creation and maintenance of computer supported organization memory. Shared databases cannot be seen as organization memory alone. Organization memory is created with databases and tools, which provide an access to organization's previous information and knowledge. Organization memory is created with saving information and knowledge in different forms. Another important factor is the possibility to search previous information and knowledge.

In groupware environments evaluation, two groupware memory tools were identified: 1) *organization's databanks*, 2) *collaborative memory tools*. Both tools include saving and searching features. The main difference between databanks and collaborative tools in this thesis is that collaborative tools nature is more informal than organization's databanks. When databanks contain mostly documents, collaborative memory tools provide also an access to previous informal discussions.

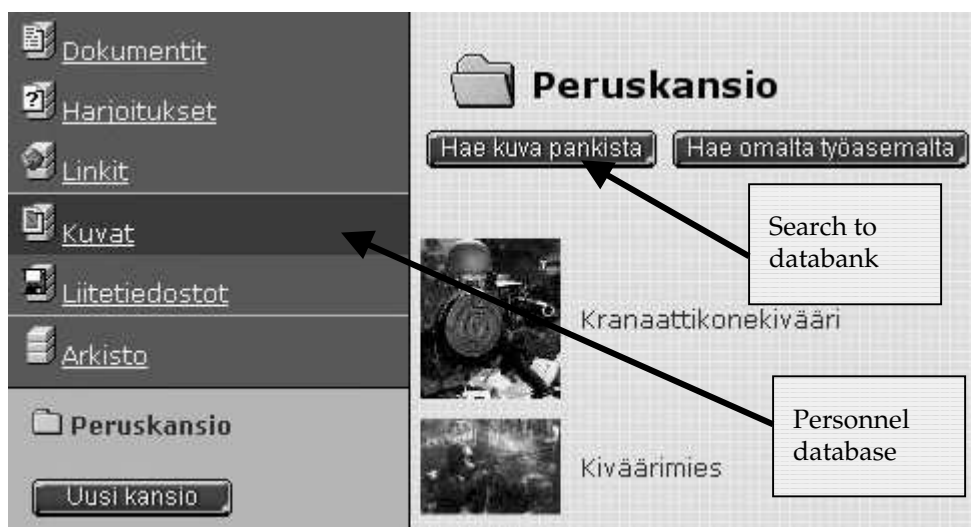
At issue of memory, it is presumable, that interaction occurs in different time and space. In computer supported organization memory, the direction of interaction is from many to many. Saved discussions and files are created with several users and they are accessible for several users. However, the search to databank may be more formal compared for example to search to discussion forum. Both memory tools support all kinds of non real time information.

Information technology can be used to support combination. Once tacit knowledge has been transformed to explicit knowledge, it can be shared easily in the organization. System might, through document analysis and classification, generate metadata to support rapid browsing and exploration of the available information. A quite different set of technologies applies to the formation of tacit knowledge through learning. (Marwick 2001, 820, 825)

One useful exploitation area for organization memory is knowledge creation and management. Groupware memory tools support all kinds of knowledge creation. Files, which are stored to databanks, have usually been approved with some authority. The knowledge of databanks exists in explicit form. Discussion forums, for example, contain stored informal interaction. The knowledge of collaborative memory tools may also exist in tacit form. It might be, that organization's databanks support more combination and internalization. Collaborative memory tools may support all four forms of knowledge creation.

Main difference between organization's databank and collaborative memory tools is in the nature of supported knowledge creation. However, both tools can support operational manager. The need for groupware memory tools can be

identified easily with planning and controlling functions. Operational manager has a need for organization memory, specially, with operational planning function. With controlling function, the groupware memory tools would be useful for capturing knowledge for future usage. Groupware memory tools would also support learning. Problems with organization memory might be, that nontext digital media have the disadvantage of being more difficult to search and to browse than text documents (Marwick 2001, 821). An example about a search tool to databank is presented in picture 14 and an example about filtering tool to collaborative space is presented in picture 15.

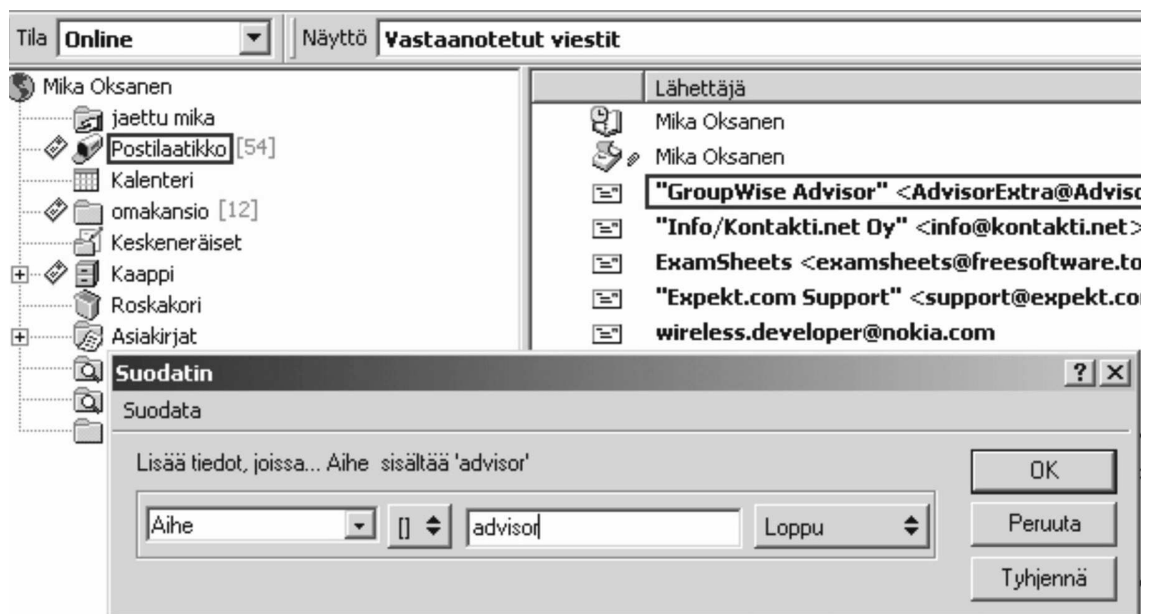


Picture 14. Personnel database with an option to search from organization's databank.

6.5 Summary of the Chapter

Groupware model can be used for the evaluation of groupware tools. Still it is not good to evaluate single tool, instead the model is more usable for evaluating groupware environments. You can say that one tool is a communication or collaboration tool. Still some tools may have both communication and collaboration features like video conferencing and discussion forums. It might be more useful to examine the whole environment and the features of the environment. All different tools cannot be divided under one function clearly. One single tool may have communication, collaboration and memory features.

In literature study email, chat and messaging were categorized as communication tools. In empirical evaluation, video conferencing was also seen more as messaging function than a shared space. If video conferencing is supported with other groupware tools, like a shared whiteboard, it can be considered as a collaboration tool. Also bulletin board can be categorized as a communication tool. However, it was not seen as a space where people work together. Bulletin board provides a channel for messaging, not a space for working together.



Picture 15. A filtering tool to shared personnel mailboxes.

Collaboration tools were categorized on more abstract level than in literature study. However, discussion forums were separated from shared media spaces. Shared media space can also be seen as an environment. Shared software can include multiform groupware like shared text editor or shared drawing tool.

Task allocator can be seen as a simple workflow tool. Actual workflow tools were not identified. This is a result of chosen environments. Evaluated environments were not directly management or coordination environments. Still the need for workflow tools exists. Shared calendars supported scheduling widely.

Shared databases cannot be seen as groupware memory tools alone. Databases need supporting features like search tools. Groupware memory tools should provide a possibility to edit, save and search organization's information and knowledge.

Groupware tools support different types of interaction, different kind of information and different kinds of knowledge creation. Groupware tools can be used to support the work of the operational manager. Groupware tools and the support for different kind of interaction, information and knowledge creation are presented in tables 5 – 8.

Task	Same Time	Different Time	Same Place	Different Places
Chat	X			X
Message system		X		X
Email		X		X
Bulletin board		X		X
Video conferencing	X			X
Discussion forum		X		X
Shared software	X			X
Shared media space	X	X		X
Shared calendar		X		X
Task allocator		X		X
Organization's databank		X		X
Collaborative memory tools		X		X

Table 5. Groupware tools support for interaction.

Task	One to One	One to Many	Many to One	Many to Many	Formal	Informal
Chat	X		X	X		X
Message system	X	X	X		X	X
Email	X	X	X			X
Bulletin board		X		X		X
Video conferencing	X		X	X	X	X
Discussion forum				X	X	X
Shared software				X	X	X
Shared media space				X	X	X
Shared calendar				X	X	
Task allocator	X	X	X		X	
Organization's databank				X	X	
Collaborative memory tools				X	X	X

Table 6. Groupware tools support for interaction

Task	Real Time	Non Real Time	Text	Audio	Picture	Video
Chat	X	X	X		X	
Message system		X	X	X	X	X
Email		X	X	X	X	X
Bulletin board		X	X		X	X
Video conferencing	X	X	X	X	X	X
Discussion forum	X	X	X	X	X	X
Shared software	X	X	X	?	?	?
Shared media space	X	X	X	X	X	X
Shared calendar	X		X			
Task allocator	X	X	X		X	X
Organization's databank		X	X	X	X	X
Collaborative memory tools		X	X	X	X	X

Table 7. Groupware tools support for information.

Tool	Socialization	Combination	Externalization	Internalization
Chat	X		X	
Message system		X	X	
Email		X		
Bulletin board		X		
Video conferencing	X	X	X	X
Discussion forum	X	X	X	X
Shared software	X			
Shared media space	X	X	X	X
Shared calendar				
Task allocator				
Organization's databank		X		X
Collaborative memory tools	X	X	X	X

Table 8. Groupware tools support for knowledge creation.

7 FRAMEWORK: GROUPWARE SUPPORT FOR OPERATIONAL MANAGEMENT

This chapter is a synthesis about the empirical model of the operational management and the knowledge gained from groupware tools evaluation. Management tasks and groupware support for the operational management is presented in unity. The result of the synthesis is a framework about groupware support for operational management. Groupware tools are grouped under different modules.

7.1 Planning Modules

While planning, manager completes tasks, which contain different types of interaction, information transfer and knowledge creation and management. The tasks of the planning function were presented as separate tasks while in real life these tasks are overlapping and iterative. The environment, which supports planning, should support all different planning tasks.

Planning environment should provide tools for synchronous and asynchronous interaction and from one to one interaction to many to many type of interaction. Some meetings, like decision-making meetings, are formal. However, the idea generation meetings may be very informal. The form of information differs between different tasks. During planning, manager needs tools to gain both real time and non real time information. Used tools should support multifaceted forms of media. Operational manager needs and uses tacit and explicit knowledge for decision-making and idea generation. Operational plan of action is usually saved in database and can maintain explicit knowledge.

Supporting environment should provide tools for communication, collaboration and an access to organization's memory. Synchronous communication tools, like chat with shared whiteboard and video & audio conferencing are useful for real time meetings. These groupware tools facilitate the exchange of ideas. Shared software and video are useful for illustrating personnel thoughts. A

possibility to store conversation and drawings would support personnel and organizational memory.

Collaboration tools like discussion forums and shared media spaces are useful in many cases. Collaboration tools support asynchronous interaction, which is useful for example during detailed planning. Operational manager can share the draft about operational plan of action and receive comments during planning. These tools can also provide shared information and knowledge.

Fayol (1987) identifies a need for organizational memory: *“Good specimen plans should be made generally available (from past history of the firm, published sources, trade associations, universities, or consultants). Experience and general discussion should help single out those plans to be used as examples.”* (Fayol 1987, 26)

Groupware memory tools can support operational manager during search of information and knowledge. Both tools (organization’s databanks and collaborative memory tools) are useful. Search to databank provides an access to explicit knowledge about previous plans. Search to collaborative memory provides an access to tacit knowledge like experiences about similar cases.

Planning should not be supported with single groupware tools, but with an integrated set of different tools that is groupware environment. Usually environment should be tailored for each case. Groupware can be used in planning. Groupware provides tools and environment for information and knowledge search and idea generation. Additionally group decision-making can be supported. While manager is producing operational plan of action, groupware can provide tools for communication, collaboration and organization memory. Also parts of the planning process can be saved for future use.

7.2 Groupware Support for Organizing

Organizing was usually planned in operational plan of action. The actual organizing cannot be supported, but groupware can support planning and provides flexible communication lines.

In communication, managers used mostly phone, but other tools are also needed. Manager needs communication tools for asynchronous, formal and many to many kind of interaction. Some conversations should be saved, like exception handling discussions. Multiform information should also be supported. Communication lines should provide an access to organization's databases and memory.

Groupware can facilitate setting up communication lines by providing multiform communication, collaboration, coordination and memory tools. Different groupware tools can support interaction in different time and place. Groupware tools can support multimedia like text, audio, pictures and video. In operational level, groupware terminals should be mobile. Groupware can provide communication structure. Phone and other tools will be needed besides groupware. These other tools could be integrated to groupware environment.

One problem with the usage of groupware on operational level is linked to the mobile use of groupware. For example support for mobile meetings has not been so much addressed in the research. Mobile meetings are difficult to assist by means of traditional meeting support. Suitable terminal for mobile meetings are problematic. Even laptop PC seems to be too heavy. (Bergqvist, Dahlberg & Ljungberg 1999, 82, 91). *"Particularly within interactions the ways in which a user needs to be mobile have largely been ignored within computer supported cooperative work"* (Luff & Heath 1998, 314).

7.3 Commanding Modules

Operational commanding function is basically communication between operational manager and subordinate. Communication occurs in all forms of interaction and considers all types of information. Communication between operational manager and subordinate contain informal conversations, formal commanding meetings and sharing documents and knowledge. Operational managers have a need for asynchronous interaction specially, in shift work. Interaction occurs also in different places.

Training and familiarization were important tasks in commanding. These tasks are committed usually at same time and in same place. However, these kinds of training occasions are hard to arrange. Training costs are a considerable source of expenses for many industries. The problem is compounded when the trainers and trainees are geographically located a far. One of the applications of Collaborative Virtual environments are aimed to remedy this problem or at least reduce the costs involved in training. If collaboration is achieved, the need for the trainer and trainee to be present at the same location is eliminated. (Hosseini & Georganas 2001, 621)

Commanding meetings occurred usually at same time and in same place. However, usually all the group members had no possibility to participate these meetings. People work in different places and in different shifts. Dispersed synchronous commanding meetings could be supported video & audio conferencing. These meetings can be saved and reviewed afterwards. Shared software like shared white board can be used for working together in dispersed meetings. These tools would support for example publishing the plan of action.

Message system or email can be used for asynchronous, routine commanding. These are suitable tools for one to one interaction. Manager can also receive individual feedback from subordinates. Message systems can also be used for task allocation. In commanding interaction is usually formal. Message systems support formal interaction better than email. Structured messages can be saved and verified later. Message system may also include coordination features, which are discussed in the next chapter.

Discussion forums and shared media spaces enable formal and informal asynchronous interaction between many users. These tools support and complete training and familiarization. All the questions and problems cannot be answered and solved during training events. New issues may appear during the work. Learning can continue after training in shared environment, where participants can make questions and receive answers from colleagues or superiors. Important collective learning happens when individuals express their

opinions and challenge each other's viewpoints (Zollo & Winter 2002, 341). Discussions can be stored and used in future. Discussion forums enable people to share experiences and tacit knowledge. Stored conversations can capture tacit knowledge for future use. Training can also be supported with multimedia databank. Training events can be recorded and video clips can be stored to organization's databank.

7.4 Coordination Modules

In coordination, scheduling resources and scheduling tasks are important. In scheduling, real time information is needed about other people's schedules and organizations resources. The outcome of scheduling is formal. Information has to be very exact. Scheduling tools should also be communication tools. Subordinates may have wishes about shifts. Scheduling task is formal interaction between operational manager and subordinate. Needed medium in scheduling is simple. Usually text and pictures are the only needed type of information.

Based on findings from empirical study, follow up and handling exceptions were not computer supported. Follow up was not planned or systematic. The interaction was usually informal. However, there exists a need for planned follow up, but the managers had no tools for executing it. The work is usually scheduled and managers should be aware about the progress of the work. Operational managers need information about the status of executed tasks.

Exception handling was one common situation, which operational managers have to handle. Exception is a situation, which cannot be predicted. Usually these situations demand synchronous dispersed interaction. Manager has to give advices and solve problems, but he/she may not be able to be at same place with subordinate. Phone was quite used tool for exception handling, but it is not always adequate.

One suitable and used tool for scheduling resources was a shared calendar. Shared calendar provides real time information about personnel's timetable.

Shared calendar makes possible to search suitable time for a common meeting. Shared calendar contains also a possibility to schedule facilities. The problem with shared calendars is to reach the *critical mass*. Critical mass means having enough users of the environment. Furthermore these must be people the user wants to collaborate with. The importance of critical mass can be illustrated by an example: a Lotus Notes discussion database can fail as a forum for exchanging ideas because there is an insufficiently large number of contributors so that discussions and topics rapidly become stale. (Monk & Scholtz 1996)

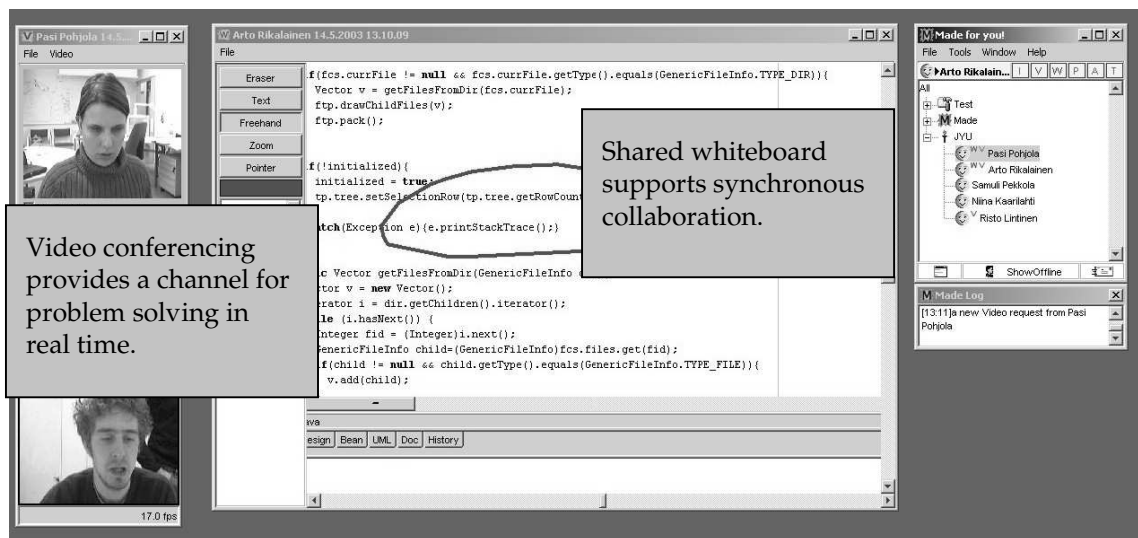
Specialized use of structured messaging in task allocation is an example about coordination tool. Structured messaging can be used for allocating tasks to subordinates. Task allocating tool provided feedback about the status of the task to manager. With task allocator, manager could follow up the status of certain task. Another tools for scheduling tasks could be shared and dynamic flowcharts. However, these kinds of tools were not identified in groupware environment evaluation.

Exception handling was one important task. Exception can be a problem, which has to be solved before the work can continue. Exception handling includes knowledge creation and change of information. Exception handling should be supported with wide set of groupware tools. Exception handling environment should be a collaborative environment for synchronous but dispersed interaction. Environment should support multimedia, socialization and internalization. An example about groupware tools for exception handling is presented in picture 16. Video provides needed information from subordinate. Drawing table supports the change of ideas and knowledge. Audio device and message system support synchronous communication. In exception handling, there should also be a possibility to access organization's databases.

Coordination tasks, like scheduling, follow up and exception handling, are important issues in operational management. These tasks include interaction, information and knowledge creation, which can widely be supported with groupware tools.

7.5 Controlling Modules

Manager needs information about the quality of executed work. Manager uses this information for evaluating the work and makes reports about it. One important task, which is linked to evaluation, is learning from work. Incremental improvements in operating routines can be accomplished through the tacit accumulation of experience and occasional acts of creativity (Zollo & Winter 2002, 341).



Picture 16. An example of video and audio communication tools with shared whiteboard.

In monitoring, manager needs information from subordinates about executed work. Monitoring can be formal or informal. The evaluation and reporting of the work can be done in a group. Learning situations should include asynchronous and many to many type of interaction. Learning situations should also be both formal and informal. Learning should be supported with multiform information and all forms of knowledge creation.

Discussion forums and shared media spaces can support monitoring, evaluation, reporting and learning. Collaboration tools can provide a space, where group members can have an access to group objectives and plans, produced documents and other needed information. Collaboration tools provide also a space, where group members can have discussions about the

work. The ability to collaborate with others via a shared information space becomes vital for knowledge workers (Hayashi et al. 1999, 101). Also reports can be published. Another important feature in collaboration tools is, that group members are allowed to comment plans, reports and other documents. This feature supports specially evaluation. Group members can also give asynchronous feedback to each other. Collaboration tools support different forms of knowledge creation. This feature supports learning.

Organization's databanks and search tools to collaborative memory can also be used for learning. Executed work can be evaluated with previous experiences and previous work. Groupware memory tools provide also a possibility to store captured tacit knowledge to explicit form.

Groupware provides a possibility for all group members to participate controlling. Groupware tools are useful specially for saving information and knowledge for future use. The storage of gained information and knowledge reduces risks, which may appear, if important worker is lost. With suitable tools controlling function could be integrated with coordination.

7.6 Summary of the Chapter

Physical distance can be an obstacle to effective knowledge integration (Okhuysen & Eisenhardt 2002, 370). Geographically distributed teams experiences are very substantial reduction in frequency of communication, particularly informal interaction. This gives rise to a number of difficult coordination issues (Handel & Herbsleb 2002, 1). The role of technology is to overcome barriers of time or space that otherwise would be the limiting factors. Technology can assist group, who may meet only occasionally or even never (Marwick 2001, 817, 827). Groupware can support operational management, which is distributed in time and space. However, operational management cannot be supported with single tools. Groupware should provide a whole environment for operational manager and subordinates.

This chapter presented general framework about groupware support for operational management. The framework presents five groupware modules and their exploitation in operational management. The framework does not handle single groupware tools. Instead groupware is divided into modules. A module is an integrated set of needed groupware tools, which can be used to support certain management tasks. The framework is presented in picture 17. According to framework, all operational management tasks can be supported with groupware. The framework gives examples how the work of the operational management can be evaluated, and supported with suitable groupware modules. Framework was built with empirical models about operational management, groupware tools and the evaluation criteria presented in chapter 4. The support of the proposed groupware module to specific managerial tasks can be verified with used evaluation criteria.

The use of groupware supports the work of operational manager. Groupware can also bring extra value for the organization. The use of groupware memory tools, such as organization's databases, decreases risks of losing essential information of knowledge. Groupware facilitates interaction between personnel in different places. This will facilitate knowledge sharing and learning between dispersed departments. Groupware can also facilitate subordinates participation for example to planning. Operational manager will gain synergy benefits from receiving subordinates' tacit knowledge.

GROUPWARE MODULE	SUPPORTED TASKS
<p><u>Module 1, synchronous communication environment</u></p> <p>Real time conferencing: video & audio or chat</p> <p>Shared software: whiteboard etc.</p>	<ul style="list-style-type: none"> - Exchange of ideas and knowledge - Group decision-making - Commanding meetings - Exception handling
<p><u>Module 2, collaboration environment</u></p> <p>Shared media space for asynchronous collaboration</p> <p>Discussion forums</p>	<ul style="list-style-type: none"> - Detailed planning - Search of information - Search of knowledge - Training & familiarization - All controlling tasks
<p><u>Module 3, groupware memory tools</u></p> <p>Organization databanks</p> <p>Search and filtering tools to collaborative environments like discussion forums</p>	<ul style="list-style-type: none"> - Search of information - Search of knowledge - Training & familiarization - Learning - Store information and knowledge for future use
<p><u>Module 4, asynchronous communication tools</u></p> <p>Structured messaging for asynchronous communication</p> <p>Structured messaging for task allocation and coordination</p>	<ul style="list-style-type: none"> - Task allocation. - Gather feedback - Routine management - Scheduling tasks - Follow up
<p><u>Module 5, group scheduling tools</u></p> <p>Shared calendar for scheduling</p>	<ul style="list-style-type: none"> - Scheduling resources - Scheduling tasks

Picture 17. Framework: groupware support for operational management.

8 DISCUSSION & SUMMARY

This chapter summarizes and discusses the whole thesis. It includes the discussion about the research that was carried out. The research methods and results are evaluated and furthermore problems and proposals are considered for future research. The theoretical management and groupware models of this framework were developed on the basis of literature study. The models, that were used as the basis for empirical research and as well as the results of the empirical study were not in *disharmony* with previous research.

8.1 Evaluation of Results and Methods

Many empirical studies provide recent information about the work of the operational managers and existing groupware environments. However, it was necessary to find out detailed information about current operational management functions. Groupware support cannot be evaluated without a sense of the managerial work. The framework, based on empirical findings, provides examples on how the work of the operational manager could be supported with groupware.

The operational management and groupware models have already been used successfully in related field studies. This increases the reliability of the models. Chosen criteria are wide and have also been used in previous research. All factors related to operational management were not analyzed and all existing groupware tools were not presented. However, this thesis provides an extensive picture about current possibilities of using groupware in operational management. To evaluate groupware support for operational management with certain criteria has been proved to be a suitable approach for this study.

Operational management could be evaluated additionally with other management theories. Another suitable functional approach to operational management would have been to divide operational management to planning, execution and evaluation phases. Semi-structured interview was a suitable method for the research about operational management. There was enough

basic information about operational management. However, information about the tasks of the operational management was not adequate. It was not possible to make adequate structured and quantitative queries about the tasks. Qualitative approach was more suitable, because it allowed interviewees to elicit new information about the work of the operational manager. On the other hand, unstructured interviews would not be effective enough, because the focus of the interviews would have broke up. The semi-structured interviews guided the focus of the interviewees to the managerial functions. Interviewer could make additional and 'probing' questions, if needed. *Weakness* of this method could be that the results are not extensive. The selection of the managers, which are interviewed for the research, was considered carefully. Interviewees represented different organizations.

The chosen groupware environments contained many different groupware tools. One environment (MADE) was still in development. Other three were used by different organizations. The Lotus Development Corporation's model was useful for categorizing groupware tools. However, the separation between collaboration and communication tools was not accurate.

8.2 Problems With the Usage of Groupware

Many of the social aspects of work, which are important in knowledge management, cannot currently be addressed by technology. There can be some problems with collaboration environments. Few of the problems are found, such as flaming, personal abuse, and irrelevant postings. (Marwick 2001, 4, 6).

Dispersed synchronous interaction has to be supported. Groupware terminals, which are used on the operational level, should support mobile use. However, the mobile use of examined groupware environments, was limited. In some cases, user could use some tools with mobile phone. Before groupware can be used widely on the operational level, problems with the mobile terminals should be solved.

Groupware needs users. For example, if individuals do not update shared calendar, it is not useful. Specialised collaboration tools need user participation or the benefits of the synergy are lost.

The successful use of groupware expects that manager understands the benefits of group work. If planning, coordination and controlling are done individually, the use of groupware will not benefit manager entirely; the benefits of increased interaction are lost.

8.3 Proposal for Further Research

In future, the empirical operational management model could be evaluated with further research. Now the model provides an example about managerial tasks, although all managerial tasks were not identified.

The use of groupware on operational level should be further investigated. More empirical case studies could bring up the real problems, which may occur with the use of it.

Another area for potential study is the requirements of mobile groupware terminals. The usage of groupware on operational level creates different kinds of demands for suitable terminals.

8.4 Summary of the Thesis

The objective of the thesis was to present a framework about groupware support for operational management. The main question of the research was: *can groupware support the work of the operational manager*. The problem was divided under three sub questions considering managerial tasks, groupware tools and groupware support to operational management.

The model of operational management was built *on the basis of the Fayol's model* and literature related to operational management. Model can be used to examine and analyze operational management tasks. Five different functions are extensive and every function is needed. Group work was examined with in

management functions in order to provide an understanding about operational managers' working environment. This model provided the theoretical background for empirical study.

The model of groupware tools was built *on the basis of the Lotus Development Corporation model* and literature related to groupware. The groupware model can be used to divide groupware environments to separate tools. There can be difficulties with making clear distinctions between for example communication and collaboration tools. Organization memory was examined with groupware to provide an understanding about its usability. This model provided theoretical background for the evaluation of groupware tools.

The *evaluation criteria* that were used were analyzed. Criteria were chosen on the basis of the literature study. These criteria are needed for the evaluation of the support of the groupware for operational management. Criteria were divided to *forms of interaction, forms of information and forms of knowledge creation*. The criteria enable evaluation with different dimensions. Different criteria also help different kinds of readers. Presented evaluation criteria were wide and extensive for this research. With these criteria, the framework about groupware support to operational management can be proved to be more reliable.

The empirical research about operational management goes deeper into managerial tasks. Fayol's model is quite general and model had to be tailored to operational management. In empirical research, the focus was on operational level. In operational management, totally twenty one (21) *different tasks* were identified, categorized with Fayol's model and evaluated with the criteria of interaction, information and knowledge creation. Empirical model about the task of the operational manager provides new information about the subject.

Groupware tools evaluation based on the evaluation of four different groupware environments. *Groupware tools were categorized* and examined with the criteria of interaction, information and knowledge creation. The separation of different tools was not always clear. Some communication tools could also be categorized as collaboration tools and vice versa. The empirical model about

groupware tools provides information about recent and existing groupware tools and their support for different type of interaction, information and knowledge.

The framework presented a model about groupware modules, which can support the work of the operational manager. Groupware tools are grouped under five different groupware modules. The *framework presents groupware modules, which could support operational management*. The support is evaluated and verified with the evaluation criteria.

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PREPARING INTERVIEW QUESTIONS

□ *Basic background information*

Age?

Education?

How long have you been working in your current work?

□ *Job description*

Title?

Which are your most important managerial tasks (1-3)?

□ *Subordinates*

How many subordinates do you have?

What are your subordinate's most important working tasks?

□ *Presentation of the research*

The purpose of the research is to find out: can groupware be used to support operational manager.

For the research, a wider understanding about the work of the operational manager is needed. Also an understanding is needed about existing interaction, information and knowledge management.

The tasks are analyzed and categorized with five management functions: 1) planning, 2) organizing, 3) commanding, 4) coordinating and 5) controlling. The interaction, information and knowledge are identified from these tasks.

□ *Scheduling the actual interview*

Time of the actual interview?

Place for actual interview?

Discussion about suitable managerial scenario.

INTERVIEW QUESTIONS

□ *The basic information about managerial scenario*

Scenario is a certain operational working task, which is available for examination and which can, for example, be marked out with certain time period.

Could you describe managerial scenario shortly?

What kind of task are we talking about?

What is the time period of the task?

What are the objectives of the task?

What are the outcomes of the task?

Who will participate the task?

□ *Managerial tasks related to the scenario*

In managerial tasks, the tasks are separated with different management functions. Also the nature of the task is examined.

"Help" questions are made to facilitate the identification of the tasks.

□ *What kind of planning should be done:*

What kind of information or knowledge is needed for the planning?

How is information and knowledge obtained?

What kind of decisions have to be done and how?

What kind of plans have to be done and how?

Are the plans stored?

□ *What kind of organizing is needed:*

Organizing the personnel: Is there a need for reorganizing?

Organizing the communications: Are there problems?

- *What kind of commanding tasks there exists?*

What kind of tasks have to be pointed for subordinates?

Which kind of situations is the commanding needed?

What kinds of devices are used for commanding?

How exact are the tasks?

How is feedback gathered from the group?

- *What kind of coordination tasks there exists*

Is the work scheduled?

Do the employees need working schedules?

How is the progress of the work monitored?

- *If needed, how are the employees guided? What kind of controlling tasks there exists?*

What things, concerning the employees, have to be monitored?

What things, concerning the tasks, have to be monitored?

Are you trying to learn from your work?