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EVALUATION OF WORKFLOW MANAGEMENT TECHNOLOGY FOR THE CO-ORDINATION OF TELEWORK

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Telework is an application area, which still possesses a large growth potential. The flexibility in the dimensions time and location of task execution stands for an innovative work organisation form. However, the main obstacle of telework is an increasing effort that has to be made for process co-ordination and monitoring. Therefore the objective of the COBIP project[1] is to increase the competitiveness of the companies by providing a workflow-based infrastructure that is capable of supporting and enhancing necessary interaction and co-operation methods. This document shows the results of the COBIP project in different areas of application, i.e. telework within a media and design company, in the body shop of a car manufacturer and telework in systems integration.

1. INTRODUCTION

Telework has become a very promising concept for the spatial and temporal distribution of work. The flexibility of telework in the dimensions time and location of task execution makes it possible to take advantage of this work organisation form to improve companies' competitiveness. Today, telework is mainly used for isolated tasks and those that require less integration into business processes of the companies. Telework will only achieve its full potential, if attention is paid to the fact that the work done in a company is in general co-operative work. Increasing

efforts for co-ordination and monitoring are seen to be the main obstacle concerning co-operative telework. Therefore, business process modelling and workflow management are needed as a supporting methodology and instrument.

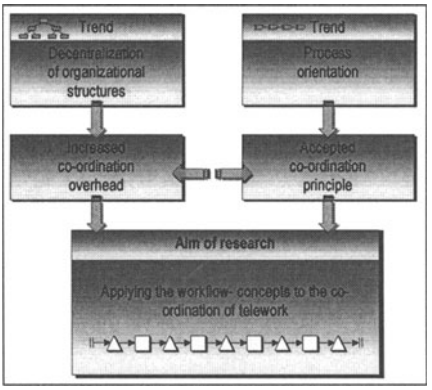

Figure 1: Approach of the COBIP project

1.1 Telework

Telework within the scope of the COBIP project is regarded as contractually agreed work that is fulfilled off-site, i.e. the employee is at least temporarily dislocated from his "normal" office. It can be carried out as home-based, centre-based, mobile or in a mixed location pattern and is characterised by the use of public means of communication and the corresponding technological devices (Kress, 1999). Intra-organisational tele-co-operation describes all forms of tele-co-operation *within* a company's organisation. Within the scope of the COBIP project telework does not leave the intra-organisational level.

Definition 1: Telework

> Telework is work done by people outside of business premises, in an apartment, in neighbourhood- and satellite-offices or even on the way by using public and private means of communication with the appropriate technical equipment, in order to fulfil their contract.

Apart from the advantages telework offers, the use of it also requires even more co-ordination by the company or their department managers as well as a change in the company's leadership. This aspect may lead to a loss of efficiency and thus to an to a negative trade-off while relating the investment and the return on investment of this innovative organisational form (Ruppel, 1995). The fact that employees are temporarily or completely excluded from the centralised organisational structure calls for a more and intensive planning and controlling on the basis of a suitable structuring of underlying business processes. Activities with the following characteristics are trend-setters for telework (Reichwald, 1994):

- activities with a high degree of autonomy,
- located in dispositive and creative sectors and
- result-orientated valuation.

Furthermore an exact quantitative and qualitative control is necessary for repetitive co-operative tasks, which are handled in a short period as it is the case at all pilot sites. This requires a high structured degree of the underlying process concerning the functions, clearly defined and differentiated work contents, which lead to measurable results (Wollnik, 1992).

1.2 Workflow management

New organisational forms of managing business processes require the assistance of planning and controlling the processes. Workflow management systems are one possibility to manage an enterprise in the context of business process re-engineering. These systems work on the basis of defined processes (workflows).

Definition 2: Workflow

> A workflow is "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" (WfMC, 1999).

A workflow is a partially or completely classified number of activities. They form - as a graph- the basic elements for workflows. Activities can be defined in a hierarchical order. On the lowest level of hierarchy the activities are accomplished by employees or computer programs. There is a widespread area of how work flows within an office environment. This reaches from a very unstructured e-mail-based communication to well-structured production workflows (Nastansky, 1994).

A Workflow management system is a "system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invokes the use of IT tools and applications" (WfMC, 1999).

2. THE COBIP SYSTEM

COBIP makes a set of modules available for the management of telework. Figure 2 shows an overview of the COBIP architecture (Dangelmaier, 1998).

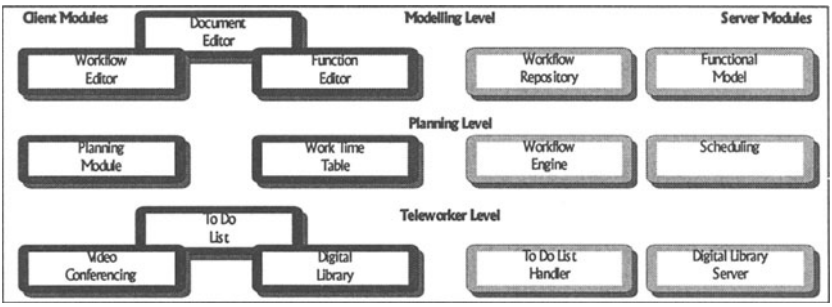

Figure 2: Modules of the system

Documents are the basis for the modelling of a new workflow. The modelling of document types takes place in the document editor. The function editor serves for the administration of all functions executed by the employees. The function tree thereby supplies a qualitative description of the enterprise as a prerequisite for the modelling of the qualifications and entitlements of the employees.

The development of a workflow model normally takes place top-down. A workflow is modelled as a sequence of active nodes (activity_nodes – rectangles) and passive nodes (state_nodes – triangles) that are connected to each other by the use of directed graphs.

It is up to the employees to define their availability. With the help of the work time table, the employees can fix their working time themselves whenever and wherever they want to be available for working.

Most of the tasks related to the handling, instantiation or execution of workflows can be done within the monitoring module. Additional planning and scheduling functionality allow the actor assignment basing on the current work load. The following figure shows one modelled example of a workflow (Dangelmaier, 1999).

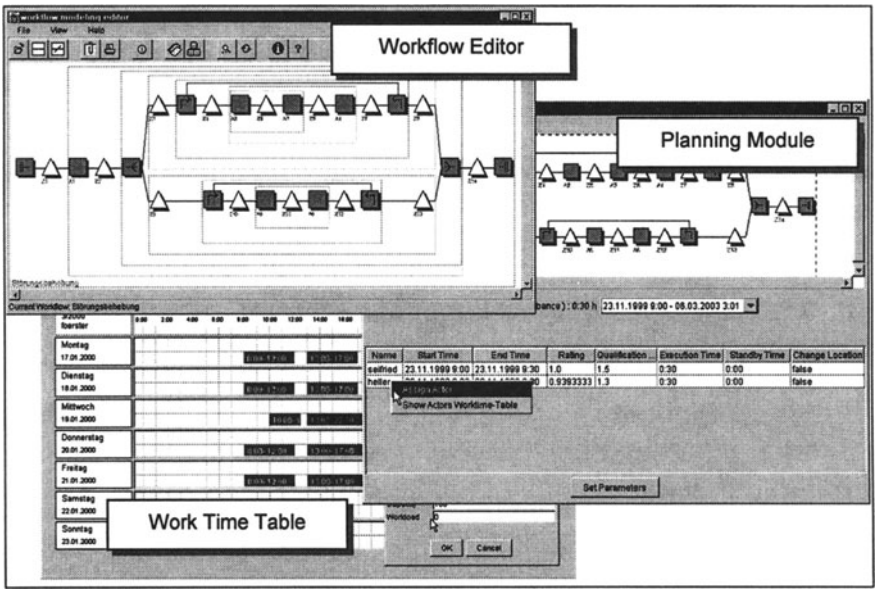

Figure 3: Example of the modelled workflow

The need to access and store work-related documents often arises during the execution of telework activities. The Digital Library service provides an efficient way to organise such documents and provide easy access. This service can be viewed as a distributed client-server application that permits a transparent access to distributed repositories of multimedia documents. Furthermore, a video conferencing system was developed and integrated to allow the teleworker to be fully integrated in the work respectively business process. This service can be used by teleworkers for formal as well as informal communication (Pinto, 1999).

3. EVALUATION

3.1 Application Media and Design

Stoilas Media & Design is an advertising agency, which creates and implements marketing and advertising concepts for Greek companies focusing on European markets. The processing of customer orders includes many co-operative business processes. Different design working steps, from the layout to the film creation, to printing or production, will be performed interactively at different locations by several people. Large printing or production orders will be worked off by external specialised companies. Furthermore several tasks, for example the design, are performed by employees and freelancers working at home or in offices. As salesmen work in their countries, they need a direct link to the company management to prepare offers and to attend customers.

Stoilas is spread across cities such as Thessaloniki, Katerini, Athens and Munich. Since high costs arise with specialised labour force and creative work cannot be controlled in an easy way, it will be necessary to manage co-operation between the employees, company management and external companies, in order to assign planned tasks to the right people and to manage task execution. As Stoilas has already built up an Intranet between these locations, the COBIP application site provides the additional co-ordination support for its business processes.

Four main business processes were identified, modelled and executed with the COBIP method. These processes are the printing tasks for advertisements, the selling of non-standard gifts, the arrangement of television and radio spots and the planning of promotion actions. Figure 4 shows one process as an example.

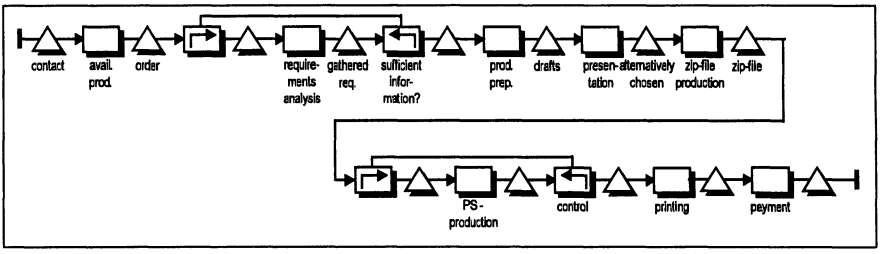

Figure 4: Business process of printing tasks

All in all there are three main criteria to assess a situation and its modifications concerning productivity i.e. cost, time and efficiency. Costs cannot be managed, only activities can. Thus it has to be looked at the activities and processes first, second at the resources consumed in the processes. Then resources consumed can be assessed by their cost unit rate. Efficiency is defined as doing things right. A process is a defined relation or change between an input and an output. This relation or change takes time. Spending time means spending resources, and causes cost. In the validation phase the following three time criteria have been considered:

1. Travel time,
2. Time to access to information and
3. Time to access to people.

The travel time could only be decreased a bit. Face-to-face communication is very important in Greece. Thus time spent for travelling to meetings is still on the same level. The transmission of huge data volumes causes safety problems due to unreliable connections. Thus for sending large files couriers are still used. Time to access to information could not be shortened since the data are hold in separate software programmes. Access to people has been improved and speeded up due to the monitoring functionality.

The users have gained the following outcomes. The quality of user tasks concerning autonomy and variety has increased. Task satisfaction and motivation did not change, since the tasks had remained the same. However task involvement increased since the responsibility for organising work had grown. Stress and other health issues criteria had not been considered. Skill utilisation has become broader now. The opportunities to learn new things motivated the employees to deal with the project matters whereas the need for support has grown. The status of the employees moved to a more IT-orientated one. Thus even career opportunities have increased, proved by a company leaving employee. No statement can be made about the job security or staff reduction since the COBIP project has a prototype status and an impact on these criteria was not intended. The future will show if there are any employment opportunities. Nevertheless the question was raised if employees felt threatened by the workflow control. The employees involved in COBIP at Stoilas have welcomed the possibilities the system offers, whereas the reason might be that the system did not affect their normal daily work in a fundamental way.

Daily usage of the software has led to important experiences about workflow management systems and its usage within a small decentralised organisation. From the beginning there was a high acceptance of using the software even the prototype. However, the expectations were also very high to get a tool supporting and facilitating daily work. These expectations could not be met completely. As the administrator struggled with failures and bottlenecks of the software for a long time, motivation decreased temporarily. Training actions took place continuously while explaining the software step by step to the employees during the implementation and validation phases at Stoilas. But, for persons without workflow knowledge it was difficult to understand how the system works (Araujo, 1999).

3.2 Telework in maintenance management

The Wolfsburg plant of Volkswagen, participating in this project, is the largest car plant within the Volkswagen group. The application site focuses on the co-operative maintenance of automated assembly systems. Three new production lines each with 40 fully-automated welding robots were installed for the GOLF A4. The controlling and monitoring of disturbance data formed the basis of the telework application site. A knowledge-based online disturbance management system disposes of a substantial documentation of disturbance times and filed experience reports concerning the clearing of disturbances as well as placing them at the user's disposal. The assignment of these experiences to a specific disturbance takes place by symptoms that will be obtained by the sensors of the robots and thus ensure their inter-machinery compatibility (see Figure 5).

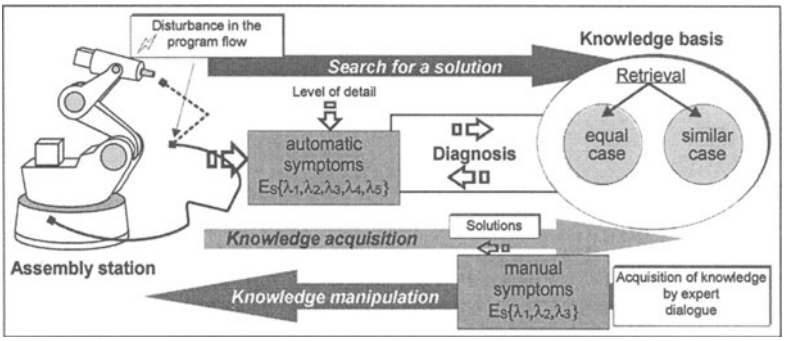

Figure 5: Knowledge-based disturbance management

The running of intelligent production facilities, requires different high-skill qualifications for the controlling, steering and maintenance. Such experts are rare and the kind of work does not suit to normal work-time schedules at all. The purpose of telework in this case is to make it possible to manage maintenance activities in advance, at any time and place, where these experts are and in co-operation with the service staff at the original geographical location of the plant. On the one hand maintenance is co-operative work. On the other hand there are similar machines, on which maintenance work can be done by the same group of people all over Europe. In this case it is of interest to implement co-ordination services and a work-platform for telework with special focus on planning and time-management functionality.

Furthermore necessary functionality for remote maintenance and service are:

- The integration of the distributed database for the recording and analysing of disturbance data.
- Services for communication between the teleworker and the maintenance staff at the production line.
- The transmission of images and annotations for monitoring robots for exceptional handling.

A four-phase model was set up for the introduction of telework and workflow management. The first phase of the concept involved pinpointing the organisational and technical status quo at the pilot site, notably analysing business processes and examining their suitability for the possible introduction of telework and workflow management. It became evident that the only process suitable was that of disturbance management. Having established the organisational and information-related strategy for the introduction of telework to be incorporated into the target concept, this strategy then needed to be realised during the introduction phase. It became clear, however, that organisational problems meant that the flawless implementation of the target concept was not possible. Before the workflow management system could be employed to co-ordinate telework, the organisational structures of the pilot site as well as business processes had to be simulated in the COBIP project. Then, telework and workflow management were established in a pilot phase. The last phase entailed examining the implementation at the pilot site.

Telework opportunities at the pilot site have had in most cases a positive resonance by the employees. There were some doubts among participants, however, to the prospects of a successful realisation of such a concept. "After all, the maintenance of machines can only be carried out on location." A similar attitude

also prevailed on the management level. Figure 6 shows some doubts and risks encountered.

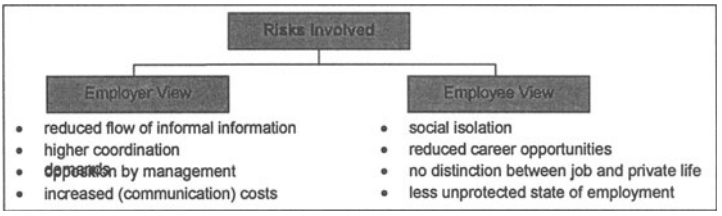

Figure 6: Telework and the risks involved

During working hours, often informal conversation takes place that will lead to further knowledge. This way of learning by mutual support gained in a collective working environment or by informal discussions on various solution approaches to a particular problem will be forfeited in a working environment where teleworkers largely perform as isolated entities. Therefore, at times physical presence was more frequently required than originally planned, based on the need to acquire information on informal matters. It must furthermore be said that teleworkers only spend 50% of their working hours on plant premises need to invest significant efforts during those times to catch up on the missing information. Regular meetings can only partially serve to counteract this disadvantage, whereas they also cause additional cost and time expenditures. Without the implementation of organisational changes, telework positions are not practicable therefore all decentralised forms of work organisation result in increased coordination requirements.

From the employee's point of view any form of telework will lead to time and cost savings based on a reduction in the time spent commuting to and back from work. Professional activities can be relocated to the homes of employees while being able to reconcile to the demands of working and private lives. Interviews among teleworkers have shown that an increased flexibility for the employee to manage his time is considered to be the main benefit.

In retrospect it must be said that the pilot site is only able to deal with telework and the workflow management to a limited extent, even if there are increases in productivity. It is, however, difficult to proportionately attribute such increases to the different changes that took place (Araujo, 1999).

3.3 Telework in systems integration

Tecnotron - Sistemas de Automação, S.A. is a Portuguese company operating in the industrial market as systems integrator of manufacturing execution, supervisory control and industrial logistics systems. The company's head-office is situated in Lisbon, where most of its 25 employees are based. A branch office in the north of Portugal covers sales and servicing for local customers.

Tecnotron is a project-oriented company, working on a "make-to-order" basis. This leads to extensive interaction between technical, administrative, marketing and accounting personnel, working in geographically distant places. Marketing agents and project leaders have to interact to prepare customer offers. Service technicians have to fill in reporting forms for technical and accounting purposes. Employees

have to fill in weekly time sheets, even while being at customer sites for installation and commissioning purposes. All of the above mentioned situations can occur while the intervening actors are many kilometres apart. On the other hand, some tasks may be subcontracted to external companies or individuals working at home. The high costs of skilled human resources make it vital to assign the right tasks to the right people and be able to subcontract tasks when needed, while keeping projects on schedule as well as providing good customer service. These needs can be fulfilled by a telework system capable of managing both, ad-hoc and structured workflows of the company's daily activities.

These requirements may be met by a telework system capable of managing complex workflows arising during the company's daily activities. The telework pilot at Tecnotron covers the main process of managing project proposals. Figure 7 illustrates a typical process: The requirement analysis. It is an early phase of a new system/project. The requirement analysis is usually done by the marketing/sales department, at least in a new system, with a close connection to the client. If the client approves the first specification, a new project will be started and a detailed proposal will be elaborated. It is also possible that the client himself delivers a detailed specification, which is not the case of a requirement analysis.

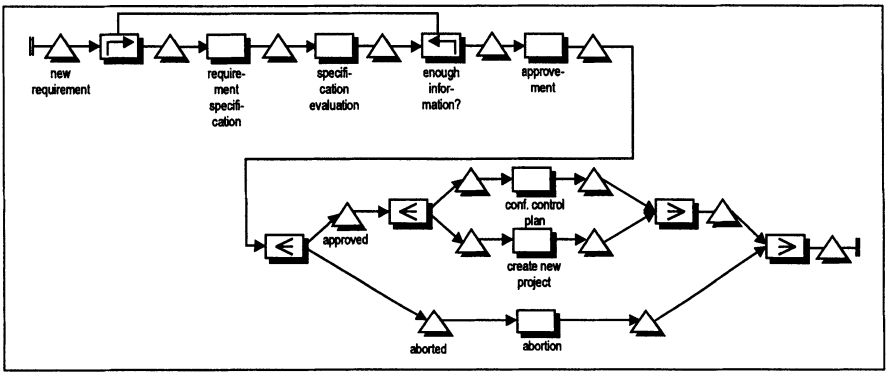

Figure 7: Requirement Analysis

The geographically distributed nature of the activities has so far been an obstacle to the quality of the project. Without adequate support for geographically distributed processes, the compliance with quality assurance procedure is difficult to accomplish and, paradoxically, may become an obstacle to efficiency and competitiveness. By means of telework it will hopefully be achieved to improve the quality and consistency of workflows independent of where the work is being performed. The COBIP project can be considered as a first step towards that direction, not so much with regard to an effective impact of the system on the company's performance indicators, but rather on the awareness of these issues and the know-how to be acquired.

Another very important issue at Tecnotron and for this reason, in any project-oriented company is the project management, i.e. budgeting, resource allocation, task scheduling and cost control. The COBIP project can be a very important tool for such companies, considering the planning and co-ordination features, as well as the support for shift models and individual work timetables. Other aspects of the

project management are not addressed by COBIP. The integration of a typical project management tool would be very advantageous (Araujo, 1999).

4. CONCLUSION

Telework, considered as an innovative work organisation-form for newly decentralised organisational structures, calls for the use of workflow management technology. Therefore the objective of the COBIP project has been the development of a planning tool and the evaluation of the use of workflow technology for the management of telework. In the project these issues were solved by a specific business process model, orientated to the implementation of decentralised structures and the support of its management. On the methodological basis of this specific model telework co-ordination services were implemented for model execution as well as an integrated digital library and a video conferencing system. These implemented modules were evaluated in different application fields – in large companies such as Volkswagen as well as small companies such as Tecnotron and Stoilas. This paper presents the COBIP system supporting the co-ordination of decentralised telework activities as well as the concepts, that were evaluated at different pilot sites, including its advantages, its impact on productivity and arising problems.

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[i] The COBIP ("telework co-ordination services for co-operative business processes") project is located within the Telematics Application Programme (UR 4002 - SECTOR 6) of the European Union.