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Supporting Distributed Corporate Planning through New Coordination Technologies

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Abstract

This paper explores the applications of new coordination technologies in distributed corporate planning. Firstly, new technologies such as Groupware, Workflow Management Systems, Internet and WWW for supporting distributed cooperative work are investigated. Then, GroupFlow, which is a Lotus Notes based workflow management solution, is selected to model and coordinate the planning processes. Qualitative planning information is exchanged in a Notes Discussion Database. And quantitative planning facts are processed by WWW-oriented Q-Calculus. Thereafter, a Lotus Notes based integrated framework for developing a distributed corporate planning system is given. Moreover, the implemented prototype is demonstrated by a corporate financial planning example in a bank. Finally, main experiences are summarized and an agent-based process management perspective is briefly discussed.

1 Introduction

The aim of corporate planning is the future-oriented decision-making. Based on the detailed analysis of external development as well as of internal strength and weakness, the current and future position of the company on the market is evaluated and targets for the future are set. Today the environment of enterprises is characterized by a growing dynamics. The continuous change of planning problems and relevant information requires new concepts for information management to support

distributed autonomous information processing and direct information exchange between planning agents.

With the transformations of hierarchical organizations into flat hierarchies and lean organizations, the decentralization of the planning process increased. Corporate planning processes are divided into several sub-processes which are carried out by autonomous planners. They are located either in different organizational units or in different but related organizations. Despite the differences, planners are connected through common tasks and resources. Their different local views have to be consolidated into a common plan. Therefore, planners have to cooperate horizontally and vertically in order to negotiate and integrate domain specific plans into an overall plan. In order to cope with the increased scope of communication and coordination tasks, active coordination of information flow and workflow within corporate planning is required [10]. Moreover, planning is traditionally based on quantitative knowledge [9]. Due to the increasing complexity and dynamics of quantitative information, related qualitative information, like additional explanation, description of premises is becoming more important. Integrated knowledge units consisting of related quantitative and qualitative information are needed in order to create the planning knowledge base.

Today the existing infrastructures support only partial aspects of the distributed planning tasks and currently there exists no integrated IT-infrastructure on the market which supports distributed planning activities as a whole. MIS and DSS support in most cases only the data dependent aggregation, the distribution and visualization of homogenous precise information. They are designed for stable, hierarchical organizations. They do not support a flexible integration of heterogeneous information sources.

Group Decision Supported Systems are used in planning for the support of planning conferences, as well as brainstorming and negotiation processes. Distributed Decision Support Systems come closest to the requirements of a distributed planning process. But they do, like the other integrated systems, provide support for neither the direct data exchange between planners nor the automatic information routing. Only a syntactical connection between individual DSSs is provided.

The ESPRIT Research Project IBIS will address the requirements for the future business information systems by developing, implementing and testing an Integrated Business Information System (IBIS) to define and perform organizational planning tasks [10]. This paper explores the applications of coordination technologies in supporting distributed corporate planning. Firstly, new coordination technologies for computer supported cooperative work such as Groupware, Workflow Management Systems, Internet and WWW are investigated. Then, GroupFlow, which is a Lotus Notes based workflow management solution, is selected to model and coordinate the planning processes. Qualitative planning information is exchanged in a Notes Discussion Database. Quantitative planning facts are processed by WWW-oriented Q-Calculus. Thereafter, the above coordination technologies are integrated into a Lotus Notes based framework for developing a distributed planning system. Moreover, the implemented prototype is demonstrated by a corporate financial planning example in a bank. Finally, main experiences are summarized and an agent based business process management perspective is briefly discussed.

2 New Coordination Technologies for Supporting Distributed Corporate Planning

In the Eighties there was an increasing interest in investigating how the activities in complex systems could be coordinated. Malone and Crowston have defined coordination “broadly” as “the act of working together harmoniously” and “narrowly” as “the act of managing interdependencies between activities performed to achieve a goal”. In some sense, business and, for that matter, other organizations are all about coordinating the work of different people [8]. They have shown a great deal of interest in borrowing ideas from human organizations to help design computer tools to support people work together more effectively [7].

Coordination and communication within joint work carried out by group members in an organization is the

subject of the discipline Computer Supported Cooperative Work [11]. Software and hardware tools, developed for a network of cooperating humans, are generally termed as Groupware [6]. Recently many practical groupware systems have been developed. In order to structure the large number and variety of Groupware systems, time, place and task dimensions are frequently applied [2]. Based on the rationale that Groupware tries to support groups by providing functions for communication, coordination and cooperation, a function dimension classification scheme has been proposed as shown in Figure 1 [11]. Typical groupware applications are placed within this framework corresponding to their function.

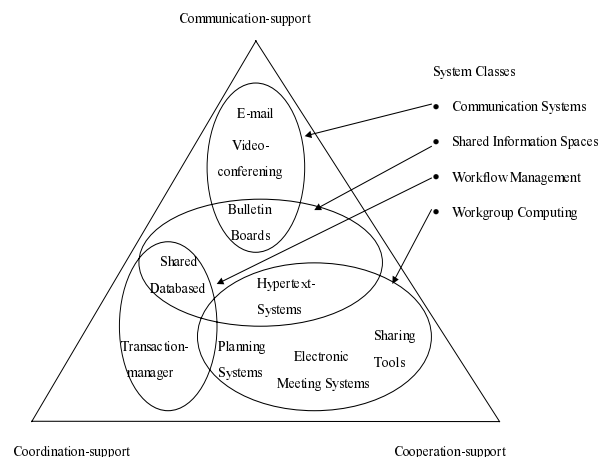


Figure 1: Classification Of CSCW Applications [11]

These CSCW applications cover a part of corporate planning process, which has up to now been performed without any computer support. In Figure 1, system classes are also developed, corresponding to the application concept of each system.

The development of **Communication Systems** provides the basis for Groupware. Electronic mail systems, conferencing systems, and bulletin board systems fall into this system class. They are used in corporate planning for the support of conferences, brainstorming, and negotiation processes.

The class of **Workflow Management** has as its priority the support of coordination functions. Workflow Management Systems provide the infrastructure to design, execute, and manage planning processes on a network [13]. Coordination functions are specified, according to the organization, with the help of process definition tools. End-user productivity is improved by eliminating overhead time spent in „setting up“ and „tearing down“. Lag time spent in routing work from one person to another

is reduced. Using workflow, managers are better able to monitor work in planning process, allocate resources, and receive ongoing feedback about status.

In contrast to workflow systems **Shared Information Systems** do not use predefined coordination and cooperation methods, but follow the idea that CSCW applications should inform rather than constraint. They can be regarded as a medium rather than a mechanism. They allow for sharing of objects such as documents, tables, graphics or spreadsheets. For example, the recent emergence of a **World Wide Web** of hypertext documents accessible over the Internet has provided new possibilities for the sharing and exchange of information. Although originally concise as a means for information dissemination it can also be used for the development of corporate planning applications because of its platform, network and operating system transparency, its ease to use and its simple integration into existing organizational technical infrastructure. The combination of scripts based on the Common Gateway Interface (CGI), enables dynamic construction of responses to browser requests. It is feasible to use a WWW server as front-end to a legacy system where calculation request are conveyed to a backend and then the calculated result are returned to the requesting browser [5].

Lotus Notes is probably the best-known Groupware product. It serves a variety of purposes ranging from basic E-mail, broadcasting, discussion and reference, to complex workflow applications that are closely interwoven with critical business processes [6]. Especially, Domino as a new server technology transforms Lotus Notes into an Internet application server, allowing any web client to participate in Notes applications securely. It includes a full implementation of the HTTP protocol to serve Notes data as well as HTML documents in the file system to web clients. These features of Lotus Notes do just that IBIS requires, so we decided to select Notes as the platform for developing a demo prototype [1]. However, because Notes does not include workflow analysis or modeling functions, third-party products like PAVONE GroupFlow are starting to fill that gap [13].

3 Applying Workflow Management System to Coordinate Corporate Planning Processes

There are now well over a dozen workflow management systems available on the market. Each Workflow Management System has its own features. For example, ActionWorkflow has long held a unique position in the

market in terms of addressing the highly collaborative way that professional workers perform and its integrated methods and tools. The FlowMark allows Notes and WWW Browser users to participate in automated process flows and tasks [1]. To identify the right workflow upon which the IBIS prototype could be implemented, on one hand the main features of corporate planning processes have to be analyzed; on the other hand, Delphi Workflow Model [4] could be used to help to define the workflow market space and to match products to IBIS requirements. According to the classification of Delphi Workflow Model and selected criteria of IBIS users, workflow management systems which have *ad hoc* capabilities and are document oriented are of interest for IBIS. As investigated by IBIS Consortium, Pavone's GroupFlow, which is a Lotus Notes based workflow management solution, belongs to the group of suitable workflow management systems for IBIS [1].

GroupFlow consists of a graphical Organization Modeler and Process Modeler, a customisable runtime module and a simulator. To explore the application of GroupFlow, a typical top-down planning process in D Bank has been implemented as a prototype [13].

The overall procedure, how financial planning has to be made within D Bank, is laid down in the organizational handbook. This handbook is passive since it has to be interpreted by the involved planners. In a top-down planning process, the chief controller triggers the process by asking the other planners from different business units to submit their planning reports. These planners have to report their financial sub-plans quarterly to the chief controller. Therefore, they have to fill out a defined report completely and then send them to the chief controller. Only after all completed reports are received, the consolidation procedure generates a consolidated plan. If the consolidated plan does not match the overall requirements/restrictions, a manual feedback will be activated to get a new set of modified sub-plans.

The top down planning process has been implemented as a template process. Firstly, the organization structure of the financial planning team in D Bank has to be modeled by using GroupFlow Organization Modeler. Then, the Notes forms in GroupFlow Application Database must be designed. Both qualitative planning information from Notes Discussion Database and quantitative planning facts processed by WWW-Oriented Q-Calculus may be integrated into these forms. Thereafter, the corporate planning process has to be modeled by using GroupFlow Process Modeler.

Now a new process may be initiated by an end-user with appropriate access privileges at any point of time. From

this starting point, the system guides the planners through the necessary steps to create and modify the desired planning documents. The planners are notified by Emails or the GroupFlow Task-lists. For example, the planner in business unit Region Southeast Asia is asked to “define planning domain”. The main part of the planning document he received is shown in Figure 2.

Speichern & Verlassen Speichern Reservieren Aufgabe abschließen Maskenwechsel

Ausnahmebehandlung Hilfe

Teilregion (Region) Southeast Asia - Define Planning Domain

Tasks : **Define planning domain**

In the process of "Define Planning Domain" the planning goals (qualitative) and target figures (quantitative) should be worked out. The planning goals are defined by the managers of upper levels and sent down to all sub-units. Subunits can read the planning goals from upper levels but can not change them. Comments on it may be made by subunits. Target figures should be filled out by all subunits.

Activities:

☒ Define planning goals (Qualitative)

☐ Define target figures (Quantitative)

Tasks Fields

Please click here to view and define planning goals.

Please click here [Quantitative Planning](#) to input planning target figures.

Process: **Plan-06-97**

Figure 2 Screen Snapshot of the Planning Document for Region Southeast Asia

From this planning document, the planner is informed “what should be done” and “how to do it”. The sub-tasks are described in detail and listed below the task description. The first task is to “define planning goals”. It concerns the qualitative part of the corporate planning process. When the planner clicks the document-link below “Tasks Fields”, then he joins in the discussion on planning goals. The discussion is managed by another Notes Discussion Database. After he finishes the task, he may set the check box on. The second task is to “define target figures” which concerns with the quantitative part of the planning process. The button “Quantitative Planning” in Figure 2 has been designed to process quantitative planning facts. It links to the corresponding URL of the HTML file where the WWW-oriented Q-Calculus are integrated. Both of these two tasks will be further discussed in the following sections.

After all tasks in the planning document are finished, the planner clicks the button “Aufgabe abschliessen” to submit his planning document to workflow engine. Then the document is automatically forwarded to the next planner or planners according to the process specified in the workflow scheme.

4 Exchanging Qualitative Planning Information in Notes Discussion Database

As discussed in section 2, the shared distributed database do not use predefined coordination and cooperation methods as workflow management systems do. They serves the purpose of coordination as a medium rather than a mechanism. Lotus Notes provides a template discussion database for developers to create customized applications. This discussion database makes it possible for planners to share or exchange qualitative planning information.

In our prototype one Planning Discussion Database has been implemented. The documents in the discussion database may be linked to planning processes built in GroupFlow via Document-links so that planners may be able to refer to these documents at any time with the planning processes running. For example, in Figure 2, when the planner in Region Southeast Asia clicks that Document-link he may view another Notes document where planning instructions from all of his supervisors are stored. He is not allowed to change the planning goals defined by his supervisor but he may make his comment on the planning goals.

5 Quantitative Planning Facts Are Processed by WWW-oriented Q-Calculus

Up to now the workflow of quantitative data isn’t automated yet because of the lack of a standardized representation of semantics of quantitative data. Another reason is that workflow for quantitative processes also must support the vertical aggregation of quantitative processing. This situation requires still a large amount of efforts. Our interest here is to extend the existing software module IPE (Integrated Planning Environment) to a WWW-oriented planning environment so that it can be easily integrated with any workflow management system without caring about their platforms.

Quantitative planning methods require that numerical data can be exchanged and processed amongst the entities involved in the planning process. Quantitative facts shown in Figure 3 are the basic elements that are exchanged amongst entities in the planning processes. For example , “Profit” with the associated value $1500 \pm 10\%$ is a quantitative fact. The quantitative facts essentially describe a model of the system related to the planning problem.

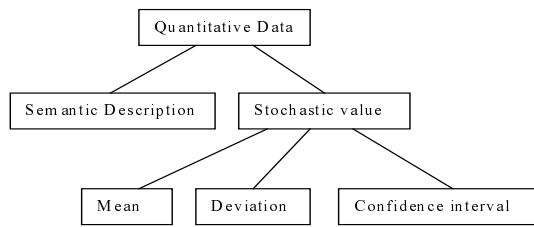


Figure 3 The Quantitative Fact Tuple [9]

One approach for representing quantitative knowledge is Q-Calculus [9]. Based on Q-Calculus, a software module called IPE (Integrated Planning Environment) has been developed at Institute for Media and Communications Management, University of St. Gallen. IPE is built on object orientation technique Visual Smalltalk. It is flexible to build and modify planning models in users' language. The functions of IPE can be classified into two functions: the numerical function for the processing of the numerical part of the quantitative information and the terminological function for the processing of its semantic description. The processing of the numerical part of quantitative information is based on filtering techniques (Kalman-Filter) and includes functions for the aggregation, consistency checking and integration of uncertain quantitative knowledge. Its terminological and numerical part are connected by procedures for the automatic derivation of equations. Thus, the terminological part controls and guides the numerical part of the knowledge processing.

The basic idea here is to use HTML documents as user interface to IPE. The link between the Web-server and the IPE that contains the Q-model and the numeric processing modules is done via the W³ CGI protocol. To enhance flexibility and extensibility of the protocol, the W³ server communicates with a pre-processing server front-end. This front-end handles low-level errors, records planning history, and also serves as a debugging facility when protocol errors occur in the application development.

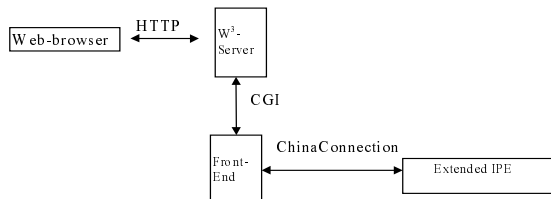


Figure 4 System Architecture and the Related Communication Protocols of WWW-oriented Q-Calculus [5]

The front-end is implemented in Perl language which becomes master of the WWW programming environment. IPE has been enhanced by extending a WWW interface. It

parses the input values from the CGI script and converts those values to the corresponding quantitative facts.

After the quantitative facts are transmitted to the Extended IPE then the numeric processing is performed. The results are thereafter returned from the IPE back to the front-end in the form of quantitative facts. From here on, the front-end performs the reverse procedure by inserting the results into a HTML template file that is submitted to the user. Then a web page generated from that template HTML file with calculated results is displayed before the user. Figure 5 is an example for such web pages. In this web page the planner may input his target figures and also do online consolidation or calculation simply by clicking the button "Speichern".

Kennzahlen	Teilregion	Gebiet 1	Gebiet 2
- Cost Income Ratio, CIR1	0i:50±5.00%	0i:50±5.00%	0i:50±5.00%
- Cost Income Ratio, CIR2	0i:60±5.00%	0i:60±5.00%	0i:60±5.00%
- Bestandsrentabilität	0i:0.80±0.10%	0i:0.80±0.10%	0i:0.80±0.10%
- Bruttoertragsleistung pro MAK	0i:0.19±0.02%	0i:0.19±0.02%	0i:0.19±0.02%

Genauigkeit:

Figure 5 Screen Snapshot of A Web Page for Tielregion

The protocol used for communication between front-end and IPE is called the *ChinaConnection* protocol[5]. It defines the formats of the information such as protocol used, HTML template files, planning history documents, Q-model, visible data, hidden data, as well as shared data etc. In the protocol the corporation between planners have been particularly taken into consideration. For example, "SharedData" in the protocol is designed for different planners to exchange or share quantitative facts while "VisibleData" for planners to process their local quantitative facts. Although client to client communication is not supported by HTTP protocol, the "CommentExpression" makes it possible to establish a communication channel among planners.

The information for connecting the HTML file with this planning web page is specified in the HTML-file itself. This is done by setting hidden fields in the FORM:

```

<form action="http://mcm.unisg.ch/cgi-bin/ekm1.pl"
method="POST" name="selectForm">
<input type="hidden" name="HOSTNAME"
value="iwipws238">
  
```

```

<input type="hidden" name="PORT" value="6020">
<input type="hidden" name="PROTOCOL"
value="ChinaConnection">
<input type="hidden" name="TEMPLATE"
value="planning/topdown/ttr.tpl">
<input type="hidden" name="ModelName"
value="WWWEKMGflow/Demo">
<input type="hidden" name="FILENAME"
value="User0">

```

The action label in the form refers to the IPE front-end that is in the case of the top down planning process allocated at <http://mcm.unisg.ch/cgi-bin/ekm1.pl>. The HOSTNAME and PORT refer to the IP and port address of the IPE system. The protocol is set to ChinaConnection. The TEMPLATE is used for the user output in order to display the results. ModelName refers to the planning Q-model in the IPE. The field FILENAME is used for identification in a workflow process. The idea of workflow here is to enable an iterative process for input processing. The input and output variables of the system's model are represented in the FORM part of a HTML file. A full discussion can be found in [5].

6 Towards A Lotus Notes Based Integrated Framework for Distributed Corporate Planning System

In order to implement the demo prototype, the new technologies discussed above must be integrated into one system. Based on the Lotus Notes development environment and Internet communication platform, an integrated framework is shown in Figure 6.

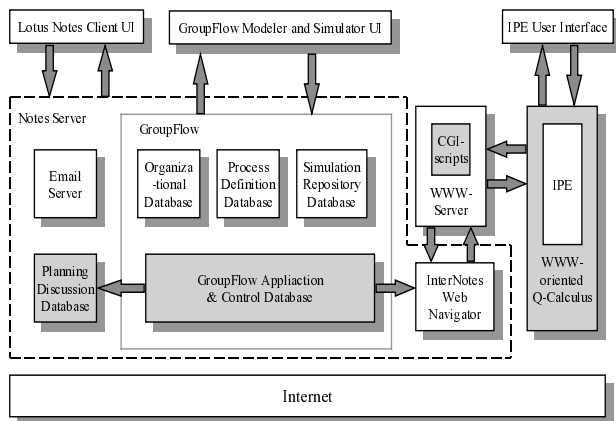


Figure 6 A Notes-based Integrated Framework of an IBIS Prototype

Integration or interoperability between software tools is normally taken to mean the ability to share data and /or

functionality by two or more tools. Integration or interoperability is normally achieved using one of the following strategies: (1) direct interaction between the tools, (2) message passing, (3) bridging (using some form of encapsulation, translation or gateway), and (4) use of a shared data store (common repository). These strategies may be mixed in the implementation of the prototype. For example, to port IPE to WWW, gateway strategy is adopted. To execute WWW-oriented Q-Calculus from GroupFlow planning documents, a message to open an URL must be passed from a Notes document to WWW browser. Therefore, after the HTML files and their template files have been designed for different business units, their URLs should be linked to corresponding forms in GroupFlow. For InterNotes Web Navigator plays the role of a Web Browser (see Figure 6), URLs can be opened directly in GroupFlow or Notes documents. Therefore there is no seam between GroupFlow and WWW-oriented Q-Calculus. Standard Web Browsers such as Netscape Navigator and Microsoft Internet Explorer can also be used instead of InterNotes Web Navigator.

7 Conclusion and Outlook

The framework shown in Figure 6 has been fully implemented in the prototype. It provides support for (1) active support for the information flow and workflow within planning processes. (2) an inter- and intra-organizational information exchange based on an open communication infrastructure and direct communication among planners, (3) the processing and integration of uncertain and possibly conflicting planning information (4) the distribution and flexible exchange of both qualitative and quantitative information.

In the prototype the integration of workflow, calculation and discussion can be tested and demonstrated. However, as Lotus Notes is quite a closed system a deep knowledge of its APIs and internal macros is necessary in order to provide a seamless integration of the different components. A more general solution based on Microsoft DCOM and ActiveX technology is under development.

From the prototype we also find GroupFlow enables E-Mail based *ad hoc* workflow. Graphical design of workflow processes can be used for the direct process enactment. Its separation of workflow modeling and organization modeling is not only quite natural but also bears some advantages. It furnishes enormous expressiveness and also servers security and organizational behavior best. The processes modeler

provides flexibility in task assignment. Tasks are assigned by person, by work group, by organizational unit or based on a role concept. This allows processes to be easily adapted to practical needs.

However, GroupFlow, like other current generation workflow management systems, offers limited support and minimal flexibility during process enactment, e.g., there is no organizational resolution at run time [13]. And they tend to operate with a central workflow engine which monitors all events in the system. They are adequate for situations where a business process is fully resourced and every conceivable outcome can be considered and controlled. In IBIS, corporate planning processes, unlike processes that are executed by machines, are knowledge intensive processes and exist in social organization settings. Interactions of corporate planning are fairly sophisticated, including negotiation, information sharing, and coordination and the problem solution cannot entirely be prescribed from start to finish. Therefore, a more flexible and robust process management approach is still needed to support a more effective cooperation.

In our opinion, a richer model to this kind of workflow should therefore include not only how activities progress, but also how the actors performing them relate to each other intentionally, i.e., in terms of concepts of Coordination Theory such as actor, goal, dependency. As to this problem, a goal-achieving perspective and an actor-based approach for modeling knowledge intensive processes have been proposed [12]. The most natural way to view the business process is as a collection of autonomous, problem solving agents which interact when they have interdependencies [3]. The disparate components of a business process are each represented by an agent and agents have to coordinate themselves in order to achieve their goals. No process or workflow description is existent before the work starts. In contrast to conventional workflow management, agent-based business process management takes a distributed, and hence more robust and scaleable approach.

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