CREWS Report Series 98 - 25

MAIN CONCEPTS FOR COOPERATIVE WORK PLACE ANALYSIS

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Appeared in the proceedings of the Telecooperation Conference of the 15th IFIP World Computer Congress 1998, 31 AUgust-4 September 1998, Vienna, Austria, 1998.

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Abstract

Computer Supported Cooperative Work (CSCW) studies the possibilities and effects of technological support for agents involved in cooperative work processes. Many technologies dedicated to cooperative work environments such us cooperative requirements engineering or cooperative information systems have emerged in the past decade. For many organisations, structured and unstructured cooperative activities coexist in work processes and must be managed in the final solution. It is necessary to emphasise the specificities of these processes in order to take them into account as soon as possible during design. This work presents a model which is a synthesis of the concepts we believe essential for cooperative work place analysis.

1. Introduction

The growth of connectivity greatly expands opportunities for office workers to cooperate and work together. The fast development of the information and communication technologies (allowing better, faster and cheaper treatment of the information) acts as a catalyst for all kinds of computer supported cooperative work (CSCW) systems. In the cooperative work area, the past decade has witnessed the emergence of many technologies. In addition to electronic mail and server technologies, two others have emerged in this area: groupware and workflow.

According to C.A. Ellis, groupware is a "*computer-based system that supports groups of people engaged in a common task (or goal) and that provide an interface to a shared environment* [5]. A well-known categorisation is the division into synchronous or asynchronous activity and co-located or distributed activity [10], *(figure 1)*. Workflow can be classified in the distributed asynchronous area of this matrix as electronic mail systems. This can be useful in quickly categorising, but it has limitations. According to J. Grudin, "*An e-mail system supporting discrete point-to-point communication is very different in nature from a work management system designed to support a large project over a period of years*". In his 3x3 matrix [7], Grudin

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[1] This work is partially supported by the European ESPRIT long term research project, N° 21.903, CREWS (Cooperative Requirements Engineering With Scenarios).

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differentiates between activity that occurs at different and predictable times and places, and at different and unpredictable times and places *(figure 2)*.

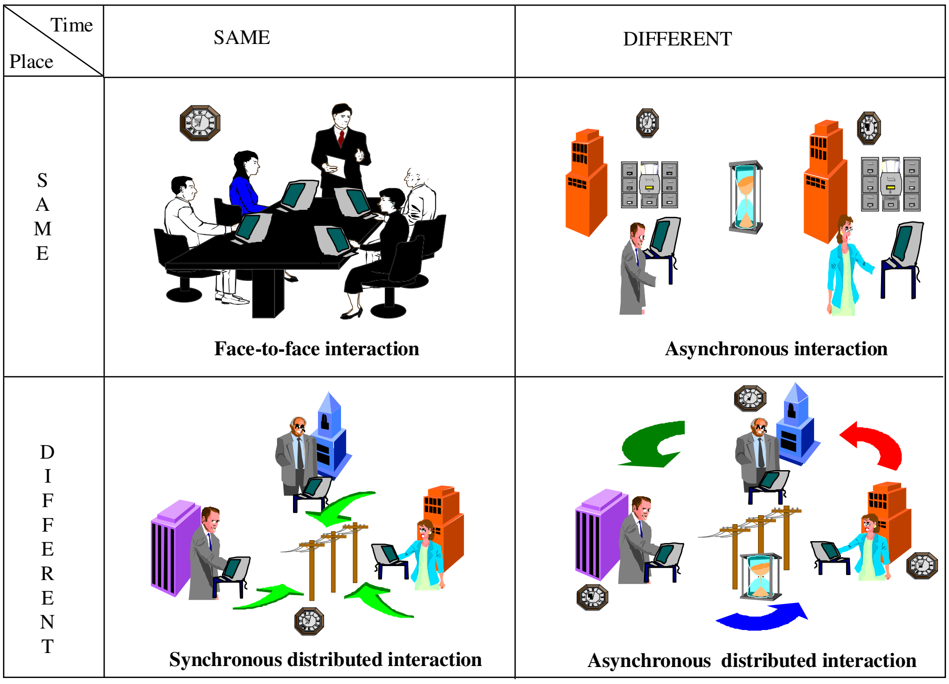

Figure 1 - Johansen's Space/Time matrix

		TIME		
		same	*different/predictable*	*different/unpredictable*
PLACE	*same*	meeting facilitation	work shifts	team rooms
	different/predictable	desktop conferencing	electronic mail	collaborative writing
	different/unpredictable	broadcast seminars	computer conferences	work management

Figure 2 - Grudin's 3x3 map of groupware options

Workflow applications focus first on the control of the information flow between various objects in the office with respect to a predefined procedure. The objects could be office workers, database servers, application files, etc. [11]. Workflow products allow the office worker to construct a diagram by linking nodes representing the office objects involved in the workflow. The links, between nodes of a workflow, control the flow of the information. In other words, workflow concerns, at first, an activity of scheduling and coordination of work between actors implicated in cooperative work processes. In a workflow application, cooperative work means that several persons are involved in reaching a common goal, but each of them acts individually in a different step (task) of the work.

CSCW applications have been divided into two different categories depending on the nature of the processes they support [22]. The first category concerns well-structured and repetitive work having important coordination and automation needs [15], [18]. This is the case for most of the office procedures. The second category of CSCW applications deals with occasional and ill-structured (ad-hoc) processes in organisations for instance, problem solving activities. The essential preoccupation with this kind of application is the information and knowledge-sharing in the work group more than the coordination of their tasks. Nevertheless, well-structured and ill-structured work processes often coexist in organisations *(figure 3)* and must be managed in the final solution [16], [17]. The integration aims to make transparent the transition between different types of group activities. This requires homogeneity and coherence of handled concepts. Frequently, users ask for adaptive workflow tools and models which can provide the robustness and the security of the predefined procedures and the flexibility of ad-hoc applications.

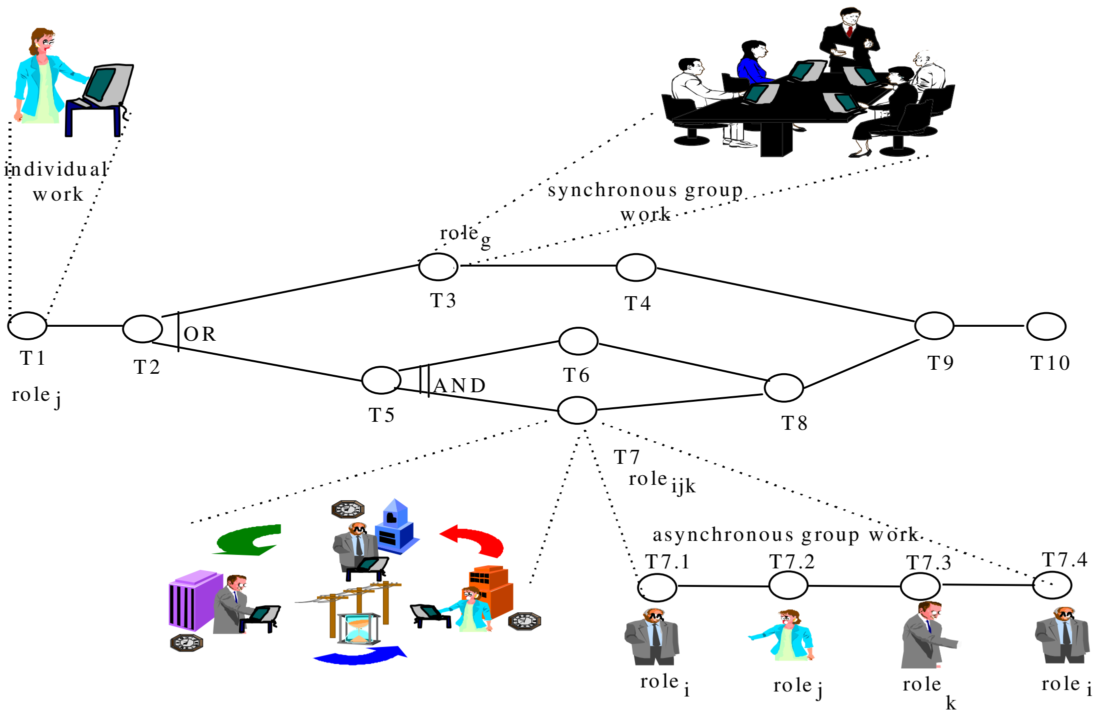

Figure 3 - An asynchronous cooperative process (workflow) coordinating individual and cooperative works

As information technology is becoming an integral aspect of organisations, more stakeholders with less formal training must be involved in requirements elicitation, validation and usage over long periods of time in a traceable manner. Effective and efficient team interaction become even more critical because systems must be continuously adapted to changing business practice and needs. Involving users and customers during the development of a requirements specification is a generally accepted goal. Requirements specification abstractly describe a future real world which stakeholders and requirement engineers have agreed on. Requirements engineering process is a cooperative process in which stakeholders and requirement engineers have to understand each other when eliciting and understanding requirements and reconciling differences at technical and social level. This is explored in the CREWS project [24] which will develop, evaluate and demonstrate the applicability of methods and tools for cooperative scenario-based requirements elicitation and validation [21], [23].

Our purpose is to provide a single set of the main concepts for analysing cooperative work processes. In order to take into account the specificities of cooperative work, we have considered models dealing with flow of task, role, and/or intention representations. This paper proposes a synthesis of the models we have studied. It is organised as follows. In the second part, we describe how cooperative work technologies imposes adaptation and often radical changes in the habits and processes of organisations. In the third part, we present briefly the models dealing with cooperative work representations we studied. This study shows a convergence on a set of concepts such as goal, procedure, task, role, actor, resource, decomposition of tasks, etc. However an appropriate model for cooperative work should also provide means to represent unstructured collective activities. In the fourth part, we propose our synthesis for these models, with the concepts which are essential from our point of view for cooperative work analysis.

2. Project oriented structures leading to horizontal organisations

Individual activities become integrated into group work, involving collaboration, cooperation, coordination and communication. Groups can carry out tasks which are not feasible individually. An organisation is a set of work processes and work groups which coordinate their activities, cooperate and negotiate with other people. The effectiveness of the organisation depends on the efficiency of groups which constitute it. The efficiency of the group depends on the cooperation between its members and decisions produced by them.

The aim of groupware is to support people working together. Workflow and other groupware systems can provide to the company the necessary competitive advantages to maintain or to improve its position in the market by responding better and faster to customers. Nevertheless, the automation of processes which have been structured without any consideration of CSCW technologies could not allow to organisations to reach long-dated objectives. Therefore, the organisation itself must be first improved or reengineered according the information technologies.

Until the middle of seventies, company organisation was strongly production-oriented. They were producing a lot while using few qualified manpower thanks to the fragmentation of tasks. This is the principle of scientific management founded by Frederik W. Taylor. The resulting organisation leads to a vertical division of work based on functional structures in an hierarchical structure which is sometimes very complicated. Today, the aim is not to produce but to produce efficiently in order to support selling. The increase in production capacity should not serve to increase the stock. The production process called "Just in Time Business" requires organisations which can speed up decision making thanks to minimal hierarchical structures. This is the principle of horizontal company with project teams built on processes in contradiction to the vertical company built on functions. The process is a set of activities which produces (from one or several inputs) an output valuable for the customer [9]. This approach which consists of a complete remodelling of the organisation around its processes is called "Business Process Reengineering" by Michael Hammer and James Champy [8], [9]. An horizontal organisation emphasises the communication and the capacity to immediately react to market changes. The essential preoccupation is to increase customer satisfaction. Business Process Reengineering (BPR) is completely dependent on the development of information technologies. BPR consists of analysing and designing work processes in order to make them suitable to customers' needs. Information technologies are more than technical means to implement cooperative work processes, but processes change depending on the development of these technologies. The improvement or reengineering of work processes consists first of highlighting activities which comply with customer requirements. For the sake of improving or reengineering business processes Hammer and Champy consider essential to start to describe them as accurately as possible.

3. Models dealing with cooperative work

Workflow application development starts with the modelling of the work process to automate. In order to obtain a generic model for cooperative work processes, we have considered 8 models dealing with flow of task, role and/or intention representations.

3.1. Workflow models

Each workflow product proposes its own model to graphically represent procedures. Models are numerous but there are a few theoretical studies on which they are founded. Two types distinguish themselves: a) models coming from Petri nets (for instance, ICN), b) models coming from the Speech Act Theory (for instance, ActionWorkflow).

The ICN model (Information Control Net) was developed in the Palo Alto Research Center in the seventies [4]. An information control net is a set of procedures, steps, activities, roles, and actors with a valid set of relations between these entities. Relations include the *precedence* relation between steps; the *part-of* relation between activities and procedures; the *executor of* relation between activities and roles; and the *player of* relation between roles and actors. A procedure is a set of activities linked by precedence relationship. The ICN model allows the choice of the abstraction level in the representation and the building of a complex procedure by successive refinements. Alternative, parallelism and loop structures are used to describe procedures. The extended ICN model presented in [6] incorporates the notions of goal and unstructured activity.

In the Inconcert workflow model [13] a *job* represents a collaborative activity. A job consists of *tasks*, each of which is a unit of work that can be performed by one person. Tasks can be decomposed into sub-tasks, to obtain a hierarchical breakdown structure. Tasks at the same level may have ordering dependencies defined among them: a dependent task cannot be worked on until the precedent task has been completed.

VPL [25] is a graphical language to support a model for collaborative work processes. According to this model, work is decomposed into a network of requests for task assignments, which may be recursively decomposed to finer grained tasks. The *process* is modelled as requests for tasks. *Stages* represent the communications needed to coordinate tasks. Each stage represents a task request, commitment or question as a specific step in the process. A stage is a request from one person (the plan owner) to another person. The request may be expressed in any amount of detail; it is not constrained to a set of predefined tasks. This represents the Regatta philosophy of supporting communications without restriction.

The ActionWorkflow [14] comes from Winograd's and Flores' research aiming to study group work in relation to conversation, negotiation and decision making activities. Some conclusions of Speech Act Theory [26] have been used. The model uses a simple structure: it considers a task as a communication relationship between two participants, a *customer* and a *performer*. A task is represented as a loop composed of four phases: preparation, negotiation, performance and acceptance. The process model is built by successive refinements.

All these models have some common characteristics. They use a top-down approach which enables the choice of the abstraction level of the representation and the modelling of a complex process by successive refinements. They have the same finality: to divide a work process into a finite number of stages and to describe their flow.

3.2. Process modelling

The I^* framework [27] has been developed to help supporting process modelling and reengineering. Processes are taken to involve social actors who depend on each other for *goals* to be achieved, *tasks* to be performed, and *resources* to be furnished. The framework includes a Strategic Dependency model and a Strategic Rationale model. According to I^*, a business process would typically appear as a chain of dependency relationships, rather than as a sequence of input-output flows. A Strategic Dependency model is an intentional model and allows a richer representation of an organisation than conventional workflow models that are based on non-intentional entity and activity relationships. It describes the network of relationships among *actors*. The Strategic Rationale model describes and supports the reasoning that each actor has about its relationships with other actors. It shows "how" an actor meets its incoming dependencies or internal goals and desires by modelling actor's "ways of doing things" which are called *tasks*. A task is broken down into its components. Components are broken into sub-components, and so forth. The Strategic Rationale model recognises the presence of freedom and choice at each level of decomposition.

In [19] and [20], a meta-model is proposed as a basis for cooperative process model definition. Since a process meta-model carries information about the process model, an instantiation of it shall result in a process model. The meta-model can support different levels of granularity in decision making as well as non determinism in process performance. It identifies a decision in context as the basic building block of ways-of-working and permits their grouping into meaningful modules. Parallelism of decisions and ordering constraints are also supported. The cooperative process meta-model provides means to deal with secure and rather well-structured work processes and provides the flexibility to handle ill-structured cooperative processes. It allows us to represent cooperative work processes; to integrate conversations between agents; to guide and keep track of what happened in cooperative brainstorming sessions; to model the emergence of new contexts; all these being made in an homogeneous manner. The cooperative process meta-model allows us to deal with many different situations in a flexible, decision-oriented manner.

The OSSAD method (Office Support System Analysis and Design) [2], [3] has been developed within the context of an ESPRIT project whose aim was to find appropriate methods for the development of office automation systems. OSSAD is primarily concerned with the organisational functioning. It's aim is to conduct changes in the office, taking advantages of reorganisation opportunity offered by new technology. Computer science and office automation are considered as tools which assist the individual task. OSSAD proposes two levels of modelling: the abstract and the descriptive ones. The abstract level aims to represent the organisation from the point of view of its objectives disregarding currently-used resources. The descriptive level aims to represent current or future realisation conditions in accordance with objectives expressed in the abstract level. It takes into account organisational (organisation choices, responsibility sharing, information flow), human (arrangement of workers in different departments) and technical (tools) means.

[12] represents three different view of the Enterprise meta-model [1]. The first viewpoint describes the goal of the various stakeholders. The concept of goal is central to the teleological view. Goals denote intention. The social viewpoint describes the organisational members and how they interact. The process view includes the functional and behavioural viewpoints. It shows what process elements are being performed, and what flows of resources (data, product, etc.) are relevant to these process elements.

4. Main concepts for analysing cooperative work

As a synthesis of the studied models, we propose the model illustrated in *figure 4*. This model is represented using some binary ER-like notations. A large box represents an entity-type and a small box represents a binary relationship between two entity-types. The arrow head indicates the direction in which the label of the relationship holds. For example *(figure 4)*, *process* and *role* are entity types and are related through *responsible for* relationship. The direction of the relationship and the cardinalities mean, *a role can be responsible for one or several processes*. The model also includes the notion of an *objectified relationship*. This notion is an abstraction mechanism which allows a relationship to be viewed, at a higher level of abstraction, as an entity-type. This applies for example, to the relationship *dependency* between a *process* and another *process* which is viewed as the entity-type *dependency* to enable it to enter into a relationship with the entity-type *resource*. Finally, an arrow between entity-types represents the *is_a* relationship.

4.1. The concept of role

The concept of *role* is common to all the presented models. Our understanding about it is the following: a role is the definition of an organisational intention shared by a collection of users, all of whom have the same privileges and obligations to a set of work processes in an organisation.

According to *ICN* [6], a *role* may be associated with a group of *actors*. Also, one actor may play many roles within an organisation. An actor is a person, program, or an entity that can fulfil roles to execute, to be responsible for, or to be associated in some way with activities and procedures. In the *Inconcert* workflow model [13], a *role* is a logical placeholder for the *user* (person or program) that will perform a task. In *VPL* [25], a *role* is a container for list of names of people or groups. A role is not a quality of individual, but rather a relationship between a person (group) and a particular shared collaboration space (colloquy). A given person may play several roles in one colloquy while playing different roles in another colloquy.

The I^* *Strategic Dependency* model [27] is a graph where each node represents an *actor*, and each link between two actors indicates that one actor depends on the other for something in order that the former may attain some goal. The concept of actor is specialised into *roles*, *positions* and *agents*. A role is an abstract actor. Physical agents such as human beings or software agents play roles. A position is a collection of roles that are typically played by a single agent. Agents occupy positions; a position covers a number of roles; roles are played by agents. The roles descriptive model of *OSSAD* [2] shows the current organisational structure chosen by the company (or the one which is proposed) to carry out its activities. It uses concepts of *role* and *unit*. A unit represents a set of roles assembled for the convenience of modelling. This can correspond to an administrative unit of the analysed organisation. According to *Enterprise models* [1], an *actor* is an organisational agent. An actor can be either an *individual agent* or a group (*organisational unit*). The individual concept denotes both persons, or machines, automated systems. Organisational units refer to organisational structures like departments, projects, teams, etc. Individuals and organisational units are related through the is-part-of relationship. A *role* corresponds to a set of process elements to be assigned to an agent as a unit of responsibility. Roles are assigned to actors depending on their goals and capabilities. The *cooperative process meta-model* presented in [20] attaches the notion of decision to a *role*. This captures knowledge about which decision can be taken by which role. Therefore, the basic division of responsibility in cooperative processes is imposed on the set of decisions of the meta-model. This allows to represent coordination of roles, to provide access control, and to give more appropriate guidance which is tailored to the role.

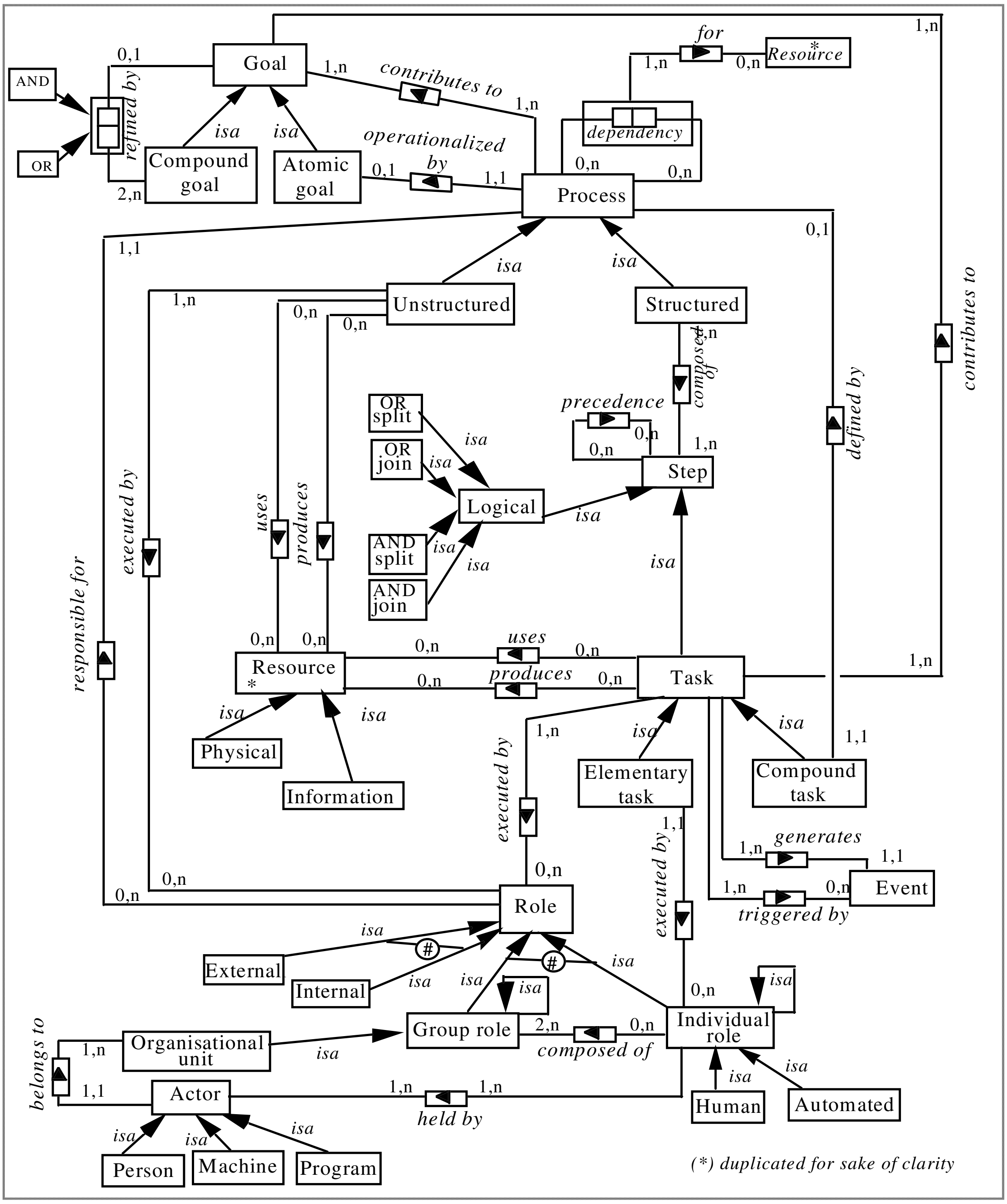

Figure 4 - A generic model for cooperative work processes

To our understanding, the *role* is the main concept for the representation of cooperative work processes *(figure 4)*. We introduce it in our model and then specialise it according to the following point of views. First, a *role* may be *external* or *internal* to the organisation. In the same time, it can describe an individual or a group. For example, the reservation clerk is an *individual role* whereas public relations team is a *group role*. A group role *is composed of* several individual roles. An *individual role* is specialised as *human* and *automated*. It is held by an *actor* which can be a *person*, a *machine* or a *program*. An *actor belongs* to an *organisational unit* which is a *group role*.

4.2. The concept of goal

Five of the presented models introduce the notion of *goal* even if this is made by the use of different labels.

Many social and organisational factors play an important role in the working of any organisation. Consequently, a useful cooperative work model must capture much more than the steps of procedures. The *ICN model* [6] advocates to choose people and *goals* as the starting point for organisation analysis, instead of choosing procedures and activities. It defines an organisational framework as a tuple *F=[G, H, R]* where G is a set of *goals*, H is a set of *actors*, and R is a set of *resources*. The *VPL model* [25] provides a shared collaboration space called colloquy, in which a set of tasks that are performed to accomplish the specified *goal* are coordinated.

The abstract model of OSSAD [2] defines stable and durable characteristics of the analysed system that any organisation choice must respect. It is based on the division of the organisation into *functions*, i.e. into sub-systems having coherent *objectives*. Each function may be divided into sub-functions, each in turn being sub-divisible: this is the "zoom" principle. At the most detailed level of the analysis, atomic functions are called *activities*. An activity has only one objective and has the semantics of the goal concept involved in ICN, VPL, I^* and Enterprise modelling. These sub-systems communicate with each other and with the environment exchanging information packages (disregarding their physical support). According to the *goal dependency* notion of I^* [27], an actor (depender) depends on another (dependee) to bring about a condition in the world. The *goal* is an assertion that the dependee will make true. The dependee is free to choose "how" to accomplish the goal. According to the *Enterprise model* [1], *goals* denote intention and express the solution to some problem (problem-solving goals), or address some general vision or wish (wish-fulfilling goals), or satisfying some constraint (constraint-handling goal). The central concept of the *process meta-model* [20] is the one of *context* which associates a situation with an *intention*. A situation is a part of the product it makes sense to take a decision on. An *intention* expresses what the user wants to achieve, the goal. It reflects a choice that a user can make at a given moment in the process.
In our synthesis model (*figure 4)*, the concept of *goal* expresses an intention, this is what must be achieved. Goals are high level objectives of the organisation. They defines stable characteristics of the business that any organisation choice must respect. They can be compound or atomic. *Compound goals* can be decomposed into sub-goals. At the most detailed level, operationalisable goals are modelled using the *atomic goal* concept.

4.3. The concept of process

Operationalisable goals are implemented using *processes*, called respectively, procedure in OSSAD and ICN, job in InConcert, plan in VPL and process in Enterprise model.

According to [6], an extended information control net is a tuple, $S= [F, O, f_s]$ where F is an organisational framework (§ 4.2), O is a class of procedural objects (activities) and non-procedural objects (roles), and f_s is a set of mappings over F and O. O and f_s capture the procedural definition of ICN. Each *procedure* has a *responsible* person associated with it. A procedure can uphold several goals. In the *InConcert* [13] workflow model, a *job* represents a structured collaborative activity. In *VPL* [25], a process is modelled as requests for tasks in a *plan*. The person who is responsible for the result of the plan is the *owner* of the plan. The owner is usually the creator of the plan, and is the only person who may make changes in the plan.

In *OSSAD* [2], the link between abstract and descriptive levels is made by the activity/role matrix. Rows correspond to activities (abstract concept) and columns to roles (descriptive concept). For each activity, roles which are implied should be shown. Descriptive models deal with the organisational, human and technical means implemented to reach of the objectives of the organisation. They represent the way the work is done currently or will be done in the future. Each activity of the abstract level corresponds to a *procedure* in the descriptive level. The procedures descriptive model shows the functioning of the organisation, in other words, current or future work organisation. It uses *procedure* and *resource* concepts. This model provides a global view of relationships between procedures. According to *Enterprise models* [1], a *process* is a set of related steps carried out towards a common desired result. At an appropriate level of abstraction, a process performs some identifiable task in the enterprise. Processes use or produce/modify *resources* that can either be of physical nature (material), or information. Processes are triggered by *events* that correspond to specific state changes of the enterprise. The *process meta-model* presented in [20] can support different levels of granularity in decision making as well as non determinism in *process* performance. It identifies a decision in context as the basic building block of ways-of-working and permits their grouping into meaningful modules. Parallelism of decisions and ordering constraints are also supported. The meta-model allows to represent both well-structured and ill-structured cooperative processes.
With respect to the cooperative work model we propose *(figure 4)*, a *process* is the operationalisation (*operationalised by*) of one *atomic goal*. It *contributes* to the fulfilment of one or more goals. There is a role which is *responsible* for it. In order to show the functioning of the organisation, the model provides a global view of the relationships existing between procedures describing the *dependencies* for resources. Finally, a process can be *structured* or *unstructured*.

4.4. The concept of structured process

The essential preoccupation of *structured processes* is the coordination of their component work steps as in OSSAD, ICN, Inconcert and VPL.

In *ICN* [6], a *procedure* is a predefined set of work *steps* and a partial ordering of these steps. Partial ordering means that all steps do not necessarily need to be executed sequentially, and that loops are allowed. Steps can be related to each other by conjunctive logic or by disjunctive logic. According to *InConcert* [13], a *job* consists of tasks with *ordering* dependencies defined among them: a dependent task cannot be worked on until the precedent task has been completed. *Plans* are composed of network of stages in *VPL* [25]. Each stage represents a task request, commitment or question as a specific *step* in the process. When two or more *event* arrows are pointing to a stage it means that the first activated event from any one of them will activate the stage (except for the AND-node which has the property that it receives all expected events before it sends any event). While stages represent the major steps in a process, there are other kinds of nodes which provide some automated capabilities within the plan: programmed nodes, condition nodes, timer nodes, start nodes, exit nodes, AND-nodes.

The *OSSAD's operations descriptive model* [2] provides the detail corresponding to a *procedure*. It models the work distribution between roles showing who does what and in which order. This model uses a formalism similar to Petri nets. In addition to the order relationship between operations, this formalism shows three possibilities of *flow of operation*: parallelism (and), alternative (or) and loop.

We define a *structured process* as a predefined set of *steps* and a partial ordering of these steps. A step can be a *task* (§ 4.5) or a *logical step* (or-split, or-join, and-split, and-join). Logical steps define the control flow (task ordering) in structured processes. *Figure 5* shows the authorised *precedence* relationships between process steps. The *and-split* and the *and-join* allow to define parallel flows with rendezvous points *(figures 5-a and 5-b)*. The *or-split* and the *or-join* allow to define alternative flows *(figures 5-c and 5-d)*. A task can only be preceded and followed by one step, except the first *(figure 5-e)* and the last ones *(figure 5-f)*.

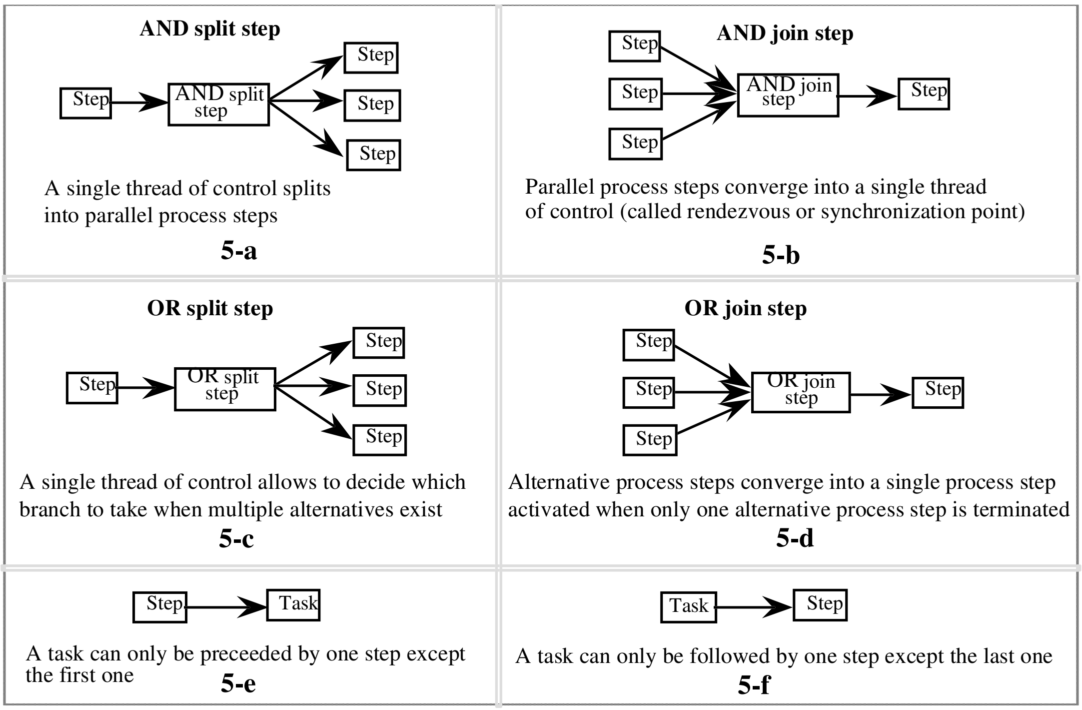

Figure 5 - Authorised precedence relationships between process steps

4.5. The concept of task

A *task* represents a work step in the process. It can be an *elementary task* or a *compound task defined by* another *process*. The notion of task decomposition has the semantics which is used in ICN (compound activity), VPL (compound stage), Inconcert (compound task) and OSSAD (vertical macro-operation).

In *ICN*, an *activity* is the body of a work step of a procedure. An activity is either a compound activity, containing another procedure, or an *elementary activity*. An elementary activity is a basic unit of work which must be a sequential set of primitive actions executed by a *single actor*. An elementary activity may also be a non-procedural entity whose internals ICN does not model within its structure. An activity is a reusable unit of work, so one activity may be the body of several work steps. In *Inconcert*, a *task* in a job is a unit of work that can be performed by one person having the assigned role. Each task in a job may also have any number of references, which are placeholders for *documents* needed in performing the task (for update or as reference material). Documents are abstract data objects which have content that can be manipulated by the appropriate application. This corresponds to the informational resources used in OSSAD and Enterprise modelling. Tasks can be decomposed into *sub-tasks*, to obtain a hierarchical breakdown structure. In *VPL*, a colloquy is composed of stages and roles. Each *stage* has an *assigned role* which is *responsible* for the stage. Stages represent the communications needed to coordinate tasks. A stage is a request from one person (the plan owner) to another person (the assignee). If the request is not to be completed manually, the assignee may create a *sub-plan* to accomplish the task. The assignee becomes the owner and creator of the new sub-plan and may make requests to others by creating stages within the sub-plan. The request may be expressed in any amount of detail; it is not constrained to a set of predefined tasks. A stage includes one or more user defined actions, called options. Each option represents a declaration that the assignee may take to represent the results of the task or decision. The act of choosing an option changes the state of the process. It does this by sending *events* to activate or terminate other stages. The event is an abstract mechanism that is used to coordinate stages.

In *OSSAD's operations descriptive model*, certain operations of a procedure may be gathered together to make macro-operations. The *vertical macro-operation* concept allows to describe operations performed by a given role in a higher level of abstraction.

In the generic model, an *elementary task* is defined as a sequential set of primitive actions executed by an *individual role* which can be *human* or *automated*. Tasks are *triggered* by *events* and their execution *generates* events. Tasks *use* and *produce resources* that can either be of *physical* or *information*. Tasks *contribute* to goals.

4.6. The concept of unstructured process

Nevertheless, organisations can not only be described in terms of structured work processes. In ICN, functional abstraction allows any activity to itself be defined as a procedure or a goal. If an activity is a goal, then there may be multiple procedures which can be invoked to attain the goal. The *extended ICN model* presented in [6] recognises that an organisation comprises resources and goals. This model incorporates the notion of *unstructured activity*. Thanks to the *horizontal macro-operation* concept, *OSSAD* also offers the possibility of highlighting the work steps which must be performed by *several roles* (cooperation). Actors can perform operations without simultaneous presence or using a synchronous communication. For *unstructured cooperative activities* which can not be represented in terms of flow of tasks, the horizontal macro-operation constitutes the most detailed modelling level that OSSAD allows us to obtain.

As advocated in ICN and I^*, and briefly introduced in OSSAD by the use of the horizontal macro-operation concept, we adopted the specialisation of the process concept into two sub-types: *structured process* and *unstructured process*. An *unstructured process* cannot be represented in terms of flow of tasks. Then the generic model allows to represent it associated to a set of *resources* that it *uses* and *produces* and a set of participating *roles*. The key concept of unstructured processes is the information and knowledge sharing in the work group.

5. Conclusion

New information technologies allow to improve the quality of products and/or services produced by business processes. The use of CSCW systems has a direct influence on the work organisation. These systems make easier the definition of -more- horizontal organisations.

The analysis of cooperative work processes, with the intention of automating them using CSCW systems, require appropriate methods and models. The aim of cooperative work analysis is to understand the nature of the studied work processes and to find, in the case of well-structured processes, the relevant decomposition in tasks with their associated roles. Nevertheless, a cooperative work model should also provide appropriate concepts to represent more than work steps in processes. Indeed, social and organisational aspects, such as goal, role, resource, have an important role in the way of working of any organisation.

In the analysis of complex organisations whose work processes are not clearly defined, it is more relevant to study first goals of the organisation instead of its different functions. In this paper, we proposed a model as a synthesis of the 8 specific models we studied dealing with cooperative work representations. This model allows us to represent any cooperative process. Some of them are structured according to a partial order of work steps associated to roles and describe "how" the corresponding operationalisable goal could be fulfilled. Some others are unstructured and are described in terms of roles and resources which are involved and goals to whom the process contributes.

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