Introduction to Groupware Task Analysis

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ABSTRACT
Groupware Task Analysis is a task analysis method that deals with the context of use of a system in the broadest sense. The task world is seen from three viewpoints that deal with different aspects of the world. The processes of GTA and their background are described in detail. In addition a task analysis tool EUTERPE is described. EUTERPE is based on GTA and allows capturing of the task models and provides some basic analysis primitives.

Keywords
task analysis, task knowledge, modeling, design process, GTA, tools, multiple representations, Euterpe

INTRODUCTION
Analyzing a complex system means analyzing the world in which the system functions, or the "context of use", which comprises (according to ISO standards like [1])

- the users;
- the tasks;
- the equipment (hardware, software, and materials);
- the social environment;
- the physical environment.

If we want to design systems for the context of use, we need to take these different aspects of the task world into consideration. In traditional literature on task analysis from the HCI (Human-Computer Interaction) mainstream, the focus is mostly on users, tasks, and software.

Design approaches for GroupWare and CSCW (Computer Supported Collaborative Work), on the other hand, often focus on analyzing the world first of all from the point of view of the (physical and social) environment. In both cases, more recent developments at least include some aspects that belong to the other categories, but it still looks like one has to choose for either the one view or the other. Section 2 presents an idea of task analysis approaches from the classical HCI tradition, and, at the same time, provides our view on phases in task analysis. In Section 3 an ethnographic viewpoint, as frequently applied to the design

of CSCW systems, is presented, where phases in the analysis process are hardly considered. As the result of combining approaches from both HCI and CSCW design, we developed our GTA (Groupware Task Analysis) framework of modeling task knowledge, which we will describe in section 4. Brigitte Jordan [2], though originally working from an ethnographic approach and focusing on GroupWare applications, provides a view on analyzing knowledge of the task world that is broad enough to cover most of the context of use as now defined by the above mentioned ISO document. We will illustrate Jordan's view in Section 5, distinguishing two factors:

- sources of knowledge: (1) individual knowledge, and (2) group;
- levels of communicability: (a) explicit, and (b) implicit.

Based on applying Jordan's 2 * 2 framework in actual design processes for large industrial and government interactive systems, and expanding the two factors from dichotomies to continuous dimensions, we describe a two-dimensional framework to analyze the different relevant sources of knowledge of the context of use. This framework provides a map of knowledge sources, that assists us to identify the different techniques that we might need in order to collect information and structure this into a model of the task world. Section 6 describe EUTERPE, a task analysis tool based on an ontology derived from GTA. The model used by the tool and how the resulting task models can be analyzed is described in section 7.

TASK ANALYSIS IN HCI DESIGN
Classical HCI features a variety of notions regarding task analysis. The concept is used to indicate different activities: (a) analyzing a "current" task situation, (b) envisioning a task situation for which information technology is to be designed, or (c) specifying the semantics of the information technology to be designed. Figure 1 gives an overview of the whole design process with all activities and sources of information[20].

Many HCI task analysis methods combine more than one of these activities and relate them to actual design stages (e.g., [3]). On the other hand, some authors do not bother about the distinction: GOMS (Card, Moran, and Newell,[4]) can be applied for any of them or a
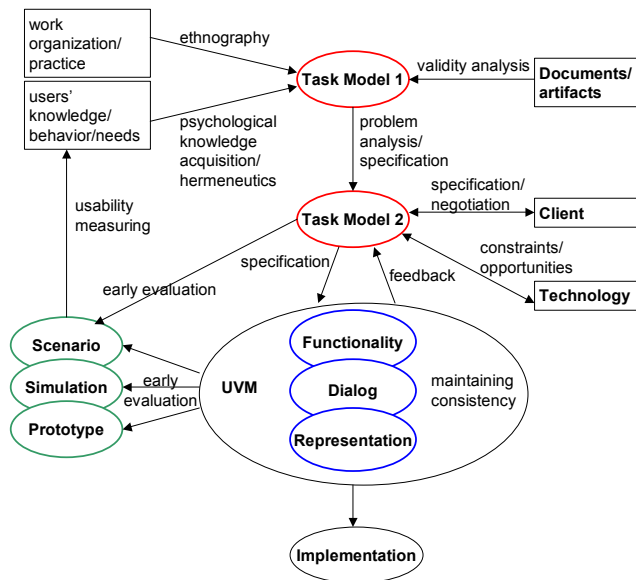
combination.

Figure 1 The design process

1. Analyzing the current task situation (Task model 1)

In many cases the design of a new system is triggered by an existing task situation. Either the current way of performing tasks is not considered optimal, or the availability of new technology is expected to allow improvement over current methods. A systematic analysis of the current situation may help formulate design requirements, and at the same time may later on allow evaluation of the design. In all cases where a "current" version of the task situation exists, it pays of to model this. Sebillotte (see [5]) elaborates a method to collect task knowledge and structure this into a hierarchical model of subtasks, Scapin and Pierret-Golbreich (in [6]) elaborate on this method and provide an object oriented formalism for modeling knowledge of existing task situations, like Sebillotte mainly focusing on activities. Task models of this type pretend to describe the situation as it can be found in real life, by asking or observing people who know the situation (e.g.,[7]). Task model 1 is often considered of a generic nature (e.g., [5]), indicating the belief of authors in this field that different expert users have at their disposal basically the same task knowledge.

2. Envisioning the future task situation (Task model 2)

Many design methods in HCI that start with task modeling are structured in a number of phases. After describing a current situation (task model 1) the method requires a re-design of the task structure in order to include technological solutions for problems and technological answers to requirements. Johnson et al. (see [3]) provide an example of a systematic approach where a second task model is explicitly defined in the course of design decisions. Task model 2 will in general be formulated and structured in the same way as the previous model, but in this case it is not considered a descriptive model of users' knowledge, although in some cases it might be applied as a prescriptive model for the knowledge an expert user of the new technology should possess.

3. Specifying technology (The user's virtual machine)

The third type of modeling activity that may be found in HCI design focuses on the technology to be designed. In principle this might be considered part of task model 2 (e.g., [4] in the case of GOMS). However, in other HCI approaches the actual design activities focus on the technology as such (e.g., [8]). In this part of design the activity is focussed on a detailed description of the system as far as it is of direct relevance to the end-user. Oberquelle (see [9]) introduces the concept "virtual machine" to indicate "the functionality of the system ... where implementation details and details of the underlying hardware are suppressed". Tauber ([10]) elaborates the concept of the user's virtual machine (UVM) which indicates the total of user relevant knowledge on the technology, both semantics (what the system offers the user for task delegation) and syntax (how task delegation to the system has to be expressed by the user). In actual design iteration will be needed between the specification of these two models, which should be an explicit activity, making the implications of each obvious in its consequences for the other.

HCI task models represent a restricted point of view

All HCI task modeling is rather narrow focused, considering mainly individual people's tasks, although Johnson (e.g., [7]) considers the aspect of roles and the phenomenon of allocating subtasks to different actors. Most HCI approaches are based on cognitive psychology. Johnson refers to knowledge structures in long term memory. Tauber refers to "knowledge of competent users". HCI approaches focus on knowledge as can be modeled after individuals who are knowledgeable or expert in the task domain, whether this domain already exists (task model 1) or still has to be re-structured by introducing new technology (task model 2 and the UVM).

As a consequence of their source, HCI models seldom provide an insight in complex organizational aspects, in situational conditions for task performance, and in complex relations between tasks of individuals with different roles. Business processes and business goals are seldom part of the knowledge of individual workers, and, consequently, are seldom related to the goals and processes as found in HCI task modeling.

DESIGN APPROACHES FOR CSCW

CSCW work stresses the importance of situational aspects, group phenomena and organizational structure and procedures (Schael, [11]; Shapiro, [12]). Shapiro even goes as far as stating that HCI has failed in the case of task analysis for cooperative work situations, since generic individual knowledge of the total complex task domain does not exist. CSCW literature strongly advocates ethnographic methods.

Ethnography

Ethnographers study a task domain (or "community of practice") by becoming a participant observer, if possible with the status of an apprentice, being accepted as an outsider in this respect and being themselves aware of their status of analyzing observer. The ethnographer observes the world "through the eyes of the aboriginal" and at the same time is aware of his status of an outside observer whose final goal is to understand and describe for a certain purpose and a certain audience (in the case if CSCW: a design project). Ethnographers start their observation purposely without a conceptual framework regarding characteristics of task knowledge, but, instead, may choose to focus on activities, environments, people, or objects. The choice of focus is itself based on prior ethnographic observations, which illustrates the bootstrapping character of knowledge elicitation in ethno-methodology. Methods of data collection currently start with video recording of relevant phenomena (the relevance of which, again, can only be inferred from prior observation) followed by systematic transaction analysis, where inter-observer agreement serves to improve reliability of interpretation. Knowledge of individual workers in the task domain may be collected as far as it seems to be relevant, but it is in no case a priori considered the main source, and will never be considered indicative for generic task knowledge.

The scope of ethnography

The ethnographic approach in unique in its attention to all relevant phenomena in the task domain that are not explicitly verbalizable by (all) experts (see [13]). The approach attends to elicit knowledge and intentions that are specific for some actors only, conflicting goals, cultural aspects that are not perceived by the actors in the culture, temporal changes in beliefs, situational factors that are triggers or conditions for strategies, and non-physical objects like messages, stories, signatures and symbols, of which the actors may not be aware of their functions in interaction.

Ethno-methodology covers the methods for information collection that might serve as a basis for developing task model 1 (and no more than this since ethno-methodology only covers information on the "current" state of a task domain). However, the methodology for the collection of data and the structuring into a total task domain description is often rather special and difficult to follow in detail. The general impression is that CSCW design methods skip the explicit construction of task models 1 and 2 and, after collecting sufficient information on the community of practice, immediately embark on specifying the UVM, based on deep knowledge of the current task situation that is not formalized. This might cause two types of problems: on the one hand, the relation between specifications for design and analysis of the current task world might depend more on intuition than on systematic design decisions; on the other hand, skipping task model 2 may lead to conservatism in view on organizational and structural aspects of the work for which a system is to be (re)designed.

CONCEPTUAL FRAMEWORK FOR GTA

The framework for groupware task analysis that is presented here is based on comparing the different approaches mentioned earlier, and on an analysis of existing and proposed systems for HCI and CSCW (see [14]).

The framework as such is intended to structure task models 1 and 2, and, hence, as a guidance for choosing techniques for information collection in the case of task model 1. Obviously, for task model 2 design decisions have to be made, based on problems and conflicts that are represented in model 1, in combination with requirement specifications as formulated in interaction with the client of the design. For a discussion of these design activities, see [14].

Task models for complex situations need to be composed of different aspects. Each describes the task world from a different viewpoint, and each relates to the others. Consequently, the resulting final task model will be redundant at the level of representation for human readers. This will allow designers to read and to design from different angles, and provide slots for design tools to guard consistency and completeness. The three viewpoints (focus on agents, work, and situation, respectively) that we will apply in our approach are a superset of the main focal points in the domain of HCI as well as CSCW. Both design fields consider agents ('users' vs. 'cooperating users' or user groups) and work (activities or tasks, respectively the objectives or the goals of 'interaction' and the cooperative work). In this section we will elaborate our conceptual framework.

Agents

The first aspect focuses on agents. "Agents" often indicates people, either individual or groups. Agents are considered in relation to the task world, hence, we need to make a distinction between agents as acting individuals or systems, and the roles they play. Moreover, we need the concept of organization of agents. In situations where modern information technology is applied, actors will sometimes be non-human agents, or systems that comprise collaboration between human agents and machine agents.

Actor
This label mostly refers to individual persons. Important for task modeling is to identify relevant types of actors, and to characterize them on relevant characteristics. Types may be identified based on two different types of variables: (1) psychological characteristics like cognitive styles or spatial ability (see [15]); and (2) task related characteristics like expertise or knowledge of information technology.

Role
Roles indicate classes of actors to whom certain subsets of tasks are allocated, by free choice or as the result of the organization. By definition roles are generic for the task world. More than one actor may perform the same role, and a single actor may have several roles at the same time.

Roles may be performed temporarily, be negotiated between actors and accepted or refused. Actors may have internal (mental) representations of their own roles and others' roles and roles may be represented externally by instrumental or symbolic behavior and by objects (white coat, stethoscope, and wig).

Organization

'Organization' refers to the relation between actors and roles in respect to task allocation. The organization describes the agent structure in the task domain. Part of the organization is generic (as far as the structure of roles is concerned), another part concerns the current episode in the history of the task world (the organization as far as dependent on current individual actors and the roles they currently perform). Delegation and mandating responsibilities from one role to another is part of the organization, as is the way roles are allocated to actors. In organizational structure roles can be hierarchically related in several ways: a role can be a subtype of another role (a sales manager is a manager), or roles may be part of a role (a nurse is part of the company health department, which is part of the personnel division).

Work

Some approaches refer to goals as the unit of description of work (GOMS: [4]), but we prefer to focus on the structural as well as dynamic aspect of work, hence, we will take 'task' as the basic concept, and 'goal' as an attribute. The concepts of task and goal in most frameworks have either a many to one or a one to one relation – several tasks may have the same goal, and each task has exactly one goal. In activity theory tasks are referred to as 'actions' (which are, like in HCI task analysis approaches, considered to be hierarchically structured), where long-term tasks are referred to as 'object' or 'motive' (Nardi, [13]). We make a distinction between tasks and actions in the 'classical' HCI terminology, and, moreover, we will elaborate task structure and the structure-related concepts of protocol and strategy.

Task

Tasks can be identified at various levels of complexity. The unit level of tasks needs special attention. Payne and Green (in [16]) call this the 'simple task', but this notion may either indicate an artifact of a system, or a psychological concept, which sometimes results in ambiguity in analysis. We need to make a distinction between (1) the lowest task level that people want to consider in referring to their work, the 'unit task' (Card, Moran, and Newell, [4]); and (2) the unit level of task delegation that is defined by the tool that is used in performing work, like a single command in command driven computer applications. This last type of task we will call 'Basic task' (Tauber, [8]). Unit tasks will often be role-related.

Complex tasks may be split up between actors or roles. Unit tasks and basic tasks may be decomposed further into (user) actions and (system) events, but these cannot really be understood without a frame of reference created by the corresponding task, i.e., actions derive their meaning from the task.

Task structure

The task structure will often at least partially be hierarchical. For the indication of temporal order and dependency structure, concepts like the 'constructors' of Scapin and Pierret-Golbreich ([6]) are relevant. Task structures for task model 1 are not always known by single actors, mainly when different roles are involved in performing different subtasks. On the other hand, performance on certain subtasks may influence the procedures for other subtasks.

Actions

Actions are identifiable components of basic tasks or unit tasks, which have a meaning in performing a unit of work, but which derive their meaning only from the task they are part of. For instance hitting a return key has a different meaning depending on whether it concludes a command, or confirms the specification of a numerical input value. The speech act of confirmation has a different meaning depending on whether it follows another person's question or command. On the other hand, actions are the smallest elements of a basic or unit task that change or define the meaning of that task. In describing actions, the goal is to identify the meaning, not the physical characteristics.

In Activity theory these components seem to be equivalent to 'operations', which are at the level of automatism and the elements of subconscious feed-back loops. This theory stresses the phenomenon that actions may become operations by continued learning and experience and that they must become 'actions' again when the operations are frustrated. Typical actions in HCI and CSCW are the specification of objects or events, and speech acts. Actions may aim at changing (or operating on) attributes, 'location' or existence of objects, change attributes of the environment, or may affect mutual task performance between different actors. Actions that concern the 'content' of an object may often be considered to act on other objects that are contained in the current object ('themes', see below). Actions, as parts of basic tasks or unit tasks, are often not explicitly 'known' (i.e., verbalizable) or actors are reluctant or unable to be very precise in this respect.

Protocols

This concept indicates actual 'rules' as turn out to be applied for decomposing tasks, to be distinguished from 'rules' that may be stated explicitly in instructions which are sometimes not actually followed. Protocols may be situated, i.e., the environment and the presence of actors with certain roles may constitute conditions for protocols to be triggered.

Strategies

'Strategies' indicate structures that can be considered protocols used mainly by experts or typically preferred by them. These structures will often be situated in the same way as protocols are. Strategies may have started from explicit problem solving and knowledge formation episodes

and subsequently have become implicit expert knowledge. Strategies will be role related.

Situation

Analyzing a task world from the viewpoint of the situation means detecting and describing the environment (physical, conceptual, and social) and the objects in the environment. Object description includes an analysis of the object structure.

Object

Each thing that is relevant to the work in a certain situation is an object in the sense of task analysis. In this framework, 'objects' are not defined in the sense of 'object oriented' methods. Objects may be physical things, or conceptual (non-material) things like messages, gestures, passwords, stories, or signatures. Non-material objects as well as physical objects may in the task situation be referred to by external representations of different character: verbal labels, graphics, metaphors, gestures. Actors that perform a certain role may be objects in a task situation and will be labeled 'active objects'. Non-human system components like computer-based agents may also be active objects.

The identification of relevant objects will depend on the condition of knowledge (explicit or implicit) and on whether the object figures in a task for a single person or in group situations. Relevant objects may be used to transport meaning and information between different agents without any of them being aware of the objects' nature (e.g., anecdotes that contain strategic information). As far as explicit knowledge is involved, analysis of verbal material from archival sources or from interviews may be of help, starting with the identification of nouns in relation to task references. For implicit knowledge about objects, observations and ethnographic methods have to be used, both for detection and for description.

Object structure

In order to describe the semantics of objects, two kinds of relations between object types have to be identified.

1. Object types are related via a type hierarchy, indicating sub-type - super-type relations. Sub-types inherit the characteristics of their super-type as far as no further specifications have to be added. Analysis will reveal the exact relations of object types of certain levels in a type hierarchy featuring in the task world.

2. Semantic relations between object types may metaphorically be indicated by place relations, where a certain type of object can be 'in' or 'on' another object type Apart from the relation between object types, objects will be related to tasks as agent (active objects), as subject, or as featuring in conditions of task structures. The identification of object structures will be an analytic (HCI type) activity, based on verbal protocols from actors and on systematic observation of the situational relations in which objects are used.

Environment

The task environment is the current situation for the performance of a certain task. It includes actors with roles, conditions for task performance and for strategies and protocols, relevant objects, and artifacts like information technology that are available for subtask delegation. The history and temporal structure of relevant events in the task situation is part of the actual environment. The environment features as condition for task structures (inclusive protocols and strategies as far as these are situated). The analysis and description of environments often will need ethnographic methods.

SOURCES OF KNOWLEDGE

Collecting task knowledge for analyzing the current situation for a complex system has to start by identifying the relevant knowledge sources. In this respect, we refer to a framework derived from [2], see Figure 2

Task world knowledge	**Individual**	**Group**
Explicit	**a**. knowledge and skills	**c**.models/stories/ instructions
Implicit	**b**. intuition/ expertise	**d**. culture/community of practice

Figure 2 Dimensions of knowledge

Relevant task domain information may have to be collected focusing on different phenomena, using different methods of data collection. Based on an analysis of the character of the knowledge sources in this framework, different methods are identified to collect all information needed to construct a model of the current task world.

Collecting task knowledge

Going from knowledge that is available from professionals in the task world and domain experts, via knowledge that is present in the culture and in the social environment towards artifacts and the physical environment, we encounter knowledge in the cognitive psychological sense, awareness and anecdotal material in the culture, and traces of manufacture and use as well as environmental opportunities and constraints.

Going from explicit knowledge, via skills and rule based behavior, through intuitive and instinct-like behavior in individuals and groups and culture, we meet documented knowledge and conscious representations, stories and myths, as well as unspoken and unspeakable insights that still prove to be valid for guiding or monitoring adequate behavior in the context of use.

For task knowledge in cell a, psychological methods will be used including those elaborated by [7] and [5]: interviews, questionnaires, think-aloud protocols, and (single person oriented) observations. For knowledge indicated in cell b observations of task behavior will have to be

complemented by hermeneutic methods to interpret mental representations (see [15]). For the knowledge referred to in cell c the obvious methods concern the study of artifacts like documents and archives. In fact all these methods are to be found in classical HCI task analysis approaches.

The knowledge indicated in cell d is unique in that it requires ethnographic methods like interaction analysis (see [2]). Moreover, this knowledge can be in conflict with what can be learned from the other sources, as is already shown in the examples presented in the previous sections. First of all, explicit individual knowledge often turns out to be abstract in respect to observable behavior, and turns out to ignore the situatedness of task behavior. Secondly, explicit group 'knowledge' (e.g., expressed in official rules and time schedules) often is in conflict with actual group behavior, and for good reasons. In fact, official procedures do not always work in practice and the literal application of them is sometimes used as a political weapon in labor conflicts as a legal alternative for strike. In all cases of discrepancy between sources of task knowledge, ethnographic methods will reveal unique and relevant additional information that has to be explicitly represented in task model 1.

The allocation of methods to knowledge sources should not be taken too strictly. In fact the knowledge sources often cannot be located completely in single cells of the conceptual map. The main conclusion is that we need these different methods in a complementary sense, as far as we need information from the different knowledge sources.

It can be shown that different techniques of data collection and data analysis are needed for different types of knowledge, and these techniques seem to map systematically on to the "two-dimensional" framework of knowledge sources. Related to the different types of knowledge and the techniques is the notion of reliability of collection of information, and the validity of the resulting knowledge. We consider the validity of the knowledge in relation to the history and time aspects of the task world. E.g., experts may base their current knowledge on training they received in a different phase of equipment application, and documents may reflect a rule that is yet to be accepted by the authorities who control task performance.

EUTERPE, A TASK ANALYSIS TOOL
Our task analysis environment EUTERPE[1] has been developed to aid the process of task analysis. Although it is still under development, it is already being used in design projects in both educational and industrial settings. EUTERPE was developed because task analysis is still an activity that needs support. Task analysis is useful activity but it is often also a very unstructured and time-consuming activity. Many methods exist, but thoughts on task models and what they describe exactly have not been stabilized yet. Furthermore, task analysis methods usually only deal with

task *modeling* and not really with task *analysis*. After the task world has been modeled it is up to the analysts to interpret the task model and find out where causes of problems can be found or where there is room for optimization of the work. These may be one of the reasons that cause task analysis to be both ineffective and inefficient.

A task model that can describe the task world including cooperative aspects and that allows some form of analysis could improve the task analysis process and outcome. In [17] a formal approach based on model checking techniques is described for analyzing user interfaces. A similar approach could also be applied to analyzing task models. However performing a formal analysis of a task model requires a formal representation of the task model that is suitable for doing an analysis, especially for analyzing cooperation.

Although a formal analysis can be the basis for analysis, it is not on the level analysts prefer to work. Hence representation tools can effectively hide the formalism and provide means to assist in analyzing the environment that is being studied. In addition, a tool can also provide more structured ways of doing task analysis. The next sections describe such a tool - EUTERPE - based on Groupware Task Analysis that supports formal analysis both on a logical and a visual level.

Theoretical background
During task analysis many aspects are modeled. Which aspects are modeled and which are not, is part of an ongoing discussion among scientist and practitioners. We have based our tool on an ontology[18] which gives structure to the relevant aspects of the task world that we think are important.

A Task World Ontology
EUTERPE is based on a task world ontology that describes the way we look at the task world during task analysis. This ontology is derived from the conceptual framework of GTA that was described in the previous sections. It defines the relevant *concepts* and *relationships* between them that we regard relevant for the purpose of a task analysis. The ontology is of great importance because it is the conceptual basis of all information that is recorded and the way it is structured. Unfortunately, most task analysis methods do not define an ontology. Our ontology is derived from the three viewpoints from GTA and incorporates aspects of several other task analysis methods.

Concepts and Attributes
The *concepts* defined here are based on GTA and can be found in most other task models as well (with the exception of the *event* concept). This section will define the concepts and the next section will define their relationships in detail.

- **Object.** An object refers to a physical or non-physical entity. A non-physical entity could be anything ranging from messages, passwords or addresses to gestures and stories. Objects have attributes consisting of attribute-

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[1] EUTERPE is available at http://www.cs.vu.nl/~gerrit/gta/

name and value pairs. What can be done with an object is specified by actions, for instance *move*, *change*, *turn off* etc. Furthermore, objects may be in a type hierarchy and can also be contained in other objects.

- **Agent.** An agent is an entity that is considered active. Usually agents are humans but groups of humans or software components may also be considered agents. Agents are not specific individuals (like "Chris") but always indicate classes of individuals with certain characteristics.

- **Role.** A role is a meaningful collection of tasks performed by one or more agents. The role is meaningful when it has a clear goal or when it distinguishes between groups of agents. A role is consequently *responsible* for the tasks that it encompasses and roles can be hierarchically composed.

- **Task.** A task is an activity performed by agents to reach a certain goal. A task typically changes something in the task world and requires some period of time to complete. Complex tasks can be decomposed into smaller subtasks. Tasks are executed in a certain order and the completion of one task can *trigger* the execution of one or more other tasks. A task could also be started because of an event that has occurred in the task world. Important for the task concept is the distinction between unit tasks and basic tasks, where (ideally) a unit task should only be executed by performing one or more basic tasks. The relationship between the unit task and basic task is interesting because it can indicate the problems that an agent may have in reaching his goals.

- **Event.** An event is a change in the state of the task world at a point in time. The change may reflect changes of attribute values of internal concepts such as Object, Task, Agent or Role or could reflect changes of external concepts such as the weather or electricity supply. Events influence the task execution sequence by *triggering* tasks. This model does not specify how the event is created or by whom.

Relationships

The concepts defined in the previous section are related in specific ways. Figure 3 shows all the concepts and relationships together in a diagram.

Deriving representations

The ontology only defines a structure for the task model data and does not limit or dictate any representation. The tool is based on a repository that contains the project data and all the representations are views on the repository. The task world ontology is specified in a logic programming language (Prolog) and is the main data structure for the repository. EUTERPE offers several different representations and all the representations are coherent because each representation is build up on the fly out of the same information specified using the ontology. For instance a

task tree representation does not exist in the logical model but the structure is derived from the specified Subtask relationships of tasks. By issuing queries to the Prolog engine all the relationship can be inspected. This way the users of EUTERPE can work with the representations without having to deal with the logic representation underneath.
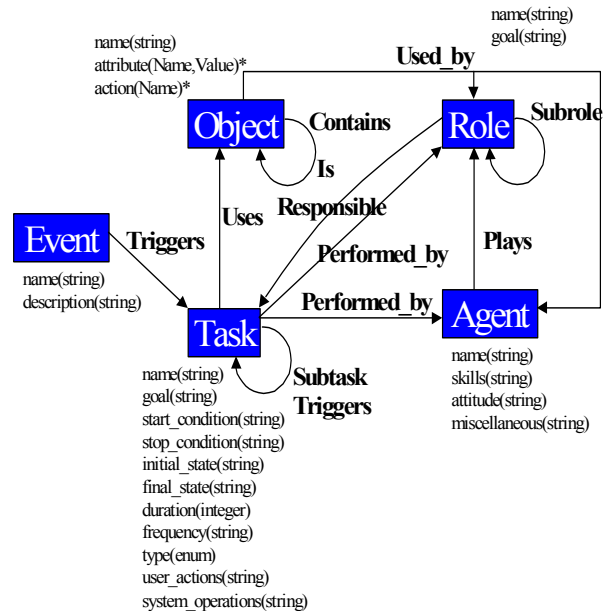

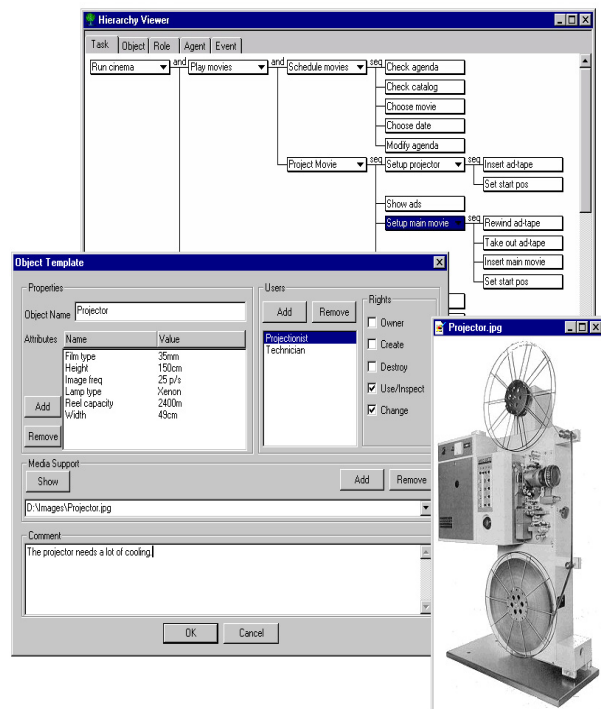**Figure 3 Concepts and relationships**

Figure 4 Some representations

Besides task trees EUTERPE also offers templates that show detailed task information and some context information

such as the objects used in this task or the roles that are involved in this task or any of the subtasks, Figure 4. A somewhat different kind of view is the web browser view [20]. EUTERPE also allows task model evaluation. This can be done using Analyzer viewer to perform several queries. The questions for the queries are predefined based on what question designers might have. E.g.: it is possible to find out how many tasks doe not have associated objects. The results are represented with colors.

CONCLUSIONS

This paper gives an overview of Groupware Task Analysis from both a theoretical and practical perspective. The conceptual framework of GTA with the three viewpoints agents, work and situation, extends the classical task analysis approaches and makes a clear link to CSCW approaches. From a practical perspective a task world ontology was described that gives structure to the task models themselves and it was shown how the ontology is used in practice with our tool EUTERPE. Task analysis includes both modeling and analysis activities usually with an emphasis on modeling. A semi-formal approach based on the ontology allows various ways of analysis that are supported in our tool.

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