

Modeling Complex Processes in GTA

G.C. van der Veer, M. van Welie, D. Thorborg[†]

Vrije Universiteit, Department of Computer Science

De Boelelaan 1081a, 1081 HV Amsterdam, The Netherlands

[†]Linköping University, Department of Computer and Information Science

581 83 Linköping, Sweden,

Email: {gerrit,martijn,thorborg}@cs.vu.nl

ABSTRACT

GTA is a method for groupware task analysis. Representations of task models in GTA originally focused on object oriented templates of the various elements, and on hierarchical relations between elements as seen from separate viewpoints (work, agents, and situation). In order to model time aspects and complex processes, we introduce new concepts as well as new types of representation inspired by workflow representation techniques.

Keywords

GTA, process models, task knowledge, task modeling, workflow

ANALYTIC MODELING IN DESIGN

Systematic design of complex systems starts with a phase where the current work situation is analyzed. Knowledge of a current work situation, collected by knowledge elicitation, ethnography and other methods, is of a broad variety. An important step in this phase of design is to model all relevant task knowledge, including both static knowledge and process knowledge, in a model that includes indications of conflicts, diversity in procedures and situational conditions of tasks. The resulting representation of this phase of task analysis we will label “Task model 1” (van der Veer et al. 1995) (TM1). TM1 is valid if it represents all relevant aspects of a current work situation as far as the knowledge is needed for future (re)design.

Ideally, the next step in design is to envision the new world, i.e., the work situation for the case that the intended design is finalized and the specified technology is implemented. New technology will change the work situation, and will often strongly impact the work organization and procedures. All of this is part of the envisioning, so all of this should be represented in this phase of design. We speak of “Task model 2” (TM2) to indicate a representation of the envisioned new task situation. TM2 should represent the same aspects of work, work organization, and work situation, in order to allow analysis of the changes and to make decisions for detailed design.

The development of TM2 will be based on TM1 (including the conflicts, needs, and diversities recorded), on negotiation with the client of the design (including standards, corporate image, usability criteria, budget for design and implementation), and on status and envisioning of enabling technology (situational constraints, predicted possible developments). In later phases of design (specification, evaluation) detail specifications will often require a re-consideration of TM2, and, hence, new negotiations with the client of design.

GTA - GROUPWARE TASK ANALYSIS

GTA (van der Veer et al, 1996a) is a method for task analysis that provides a conceptual framework and related techniques and tools that allow the analysis and design of complex systems, where different users with different roles and competences, as well as stakeholders (significant others who do not physically use the technology concerned but who's work is affected by it) apply complex technology in complex work situations and work organization. The label Groupware indicates the basic assumption of GTA that complex interactive systems and work processes can not fruitfully be analyzed from the point of view of single work places or single user-computer interactions. Each element of work is part of a large process that involves organizational aspects as well as the situation - both in its spatial relations and in its history of past events. GTA allows three views on knowledge about the task domain: *work*, *agents* and *situations*. Together these views provide the conceptual framework for analyzing and modeling TM1 and TM2.

Work

Modeling work means representing work activities in their relation to each other. The classical approach in this view is best represented in “Hierarchical Task Analysis” (HTA, see Kirwan and Ainsworth, 1992), where work is described as a hierarchical structure of tasks and subtasks. Approaches like GOMS (Card, Moran, and Newell, 1983) connect a

goal to each task (hence there is a structure of subgoals), and define the smallest elements of a task / goal hierarchy as “unit tasks” (which are the end-nodes of the task tree, and, as such, from the point of view of the user, the smallest elements that are meaningful complete tasks with a goal). Tauber (1990), in addition, defines the concept of the system’s “basic task”, indicating units of task delegation as provided by technology. The elements of GTA’s conceptual framework for the work view consist of a small number of concepts:

- Work may be structured in one or more *task structures*, where the structure of subtasks has to be described by constructors, that are specific to the task domain. Constructors may indicate a temporal sequence, triggering of sub-tasks by each other, loops, conditional choices, etc.
- At the high end of a task structure are *business goals* and tasks related to them. This type of task is often not delegated to a single person or role, and, especially for high level goals there may be several tasks that could provide a way to achieve the goal requiring a flexible structure.
- At the low end of a task structure we find actions, elements that derive their meaning from the unit task they are part of. E.g. hitting a return key is meaningful, but the meaning varies between situations where one is typing text in a word processing, navigating between cells in a spreadsheet, or issuing a command to an operating system.
- A set of tasks that belongs to a single role, i.e., is intended to be performed by a single person, often has a well-defined structure. If the structure is generally considered to be “good” or common work practice, we label this “*protocol*”. If the procedure is characteristic for experts in a certain task domain (e.g., developed on the base of learning or experience) we call this “*strategy*”.

Agents

Many task analysis approaches seem to take for granted that task knowledge of experts contains a considerable part of generic task knowledge. However, in practice we immediately find that complex processes are performed by people playing different roles. Approaches like TKS (Johnson, 1992) introduce this concept and relate it to a specific set of tasks and a task structure. Most of the classical task analysis techniques only work if we focus on a single role. Ethnography, on the other hand, is strong in investigating whether roles exist and how they relate to structures of work and to situations. In our viewpoint an agent is an active entity, usually a human or a group of humans, but intelligent systems are also considered agents. In analyzing the viewpoint of agents, GTA needs several concepts:

- Groups of *agents* need to be described in terms of their relevant characteristics. This refers to the importance of relating actors to the requirements of tasks. General characteristics that may be relevant depending on the technology applied may be typing skill, experience in using devices like mouse, language abilities. More “remote” variables like spatial ability and fear of failure may impact the interaction between actors and technology in certain situations. Task related aspects of actors refer to knowledge and experience with the domain of work.
- People can take one or more *roles*. Groups of people may in some task domains do the same (the “secretariat” is an instance that may consist of one or more agents, from the outside it performs a single role). Agents may perform several roles simultaneously. The relation between agents and roles may be established and disconnected over time, based on conditions of the situation (election for a post, being the next in the row to succession, self-selection).
- Agents and roles are related to each other in an *organization*. The analysis and representation of an organization should include information on *responsibilities* for tasks, task *delegation*, and the *assignment* of roles. Another part of the analysis of the organization concerns competences and ownership of elements in the situation, like “things” (See below).

Situation

Describing the situation as far as relevant for task analysis is often neglected in classical task analysis. An exception is Walsh (1989) who actually starts his technique by identifying objects and environments, before concentrating on activities and tasks. Ethnographic schools, on the other hand, always start by literally going into the situation, experiencing and subsequently analyzing it from within. In GTA there are various concepts needed to deal with the situation:

- Designated objects as analyzed by Walsh will be labeled “*things*” in our framework. These may be physical objects, or non-physical things like passwords, PINs, standard jokes, or stories. Things feature in tasks, sometimes being manipulated or created by tasks, sometimes as elements in conditions for starting or stopping a task. Things may act as symbols for roles (uniforms, portable phones, boy-scouts’ handshake). Things may have attributes (opportunities for change) like a date of last inspection, a pointer to an owner.

- Things feature in a *structure*. In some cases it makes sense to represent things in a type hierarchy (e.g., in offices, there may be a type structure of paper fill-in forms). Often things provide places for other things (a letter may contain a header, a content, several appendices, and a signature)
- *Events* model things that happen in the task world over which the actor does not always have direct control, e.g. lightning strikes, a power failure, a colleague has become sick, a burglary, arrival of new mail etc. When analyzing highly complex situations such as a cockpit or a construction yard the event may prove very useful in modeling the rapidly changing situations.
- All tasks in a work domain are performed in an *environment*. The environment can be conceived as a thing, which has static and dynamic aspects. Environments are characterized by the things, the agents and roles that live in it but also more dynamically by the events that have taken place and those that may occur in future.

The three viewpoints described in this section are described in shared concepts that are interrelated. In the first versions of GTA, we focused on representing the separate viewpoints. Work can be represented in task structures that mainly illustrate the hierarchic nature of the relation between higher order tasks and subtasks. In the same way the organization of agents or situations can be represented in role type/containment hierarchies. From the start GTA provided object oriented templates for representing the single concepts in their relation to the other relevant concepts, much like MAD for tasks (Scapin and Pierret-Golbreich, 1989) and ETAG for things (Tauber, 1990). In these templates, a concept like an thing is related to other things (sub type relation, contains relation), to actors and roles (ownership), to tasks, etc.

NEED FOR REPRESENTATION OF PROCESS

Task analysis techniques often focus on a single viewpoint (HTA, MAD, GOMS) or at least restrict themselves to separate representations for different viewpoints: ETAG uses separate structure descriptions for things (the UVM) and for tasks (the dictionary of basic tasks), and so did GTA in its ancient format. Experience with GTA in a variety of actual design situations (office work, construction hall, mobile communication, business processes industrial process control) showed that GTA in its original versions lacks possibilities that are essential to completely model relevant task knowledge (van der Veer et.al 1996b). Like other modeling techniques, GTA did not allow adequate handling and representation of time aspects and synchronization, parallelism and dataflow;

A representation technique that seems promising in this respect may be found in workflow management tools. Here, tasks are in fact represented by streams of entities that travel between situations or roles. Workflow representations allow the distinction between three types of organizational processes (Grudin, 1994): *material* (to be interpreted as products of the process), *information* (where information is represented in its function of driving the material process), and *human* (the coordination of people and organizations in respect to the steering of information and material processes).

GTA EXTENDED

We try to overcome the problems by a two-fold extension to the original GTA method: addition of some concepts to the conceptual framework, and inclusion of new representation formats that allow modeling complex processes. Our solution exists of including certain concepts from workflow modeling in the conceptual framework of GTA:

- *Time*, related to tasks in the form of deadlines, interval and frequency, and process time. An absolute time value can enforce the start of a certain task execution, a relative time can trigger execution of a task (start within 1 hour from a certain event or from the execution of another task). A task can be stopped at a certain absolute time, or after a certain interval. In this way time may feature in both starting and stopping conditions for tasks.
- *Input and output containers*, relating data and object transfer between tasks. Tasks often concern the handling of things. Things may be created or removed, things may be changed by changing the value of attributes, by changing the set of (other) things they contain, or by changing their location (inside other things). In all these activities, other things and “data” play a role, both as input for the task, and as results that will be transferred to subsequent tasks, whether these will be initiated by the same agent or by others. To this end, the representation of tasks needs to be extended to contain the relevant things and data.
- *Workflow events*, representing triggering or enabling relations between tasks and between data or objects and tasks. Tasks not only are related by way of decomposition into (sets of) subtasks. Often tasks result in other tasks being enforced or enabled to start or to end, even if other actors are concerned (sending an email to another person).

The extended framework allows new characteristics for the technique of modeling complex processes:

1. each process can contain several different processes (in parallel, synchronous, alternative, etc.);
2. each process can be represented as a relation between time and either roles (or actors) or objects (including data, situations, or locations);
3. consequently, each process can be represented as a directed graph of tasks, each of which related to roles or objects;
4. a task or subprocess can be part of several processes.

TOOL SUPPORT FOR PROCESS MODELING

An experimental version of the GTA tool with the new workflow viewer is now available at <http://www.cs.vu.nl/~martijn/gta/>. The tool shows processes in separate windows that also offer graph-editing facilities. A process can be chosen from a list of process or by indicating the starting task of the process. When a task is the starting task of more than one process the user is presented with a list of process in which he can select the relevant process. Currently we are working on a complete redesign of our tool in order to be able to experiment with different kinds of views. We believe that there are many other useful views, other than the classic tree, that can be of use to analysts. Apart from the workflow view we have also developed an inspector view which gives a kind of magnifying glass on the network of concepts and relations.

CONCLUSIONS

In this paper we described how we extended our conceptual framework GTA with support for modeling complex processes. By using workflow representations we add new and useful information to the classic hierarchical representations used in task analysis. Apart from a workflow view we motivated the use of other views that may prove useful in representing tasks models. In future we hope to support these views in our tools.

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