CID

CID KTH

Incorporating Work, Process and Task Analysis into Commercial and Industrial Object-Oriented Systems Development

John Artim, Mark van Harmelen, Keith Butler, Jan Guliksen, Austin Henderson, Srdjan Kovacevic, Shijian Lu, Scott Overmeyer, Ray Reaux, Dave Roberts, Jean-Claude Tarby and Keith Vander Linden

Incorporating Work, Process and Task Analysis into Commercial and Industrial Object-Oriented Systems Development

John Artim, Mark van Harmelen, Keith Butler, Jan Guliksen, Austin Henderson, Srdjan Kovacevic, Shijian Lu, Scott Overmeyer, Ray Reaux, Dave Roberts, Jean-Claude Tarby and Keith Vander Linden

John Artim, Mark van Harmelen, Keith Butler, Jan Guliksen, Austin Henderson, Srdjan Kovacevic, Shijian Lu, Scott Overmeyer, Ray Reaux, Dave Roberts, Jean-Claude Tarby and Keith Vander Linden

Incorporating Work, Process and Task Analysis into Commercial and Industrial Object-Oriented Systems Development

E-mail of author: Jan.Gulliksen@hci.uu.se

URL of author: http://cid.nada.kth.se

Incorporating Work, Process And Task Analysis Into Commercial And Industrial Object-Oriented Systems Development

John Artim, Mark van Harmelen, Keith Butler, Jan Guliksen, Austin Henderson, Srdjan Kovacevic, Shijian Lu, Scott Overmeyer, Ray Reaux, Dave Roberts, Jean-Claude Tarby and Keith Vander Linden

OOCL (USA), Inc., Cutting Edge Systems Ltd, The Boeing Company, Uppsala University, Rivendel Consulting, Aonix, Commonwealth Scientific and Industrial Research Organisation, Drexel University, Virginia Tech Blacksburg, IBM Warwick, CUEEP Institute University and Calvin College

jartim@acm.org, mark@cutsys.com, keith.a.butler@boeing.com, Jan.Gulliksen@cmd.uu.se, henderson@rivcons.com, srdjan@acm.org, shijian.lu@cmis.csiro.au, scott.overmyer@cis.drexel.edu, rreaux@vt.edu, DaveRoberts@uk.ibm.com, Jean-claude.Tarby@univ-lille1.fr, kvlinden@calvin.edu

ABSTRACT
In this paper, we report on the results of the CHI98 workshop on task, process and work analysis coupled with object modeling. This workshop was a follow-up to a CHI97 workshop of the same topic. This year's workshop took as its starting point the summary paper and framework created in last year's workshop. The goal of this year's workshop was to bridge the conceptual gulf between current HCI practice and current development practice. The result of this workshop is a proposed set of extensions to UML, a key standard in the object-oriented development community.

Keywords
Task Analysis, Process Analysis, Object Modeling, Use Case Modeling, User Interface Design, UML

INTRODUCTION
The CHI97 workshop, "Object-Oriented Models in User Interface Design," addressed the question of the role of object modeling in user interface design work [10]. The participants spent much of this two day workshop finding common ground and developing a meta-description of this common ground that characterizes the roles of object modeling in the process of user interface design. Though a few key areas of contention were outlined, all participants were in strong agreement with the framework as a description of the common ground. This framework, with the addition of some detail as a result of cooperative post-workshop effort, appeared in the SIGCHI Bulletin [11].

'97 Framework
The framework developed by the CHI97 workshop participants emphasizes a number of key aspects of user interface and system development work. The

highlights of this framework include the following points:

1. The users of a system under design work in a world of existing tasks and referents.

2. The various participants in the design process make use of one or more descriptions (models) of this user's world to document that world as it currently exists and as it might exist after the introduction of the referents forming the user-visible portion of a new system.

3. Information in one description can determine, constrain or otherwise specify the content in another description. The pattern of these inter-description relationships characterizes a system development process.

4. Common practice in the development community today makes use of object-oriented modeling techniques to model the user's domain as well as a system under construction.

5. Common practice in the HCI community employs user task analysis and scenarios to describe the users' activities.

6. It is possible to link development practice to HCI practice through the use of object models derived from a user task analysis.

These fundamentals of the framework were taken as the starting point for the CHI98 workshop.

GOAL FOR THE '98 WORKSHOP
With last year's framework as a starting point, the goal of the CHI98 workshop was to produce a method and notation framework to support, in a standard fashion, the use of task, process and work analysis and modeling as a source or specification of objects for system design purposes. Equally important, the workshop participants set out to

make this framework as compatible as possible with current development practice.

Object-oriented methodologists are currently working towards agreement on a core of notation and semantics that are common to most OO methods. This common core is referred to as the Unified Modeling Language (UML). Standardization is taking place through the forum of the Object Management Group (OMG). At present it seems highly likely that UML will dominate development approaches at least for the next few years, if not the next decade. This offers a window of opportunity for understanding how user interface practitioners can better work with the future dominant development paradigm. In light of this, much of this year's workshop was geared towards extending parts of last year's framework and expressing it as an extension of UML's semantic model [9].

The participants in this year's workshop were drawn from organizations representing commercial and industrial practice, academia, consultancy and tool development. All participants practice some form of task or process analysis. Beyond this commonality, participants represented a broad cross-section of CHI practice. Further information on the background of participants is available from the workshop's website [2].

UML AND USER-CENTERED UI DESIGN
One of the key concepts from the '97 framework was **Description**: an artifact used to help organize the HCI practitioner's understanding of the user's world. The mappings between **Descriptions** are one expression of the overall system development process used to create, manage and make use of these descriptions. The descriptions and mappings are our representation of the fundamental units of HCI activity and the results of those activities. Because **Descriptions** play an organizing role in last year's framework, our evaluation of UML and its adequacy for HCI work will begin here.

Descriptions
UML's equivalent of a **Description** is a **Model**. In UML there are, for example, use case models and object models. These **Models** are seen as units of scoping to keep track of a set of **Model Elements** that form a coherent piece of an overall system model. The semantics of UML's **Model** can adequately express our notion and use of **Description**.

Mappings Between Descriptions
Last year's summary article discussed the importance of the relationships between descriptions. These relationships represent the system development process (including the HCI process) used to arrive at a system and its user interface (a set of new referents). These mappings also guide the derivation or evolution of one description based on the content of other descriptions.

UML provides a set of relationships to trace content from one model to another. The UML construct **Dependency** provides the generic capability to indicate a conceptual dependency between two sets of **Model Elements**. Four specific types of **Dependency** are provided: **Refinement**, **Usage**, **Trace**, and **Binding**. These UML constructs provide necessary support for the processes and artifacts discussed in the workshop.

The authors of this paper strongly urge the CASE tool community to support UML's Foundation Packages in their entirety. These mechanisms are essential for the support of HCI work and for the support of collaborative work between HCI and development professionals.

PROPOSED UI EXTENSIONS TO UML
A survey of the position papers submitted for both this and last year's workshops provides a sense of the relevance of UML in HCI practice. The most striking commonality is (a) heavy use of task and scenario modeling via use cases and (b) domain concept modeling via object modeling.

Task Modeling
In both this and last year's workshop, use case based methods were discussed as a kind of task modeling [1], [7]. The difficulty with UML's approach to use cases is that it is not a generalized form of task modeling. A number of important features such as decomposability and task frequency are entirely missing from the UML model.

In addition to this missing information, use cases tend to focus on description of behavior at a level suitable for defining system functionality to an implementor. This level of behavioral description often starts at the lowest level of description that is of interest to the user task modeler. These functional descriptions avoid the higher-level details essential to good task modeling. We must recognize, however, that the use case methodology is heavily favored in the object-oriented community. This strong preference for use cases arises precisely because use cases are such a good means of organizing functional descriptions in a way that usefully leads to good object design.

On the one hand we have important task modeling content missing from the semantics of use cases. On the other hand the semantics of use cases overlaps substantially with the semantics of task models. What is more, use cases as they are currently formulated are an indispensable element of object-oriented development practice. The recommendation of this workshop is to define a separate User Task Model and provide a standard model of traceabilty between tasks and their corresponding use cases.
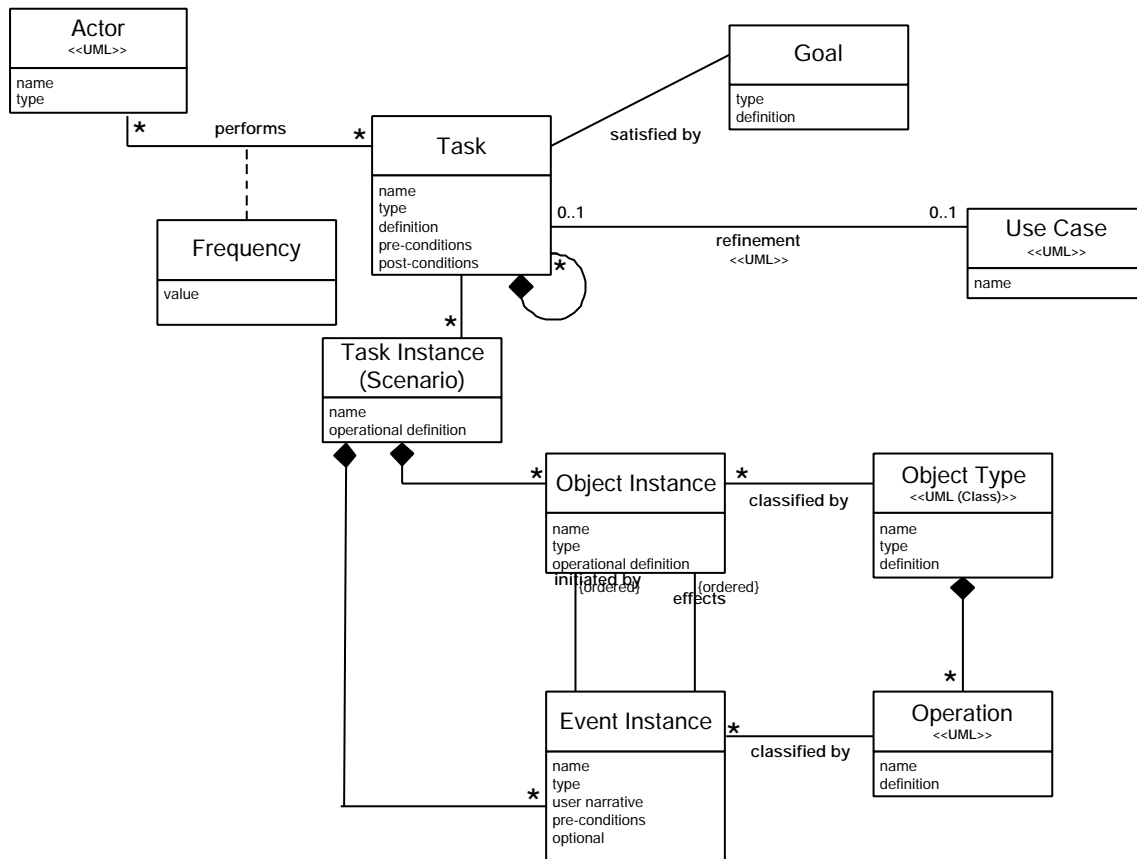
Figure 1. Proposed Task Model

Figure 1 is a representation of this User Task Model in UML notation. The central feature of user task modeling is the notion of a task. Although a number of task modeling methodologies are currently in use [6] most of these methodologies are concerned with human actors, the tasks these actors perform and the frequency with which these tasks are performed. Many of these task analysis methodologies are also concerned with the goal which motivates the user as she performs a particular task. In most of these approaches tasks can be decomposed in to finer-grained tasks.

Many HCI practitioners also favor scenario-based specification of user interface requirements. Scenarios can be used along with or independent of task modeling. For those practitioners that make use of object models to describe the user's domain concepts these scenarios provide a description of object instances that later informs the creation of an object model.

Task analysis so pervades common practice in HCI work that tool support for this activity is essential. The authors of this paper strongly encourage development of these user task-modeling extensions to enable tool support of this HCI activity.

References: Traceability to External Sources

Another issue that arose repeatedly in our discussions is the need for a mechanism to add information about external sources (documents, videos, prototypes, etc.) as annotations within a model. Literate development, which relies on source documents to inform design, has already begun discussion of this topic [4]. Clarke [3] indicated that the research group in which he did work on literate programming has considered extensions to UML to accommodate traceability to external sources [5].

The authors of this paper strongly encourage development of extensions in support of literate development.

Business Process Modeling

Another area of HCI activity is the use of work process analysis to inform user interface design Interactive software embodies a model of user work, whether it is explicitly identified or privately assumed, and whether or not it is accurate. But models of software are intended to represent functionality, where models of work are intended to represent qualities of the process, such as resource utilization, cycle time, variance of cycle time, etc. An extensive body of research and practice has emerged in this area. With regret, we were unable to give this topic the attention it deserves. As a consequence, we are not able to comment in depth on the adequacy of UML and its extensions in modeling work processes. Any modeling approach attempting support of work process modeling

would need, at a minimum, to support the modeling of processes, units of business, junctions, links, referents, elaborations and decompositions[8]. Work process modeling is essential for adequate coverage of HCI modeling activities. The authors strongly recommend that this topic be more fully explored and articulated as soon as possible so that this aspect of HCI practice can be better supported and integrated into an overall framework such as that presented here.

DISCUSSION

The most striking feature of this discussion to date has been the degree of agreement concerning core methodological issues. Last year's workshop, the workshop whose results are reported in this paper as well as another CHI98 workshop concerned with task modeling issues all came to largely the same conclusions regarding HCI practices and their relationships to development. There are, however, a number of issues where agreement was more elusive.

Process Standards in HCI

Much of our time, both in 1998 and in 1997, was spent in discussion of HCI and development process methodologies and standards. Some participants were strong supporters for and users of the ISO standard HCI process, ISO 13407. Other participants equally strongly supported various other processes and methodologies. As might be expected, this diversity of opinion appears to mirror the diversity within the CHI community at large. We would hope that all aspects of this diversity will continue to be represented in on-going discussions aimed at better understanding the role of HCI and user-centered design in the collaborative construction of software systems.

UI Architecture

One tantalizing area of discussion was user interface architecture. This year, as last year, a number of participants described user interface architectural approaches that could lead to much smoother transitions from user interface design to implementation. The allotted time was, unfortunately, too short to discuss these approaches in any detail.

Much of the discussion of UI architecture focused on the structuring of implementation architectures to facilitate the transition from user task analysis to user interface design to implementation. Despite differences in approach, there appeared to an interesting core of agreement. An extended discussion among practitioner's of UI architecture could lead to important improvements in the design and implementation of user interface. The authors of this paper strongly encourage follow-up activities in this area.

Ontological Drift

One of the key concerns highlighted in last year's discussion and summary article is the effect of ontological drift on the use of task and process analysis along with object modeling. It would appear that this is not an issue to be resolved but rather a fact of life with which to contend. Modeling and implementation activities take time. Practitioners must be aware of the rate of ontological drift in their domain and anticipate the effects of that rate of drift on their development efforts.

CONCLUSIONS

In this paper we have proposed a set of extensions to UML to better enable HCI work in close collaboration with object-oriented development. These extensions are proper extensions to UML in that they are compatible with the existing UML semantics. Because of this we would expect that this proposal should be largely non-controversial with the OMG community as well as the larger object-oriented community. The next step will be to disseminate this work to OMG and to the object-oriented community to solicit comments.

The framework from last year's workshop, though restated in terms of UML's semantics, has withstood close scrutiny and remained a useful organizing paradigm in discussing issues related to HCI and systems development processes, methods and artifacts. We would hope that this framework might continue to facilitate discussion in key areas of HCI process, methodology and user interface architecture.

REFERENCES

1. Artim, John, *Integrating User Interface Design through Task Analysis and Use Cases*, http://www.cutsys.com/CHI97/Artim.html, 1997.

2. Artim, John, *Incorporating Work, Process And Task Analysis Into Commercial And Industrial Object-Oriented Systems Development,* http://gate.cruzio.com/~artim/CHI98/, 1998.

3. Clarke, Steven, *Personal communiction*, 1998.

4. Clarke, Steven and Gilbert Cockton, *Linking Between Multiple Points In Design Documents*, to appear in Adjunct Proceedings of CHI'98, ACM, 1998.

5. Cockton, Gilbert*, Gilbert Cockton's Home Page*, http://osiris.sunderland.ac.uk/~cs0gco/#.

6. Kirwan, B. & Ainsworth, L. K., *A Guide To Task Analysis*, Taylor and Francis, 1992.

7. Lu, Shijian, Cécile Paris and Keith Vander Linden, *Integrating Task Modelling Into The Object Oriented Design Process: A Pragmatic Approach*, 1998.

8. Mayer, R.J.; Cullinane, T.P.; deWitte, P.S.; Knappenberger, W.B.; Perakath, B.; & Wells, M.S. Information Integration for Concurrent Engineering (IICE) IDEF3 Process Description

Capture Method Report. Armstrong Laboratory Report AL-TR-1992-057, May, 1992.

9. OMG, UML Semantics, http://www.rational.com/uml/html/semantics/, 1997.

10. van Harmelen, M.. Website for CHI97 workshop, *Object Models in User Interface Design*, 1997.

11. van Harmelen, M., J. Artim, K. Butler, A. Henderson, D. Roberts, M. B. Rosson, J. Tarby, and S. Wilson. *Object Models in User Interface Design: CHI'97 Workshop Summary*. SIGCHI Bulletin, ACM, October 1997.