CA8120

Georgia Institute of Technology
Office of Contract Administration
PROJECT CLOSEOUT - NOTICE

10-FEB-1999 13:54

Closeout Notice Date 10-FEB-1999

Project Number C-36-W24

Doch Id 41004

Center Number 10/24-6-R0374-0A0

Project Director POTTS, COLIN

Project Unit COMPUTING

Sponsor NORTHERN TELECOM INC/

Division Id 4409

Contract Number AGMT DTD 970317

Contract Entity GTRC

Prime Contract Number

Title SYSTEMATIC DESIGN OF INTRANET SERVICES

Effective Completion Date 31-MAR-1998 (Performance) 31-MAR-1998 (Reports)

Closeout Action:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	03-JUN-1998
Final Report of Inventions and/or Subcontracts	Y	
Government Property Inventory and Related Certificate	N	
Classified Material Certificate	N	
Release and Assignment	N	
Other	N	

Comments

Distribution Required:	
Project Director/Principal Investigator	Y
Research Administrative Network	Y
Accounting	Y
Research Security Department	N
Reports Coordinator	Y
Research Property Team	Y
Supply Services Department/Procurement	Y
Georgia Tech Research Corporation	Y
Project File	Y

NOTE: Final Patent Questionnaire sent to PDPI

C-36-W24
#1

Final Report

Systematic Design of Intranet Services

Colin Potts

Georgia Institute of Technology, College of Computing

June, 1998

Summary

The Systematic Design of Intranet Services (SDIS) project was funded by NTT Multimedia Communications Laboratories from 1996 to 1998.

Background

The SDIS project grew out of a long-standing collaborative arrangement between Georgia Tech, College of Computing and NTT Software Laboratory, which started with Kenji Takahashi's visit to Georgia Tech (1992-1993) and collaboration with Colin Potts, Potts's visit to the NTT Software Laboratory in Musashino in 1994. The SDIS project has continued that collaboration by funding the completion of (now) Dr. Anna A. Anton's dissertation research under the supervision of Potts and Dean Peter Freeman.

Previous work involving Georgia Tech and NTT had led to the development of the Inquiry Cycle model of requirements elaboration and early design, in which an evolving artifact, such as a requirements specification or collection of interaction scenarios, is subjected to questions or issues the resolution of which lead to refinements of the artifact or creation of new ones. The aim of the program of research was to develop a framework for methodology-specific or domain-specific issues and candidate refinements that would help a team of designers and customer stakeholders converge more rapidly on an effective design. In particular, we were interested in restricting our attention to the development of corporate information systems and applications that might be used across organizational boundaries and be based on a hypermedia infrastructure such as HTTP and the WWW.

This effort was part of a broad effort directed by Potts into requirements and early design methods as inquiry-driven processes. Other aspects of this research have been funded by NSF, DARPA, Motorola Cellular Infrastructure Group, an E-Systems fellowship, and Georgia Tech seed funding. Cross-fertilization between this project and the others are described in the final section.

Research Results

Our previous work had looked at the elaboration of requirements for new systems from enterprise goals and from the investigation of envisaged scenarios of use. However, we had not attempted to systematize the questions that should be asked at different stages of the inquiry process or the types of refinement that would lead to rapid convergence on an effective design. For this phase of the research, we investigated these issues more fully, particularly in the case of goal refinement.

The goal refinement methodology that has resulted, GBRAM ("Goal-Based Requirements Analysis Method") was developed from several sources of information. Our initial input was formed by reflecting on previous less systematic case studies (less systematic with respect to goal refinement, that is), including several business process reengineering or business process modeling case studies at Georgia Tech and the US Air Force, and the YPIN on-line information service. Goal refinement is an active area of research in requirements engineering, and compatible though different efforts are underway in Prof. Mylopolous's and Prof. Yu's groups at the Univ. Toronto, and Prof. Van Lamsweerde's group at the Univ. Louvain (Belgium). In addition, goal refinement plays a significant role in the CREWS effort in Europe, which involves research teams from Univ. Paris, Univ. Aachen, City Univ., London, and Univ. Namur (Belgium). Finally, but most importantly, our input came from case studies to which we applied early versions of GBRAM and which led to refinements in the method's stages and heuristics.

In this phase of our research, we have concentrated on two case-study applications: the Commercenet web server's functionality as it affects consortium membership and access to consortium intellectual property; and the requirements for a support technology for inquiry-driven refinement of application goals into detailed requirements. The first application was selected based on NTT's involvement in Commercenet and leadership role in the web site design and technology support. It afforded a fine opportunity to practice the "Industry-as-Laboratory" action research methodology that we had previously adopted in the elaboration of the requirements for the YPIN service in Japan.

The second application was driven by a concern that we adopt our own recommendations and evaluate them in the context of real, day-to-day use. We emphasize design methodology and principles rather than support technologies, but many design principles are impractical unless supported by computer-based tools, a claim that also led to the earlier development of Tuiqiao and Ecolabor, and we decided that we needed support technology for GBRAM that went beyond the simple diagram drawing and outline processing functionality of generic office software packages. Since we decided to implement a prototype support tool for GBRAM, GBRAT ("Goal-Based Requirements Analysis Tool") as a proof of concept, and since GBRAT would be a web-based application, we were committed to use GBRAM to elaborate its requirements.

GBRAM involves two principal stages: goal analysis, and goal refinement. Analysis of goals includes the analysis of input data (such as interview responses, written policies, existing requirements lists, mission statements, etc.), the identification of goals and responsible agents from the available documentation, and the organization of goals into dependency networks. Refinement of goals involves the pruning of the goal set, the elaboration of goals to take account of potential obstacles to their achievement, and the translation of goals into operational behaviors required of the proposed system. Scenarios are used primarily during the elaboration activity to support the discovery of obstacles (exceptional events or violated assumptions) and the validation of the adequacy of proposed strategies for overcoming these obstacles.

Our original intention had been to emphasize the refinement of goals into the organizational principles for web sites and web-based information delivery applications. However, it soon emerged that the complexity of the applications we were studying derived more from the actions they were required to perform and that they demanded from their users and other information providers than from the presentation structure of the information they contained. As a result, the "operationalization" of goals into requirements in GBRAM takes the form of desired system behaviors, not static information structures. The web-based applications that we have studied, therefore, are applications that are or could be part of an intranet and which depend on a heterogeneous corpus of online information (e.g. membership information in the case of the Commercenet web server and requirements-related information and documents in the case of GBRAT).

As a result of our own experiences, we have become as concerned as many other practitioners and RE and HCI researchers that a purely analytic approach to the elaboration of requirements, whether based on goals, scenarios, objects, states or any other basic category, often misses contextual factors, a full knowledge of which is needed for systems to fit their contexts of use. The problem is essentially this: even if you can elaborate the requirements as articulated by the customer effectively and efficiently, what you have been told and inferred by asking questions may not overcome the problems that the customer organization really encounters in practice. The resulting system may therefore be based on a relatively complete set of requirements but still may fail to satisfy its principal stakeholders. Methods for studying contextual factors of the kind that customers tend to neglect or be unaware of have been developed for very different purposes in the social sciences, particularly the ethnographic methodology of some forms of sociology and cultural anthropology, and there is great interest currently in applying these methods to study user organizations during the early stages of design interventions. Such methods are inquiry-driven, but are typically not conducted through the media of requirements interviews, directed meetings, or electronic communications such as e-mail or Ecolabor-like discussion support tools.

As part of parallel research projects, we had been investigating both the theoretical foundations of ethnography-driven design and the practical integration of contextual investigations with more traditional, analytic inquiry methods. We concluded the current study, therefore, by initiating a project to integrate contextually gathered information about user organizations into the inquiry cycle. The context that we have been exploring has been provided by an architecture firm in Atlanta, Portman Associates, which is the principal design organization in a multinational architectural construction project that involves a Korean client and architecture firm, a multinational engineering construction management company based in the UK, many engineering consultant firms throughout North America, and the local authorities at the site location in the Peoples' Republic of China. The application domain we are concerned with is not architecture itself so much as multi-organization design coordination and concurrent engineering, and our thesis is that requirements for general-purpose coordination support systems cannot be gathered effectively by purely rationalistic activities when the principal stakeholders come from different countries and professional cultures. Instead, rationalistically-gathered requirements must be supplemented by those induced from directed observational methods, qualitative interviews, and the analysis of project artifacts such as planning documents and design models produced by specific design projects.

So far, this work has led to the submission of two papers to international conferences. These concentrate on the coordination needs of such projects, rather than the design method used to obtain them. Methodological work is continuing, however. (See below.)

Publications and Presentations

The following publications, many also involving conference presentations, were produced during the performance of the work:

Anton, A. I., Goal-Based Requirements Analysis, Proc. 2nd Int. Conf. Requirements Eng. (ICRE'96), Colorado Springs, CO: April, 1996. IEEE Comp. Soc. Press, pp. 136-144.

Anton, A. I., Goal Identification and Refinement in the Specification of Software-Based Information Systems, Ph.D. Thesis, Georgia Institute of Technology, June, 1997. (Also available as UMI Microform 9735409, UMI Dissertation Services, Ann Arbor, MI)

Anton, A. I., E. Liang, and R. Rodenstein, A Web-Based Requirements Analysis Tool, Proc. 5th Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises (WET-ICE'96), Stanford, CA. June, 1996. IEEE Comp. Soc. Press, pages 238-243.

Anton, A. I. and C. Potts, The Use of Goals to Surface Requirements for Evolving Systems, Proc. Int. Conf. Software Eng. (ICSE'98), Kyoto, Japan, April 1998.

Eastman, C., I. Hsi, and C. Potts, Coordination in Multi-Organization Creative Design Projects. Submitted to Conference on Cooperative Information Systems (CoopIS'98), New York, NY, August, 1998.

Potts, C. and Anton, A.I., A Representational Framework for Scenarios of System Use, submitted to IEEE Trans. Software Engineering special issue on Scenario Management, Fall, 1998.

Personnel

Most of the work involved in the project was performed during Annie Anton's dissertation research, which was jointly supervised by Dean Peter Freeman and Potts. Anton graduated in June, 1997, and took a faculty position in the University of South Florida, College of Business Administration (Tampa, FL). Subsequently, she moved to the School of Engineering at North Carolina State University (Raleigh, NC). According to faculty at both universities, experience that Anton obtained during this project and its predecessors in formulating and conducting industrially sited research was a factor in their hiring decisions.

The data gathering regarding coordination in the multidisciplinary, multicompany architecture project was performed by Idris Hsi, a Ph.D. candidate in the College of Computing, Georgia Tech under the supervision of Prof. Chuck Eastman and Potts. Hsi's background is in psychology and industrial engineering. He is a former student of Prof. Ed Hutchins (Univ. California at San Diego), who is a renowned expert on team coordination.

Associated Activities, Publications and Future Plans

The current project has benefited from and has benefited other parallel efforts. Research into goal refinement and the coverage of scenario analysis by Potts is being funded by NSF. That project and GBRAM have led to ScenIC, a scenario-based instantiation of the Inquiry Cycle that forms the forward-engineering part of MORALE (Mission-Oriented Architectural Legacy Evolution). MORALE, which is funded by DARPA under the EDCS (Evolutionary Development of Complex Software) Program, involves several faculty members and graduate students at Georgia Tech in addition to Potts, the faculty being Profs. Gregory Abowd, Ashok Goel, Melody Moore (now Georgia State Univ.), Spencer Rugaber and Mike McCracken. A ScenIC tutorial exists (it was given at ICSE'98) and tool support (ScenIC View) is planned that will derive from GBRAT.

The importance of contextual information for design is described in Potts's RE'97 keynote talk. Specific contextual studies relevant to the software design process have been undertaken by Potts & Lara Catledge with the support of Motorola, and additional work is being conducted by Potts, Eastman and Hsi in the context of a multiorganization architecture and construction project. Potts and Hsi previously published a paper on the integration of goal-based requirements of the kind generated by GBRAM or ScenIC with contextual information. This work is continuing and will lead to a contextual or ethnographic data gathering approach ("EthnIC") and its integration with ScenIC.

Prof. Jay Bolter (School of Literature, Communication and Culture) and Potts, whose earlier collaboration with Prof. Badre on Synthesis contributed ideas to the Ecolabor environment, are working with a student project class to design a series of volatile hypermedia applications for idea processing and annotation. These applications, initially mimicking gIBIS and Synthesis and a simple CPM-planner, are based on a single platform, Thinklink.

Finally, we are formulating a meta-level analysis of the Inquiry Cycle as a framework for describing, comparing and creating design and planning methods.