E-NEGOTIATION SYSTEMS DESIGN ISSUES

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Abstract: Most design frameworks for e-negotiation systems have focused on achieving higher efficiency and lower transaction costs and, to a lesser extent, easy development and deployment. However, they have neglected the most important element in a negotiation: the user. In fact, no framework has properly addressed usability requirements. Usability must not only be the cornerstone of e-negotiation systems, but also serve as a driver for their development. This paper presents the five phases essential to an e-negotiation system development process and addresses how usability requirements and evaluation should be used to guide the process.

1 INTRODUCTION

The Internet has reshaped the way users and organizations carry out their tasks. From a business perspective, it has served as a platform through which services are delivered to customers and it has been used by companies to stay nimble within an extremely competitive market. From a societal perspective, it has been used to facilitate large scale decision making and conflict resolution.

Negotiation is a process by which agents (humans or software agents representing the interests of their owners) conclude deals, resolve conflicts, or make decisions. Negotiation mechanisms (also called protocols) range from auctions and bargaining to motion-raising and voting. When a negotiation process relies on electronic means (such as the Internet), it is referred to as an electronic negotiation (e-negotiation). A system implementing or supporting an e-negotiation process is known as an e-negotiation system (ENS).

Three categories of ENSs have been identified in the literature (Bichler et al., 2003): *negotiation support systems* assist negotiators with communication and decision making tasks; *negotiation software agents* replace negotiators in their communication and decision making tasks; and *e-negotiation media* provide a platform that implements a negotiation protocol.

An ENS is usually more complex than a traditional catalogue-based e-commerce application because in an ENS:

1. Interactions are more complex - An ENS has to support a wide range of sophisticated negotiation protocols.
2. Interactions need to be clearly described and defined - Interactions must be captured and described in a way that allows participants to consult and understand the protocols to be followed during the negotiation process.
3. Market conditions as well as societal conditions change rather frequently and so do the underlying negotiation protocols - The ENS designer should be able to modify the negotiation protocol easily and quickly and without risk of introducing errors, inefficiencies or inconsistencies.
4. Negotiation mechanisms need to be verified before operational use - A negotiation protocol must be formally described to allow automatic checking for consistency, correctness and completeness.
5. User demands change very often - An ENS must therefore meet user demands suitably and promptly.

ENS design requires not only a framework to provide designers with concepts, methodologies, tools, and techniques, but also a way of tying together a set of components into a useful ensemble in order to systematically develop a complete, correct, and consistent application. A design framework should support both *simplicity* (to ease integration and promote reusability by simplifying interfaces to other systems and subsystems) and

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thought through design with methodological support regardless of system requirements.

There have been several initiatives, some of them discussed in Section 2, aiming to support the ENS development process, but most lack a systematic approach which we believe is essential in view of the increasing role that ENSs are set to play in the context of e-business and e-government. Furthermore, most existing ENS design frameworks have focused on achieving higher efficiency and lower transaction costs and, to a lesser extent, easy development and deployment. However, they have paid little attention to the most important element in a negotiation process: *the user*.

This paper reports on our ongoing research to devise an ENS development process. We identify two phases within the process which address ENS particularities: *requirements gathering* and *architectural design*. We focus on usability as a way of ensuring that ENSs meet user needs.

To support interoperability during architectural design, we follow a service oriented approach where a collection of services with well-defined interfaces are designed and composed into useful negotiation services to be deployed on the ENS.

Section 2 discusses ENS design challenges. We present a five phase ENS development process in Section 3. Section 4 discusses the need for adding usability to an ENS development process. Concluding remarks are provided in Section 5.

2 E-NEGOTIATION SYSTEMS DESIGN CHALLENGES

Several efforts (Benyoucef et al., 2000; Neumann et al., 2005; Kim et al., 2006; Strecker, 2006; Bartolini et al., 2001; Bartolini et al., 2006; Strobel, 2003) to provide a framework for designing ENSs have been made. Most address specific phases of the ENS development lifecycle. However, they lack an engineering perspective which would provide a more systematic way of developing such systems. A discussion of three prominent frameworks is given next.

2.1 Prominent Design Frameworks

CAME (Computer Aided Market Engineering) (Neumann et al., 2005) is a framework aimed at supporting a market engineering process with a focus on designing electronic markets. The approach makes use of MML (Market Modelling Language) (Mäkiö, 2005) to allow a designer to configure the rules of an auction by describing a set of parameters. An executable auction based platform is then generated automatically. Most of the work within the CAME project has been restricted to auctions, and the framework requires knowledge of MML and market modelling, which may not be intuitive enough for designers.

A context-independent framework for developing ENSs was proposed in (Kim et al., 2006). It makes use of the well known Model-View-Controller (MVC) design pattern in order to promote modularity, reusability and, as a result, reduce system development effort. The general framework is aimed at providing a generic platform which can support multiple ENSs, and a platform called Invite has been developed to explore the approach further (Strecker, 2006). One reason for using the MVC design pattern is the flexibility it can provide in user interface design. However, this task may become difficult when dealing with the design of complex negotiation scenarios because MVC components are, in general, tightly coupled and thus become hard to deal with. Moreover, a not so user friendly table-based specification has been used for configuring the negotiation rules.

Generic Negotiation Platform (GNP) (Benyoucef et al., 2000) was aimed at supporting several negotiation protocols. Within GNP, the interplay of negotiations is captured in iterative patterns, called rounds, using Statecharts. GNP is a componentized approach since its architecture clearly separates application logic (i.e., business rules) from the server component (i.e., the platform). This allows for an easy deployment of new negotiation applications.

In addition to a lack of (or insufficient / non-structured / non-documented) design process, a thorough review of the literature shows that ENS design has neglected an important element in a negotiation process, which is the *user*. No approach has addressed usability requirements. We believe that usability must not only be the cornerstone of such systems, but also serve as a driver within their development process.

Next we discuss the need to provide a systematic way of developing ENSs.

2.2 The Need for a Process

The interplay of activities in an ENS development process calls for continuous communication between stakeholders (designers, market makers, third party service providers, regulators, etc.). In addition, design activities depend on appropriate methods for

describing the artefacts produced during every development phase.

An ENS development process should provide guidelines, from a software engineering perspective, to be followed so that the resulting application will meet all requirements. The process must be used from the conception of the ENS application through requirements gathering and onto deployment. In fact, Fuggetta defines a software process as *"the coherent set of policies, organizational structures, technologies, procedures, and artefacts that are needed to conceive, develop, deploy, and maintain a software product"* (Fuggetta, 2000).

An ENS is usually an online interactive application through which participants interact with each other using a variety of negotiation protocols. Most of these interactions generally take place using high speed public and private communication networks. Also, an ENS shares the following characteristics with other categories of web-based applications:

1. Such systems are usually used by large numbers of users. The eBay online auction system (which is an ENS) is a good example.
2. Such systems may have some of their components modified over time, thus requiring dynamic updates with minor downtimes for their users. It is not unusual that the market maker decides to introduce a new negotiation protocol or to modify an existing one within an ENS.
3. Constant improvements in information and communication technologies require fast updates of such systems to keep up with the pace of the advances.
4. The characteristics and functionalities of such systems can evolve as new demands arise, which requires rapid ways of inserting, removing, updating, and maintaining system functionalities.

Efforts at addressing the design process for web-based applications are described in (Ginige and Murugesan, 2001a; Ginige and Murugesan, 2001b; Lowe, 2003). Parts of these efforts provide the foundations for *web engineering* as discussed in (Deshpande and Hansen, 2001) and more recently in (Pressman, 2005), and address specific activities of a process ranging from requirements elicitation and analysis through architectural design to implementation and testing.

While ENSs and other web-based applications carry similarities as aforementioned, ENSs have their particularities. For instance, some ENSs are required to support multi-attribute negotiations, multi-criteria decision making, and multiple interdependent issues in contract negotiation, which calls for an appropriate development process to support such needs. Also, differently from most web-based applications, ENSs borrow knowledge from a broad rage of disciplines such as economics, management science, information systems, game theory, and computer science. To meet the requirement of evolving negotiation protocols, whether the ENS is under development, in an evolving phase, or in-use, the ENS development process must be evolutionary rather than static.

A key issue for an ENS development process is usability. The process should be usability-driven in the sense that user requirements must be taken into account during the development process.

3 DEVELOPMENT PROCESS FOR E-NEGOTIATION SYSTEMS

Despite the initiatives discussed earlier and the recent advances in ENS development approaches, the development process for ENSs lacks a software engineering perspective which would allow for such systems to be conceived, built and deployed in a predictable, reproducible and traceable fashion. However, we do not intend to propose a new process, but rather shed light on how to address the specific development needs of an ENS.

The usability requirements determine the success or failure of a system in that they comprise the user acceptance level given in terms of user satisfaction and performance. To address this issue, designers need to find out what the users want and require from a system. In other words, they should have the premise that "*any system designed for people to use should be easy to learn (and remember), useful, that it contains functions people really need in their work, and be easy and pleasant to use*" (Gould and Lewis, 1985).

Previous approaches have focused too much on system requirements and not enough on users. To address this issue properly, usability should not only be part of the overall system requirements, but also serve as a driver for the ENS development process. One way of doing so is to introduce a requirements gathering phase into the ENS development process, then put an emphasis on the system's usability throughout the various phases of the process.

In addition, we consider that a process needs to be configurable so that it can be customized to meet the requirements of a system under development.

From a software engineering perspective, an ENS development process should include the following phases:

Requirements Gathering - It is concerned with understanding system and user needs. That is, this phase aims at understanding the nature of the system to be developed and the required functionality. Within this context, the main objective is to capture the system's organization. This organization is viewed as a collection of components and users. In addition, this phase aims at identifying the role that each entity will play.

Interaction Scenario Development - The designer must describe interaction scenarios involving the users of the system in order to identify their goals and tasks. All interaction details such as the kind of information exchanged between participants are abstracted out. The focus is on the interactions between participants.

Architectural Design - A system is described in terms of its architectural model.

System Building and Testing - This phase comprises all implementation activities where system components are implemented and integrated to the main system (i.e., the ENS application). Testing is carried out to verify if the desired functionalities have been correctly delivered.

System Deployment - This phase comprises a set of activities that aim at delivering the system to the users.

For an ENS development process the two important phases are *requirements gathering* and *architectural design*. These phases call for the use of appropriate modelling techniques to facilitate the design and not to hinder the system's capabilities. A modelling approach for negotiation protocols within the ENS development process should take into account the need of negotiators to agree on the negotiation protocol before they engage in the negotiation process, which means that the resulting model of the negotiation protocol must be understandable by human negotiators and usable by automated systems (i.e., negotiating software agents). Furthermore, the model of the negotiation protocol should be used to configure the ENS in a "plug-and-play" fashion.

For instance, in our research we address the configurability of an ENS by separating the negotiation protocol from the main component (called the engine) of an e-negotiation media (as seen in Section 1, an e-negotiation media is one of the three ENS categories) (Benyoucef, 2007). Furthermore, using Statecharts as a modelling language allows the ENS designer to capture most negotiation protocol requirements and then have them mapped into an executable process. In our case, the Statechart describing the negotiation protocol is mapped into a web service orchestration described in the BPEL4WS language (BPEL4WS, 2006). A procedure to map Statechart models into BPEL4WS specifications is given in (Benyoucef, 2006) and it aims at minimizing the effort of designing and deploying an ENS. Using web service orchestrations to implement negotiation processes is a way of supporting interoperability which is inherent to the service oriented approach.

The service oriented approach also allows for both development and deployment of ENSs to be carried out in a cost-effective way while fostering application integration. The reasons are:

1. Web services improve Internet use by enabling program to program communication;
2. Application integration can benefit from the widespread adoption of web services;
3. Interactions between negotiation participants are complex and dynamic and, thus require mechanisms to deploy services to customers faster and at a lower cost;
4. By using web services, interoperability can be achieved within and between e-negotiation systems.

The development process discussed earlier is supposed to provide support to and be influenced by:

- *Context* (i.e., the resulting ENS design should tackle different contexts specific to the business environment, for instance different negotiation protocols for different situations);
- *Usability* (i.e., users and organizations involved in negotiations must have their demands and requirements met).

Context and usability are used in the process as triggers to make iterations, thus to enhance and/or cause redesign with the aim of delivering the right ENS to the users.

4 USABILITY IN E-NEGOTIATION SYSTEMS

An ENS requires evaluation in order to check whether organization and user requirements are being met, which will determine the acceptance of the ENS. Before committing to a usability

evaluation technique, designers need to identify the measurement criteria to adopt. One example of such criteria is the number of favorable user comments. Another example is the time to complete a transaction. This is an important criterion for a system that handles a large number of transactions such as the eBay ENS which has over 200 million registered users worldwide.

Usability evaluation techniques can be *empirical*, *automated*, *formal*, and *informal*. Examples of such approaches comprise: *heuristic evaluation*, *surveys*, *observations*, *usability testing*, and *data logging*.

Heuristic evaluation (Nielsen, 1999), also known as reviews, is a technique to find usability problems by checking whether heuristics (i.e., largely accepted usability principles) are being met or not within system design. It is a cost-effective method, easy to learn, and easily to apply.

Cognitive walkthrough (Wharton et al., 1994) is a usability investigation method where one or more evaluators make a usability inspection by going through a set of tasks and evaluating the ease of learning and understandability. This method considers that users prefer to learn new system functionalities by adopting a trial-and-error approach.

Surveys form another usability evaluation technique that can be performed using questionnaires or interviews. It has usually been used to assess user needs as well as to gather data for a large variety of purposes. If questionnaires are used to conduct the usability inspection, they can be either delivered online or in person. Online questionnaires have a low cost and can provide results faster. However, results may not be as precise as hoped, unless careful attention is paid to the participants and conditions of the survey.

Observation is another usability evaluation technique which involves watching and monitoring the activities of users. It is somewhat subjective, and interpretation of the findings is necessary. Moreover, collecting data using this technique is time-consuming. An example is Ethnography (a technique originally developed by anthropologists where they spend long periods of time in foreign societies aiming to understand the social mechanisms). Within a design context, the major objective is to achieve a thorough understanding of work practices in order to better support the system's design. This is an approach that has been receiving increasing interest. By having its starting point anchored in the Social Sciences and Humanities, it brings a provoking and relevant perspective into the design of software applications. The focus is on the detailed analysis of current work practices, as viewed by the people who actually do the work. According to (Blomberg et al., 1993), the four main principles that guide the ethnographic work are: *(1) First hand encounters*: a commitment to study the activities of people in their everyday settings; *(2) Holism*: a belief that particular behaviors can only be understood in the everyday context in which they occur; *(3) Descriptive rather than prescriptive*: describe how people actually behave, instead of how they ought to behave; and *(4) Members' point-of-view*: describe the behavior in terms relevant and meaningful to the study participants.

Usability testing (Dumas and Redish, 1999) is derived from experimental procedures and is more appropriate to be applied during system development. Usability testing usually takes place in a usability laboratory where people can be gathered to perform tests. During experiments, evaluators monitor and record tasks being carried out by individuals who take part in the test.

Data logging and metrics both involve accumulation of numeric data (NIST, 2007). Data logging provides a way to quantify online activity while metrics can be used as measures to quantity activity in online applications. Thus, online activities can be described and quantified provided that a set of metrics is developed.

The reader is referred to (Nielsen and Mack, 1994) for other usability inspection methods and a broader discussion on the topic.

Choosing a suitable method for evaluating system usability depends mainly of the universe of system users. Although surveys and usability testing are powerful techniques, they serve mainly to point out major usability problems, and results may not be precise unless careful attention is paid.

Our current investigation considers the use of a heuristic evaluation approach which relies on a set of evaluation sessions carried out by one or more experts in order to identify usability problems of an ENS under development. Such heuristics aim, for instance, at checking if:

1. The dialogue is carried out in a simple and natural fashion;
2. The system is minimalist in the sense that it does consider the human memory constraints;
3. The system offers proper user feedback;
4. The system supports consistency and its state is clearly identified by users.

We are in the process of evaluating the usability of several ENSs, some of them from academia (e.g., INSPIRE) and some from the business world (e.g.,

eBay). We plan to report on the results of the evaluation soon.

5 CONCLUSION

In this paper we reported on an ongoing effort to identify what is missing from the design process of e-negotiation systems. We identified requirements gathering and architectural design as two phases within the process that address the particularity of e-negotiation systems. We emphasised on usability as a way of meeting the needs of the users. To support interoperability during architectural design, we proposed a service oriented approach where a collection of services are designed and composed into negotiation services that are deployed on the e-negotiation system. A thorough evaluation of the usability of several e-negotiation systems from business and academia is in progress. We will report on its results when it is completed.

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REFERENCES

Bartolini, C. and Preist, C., *A Framework for Automated Negotiation*, HP Labs Bristol, Tech Report HPL-2001-90, 2001.

Bartolini, C., Preist, C., and Jennings, N. R., *A Software Framework for Automated Negotiation(Revised and Updated)*, HP Labs Bristol, Tech Report HPL-2006-33, 2006.

Benyoucef, M. and R. Keller and S. Lamouroux and J. Robert and V. Trussart, *Towards a generic e-negotiation platform*, Proc. of the Sixth Conf. on Re-Technologies for Information Systems, pp. 95-109, Zurich, Switzerland, 2000.

Benyoucef, M. and Rinderle, S., *Modeling e-Negotiation Processes for a Service Oriented Architecture*, Group Decision and Negotiation Journal 15:449-467, 2006.

Benyoucef, M. and Verrons, M. H., *Configurable e-Negotiation Systems for Large Scale and Transparent Decision Making*, Proceedings of the GDN'2007 (to appear), 2007.

Bichler, M, Kersten, G, and Strecker, S., *Towards a Structured Design of Electronic Negotiations*, Group Decision and Negotiation Journal 12:311-335, 2003.

Blomberg J. et al: *Ethnographic Field Methods and Their Relation to Design*, Participatory Design: Principles and Practices (D. Schuler and A. Namioka – Editors), Lawrence Erlbaum Associates, 1993, pp. 123-155.

BPEL4WS, *Business Process Execution Language for Web Services* – Version 1.1, http://www-128.ibm.com/developerworks/library/specification/ws-bpel/, Accessed March 2006.

Deshpande, Y., and Hansen, S., *Web engineering: creating a discipline among disciplines*. *IEEE Multimedia,* (April - June), 82-87, 2001.

Dumas, J. S. and Redish, J. C., *A Practical Guide to Usability Testing*. Intellect, 1999.

Fuggetta, A., *Software Process – A Roadmap*, Proceedings of the ICSE, pp. 25-34, 2000.

Ginige, A., and Murugesan, S. (2001a). Web engineering: An introduction. *IEEE Multimedia, 8*(1), 14-18.

Ginige, A. and Murugesan, S. (2001b). The essence of Web engineering: Managing the diversity and complexity of Web application development. *IEEE Multimedia, 8*(2), 22-25.

Gould, J. and Lewis, C., Designing for Usability: Key Principles and What Designers Think, Communications of the ACM, Vol. 28, No. 3, pp. 300-311, March 1985.

Kim, J., Kersten, G., Strecker, S. and Law, K. P., *Developing Context-Independent E-Negotiation Systems using Software Protocol and Model-View-Controller Design Pattern*, Proceedings of the Montreal Conference on e-Technologies (MCeTech), 2006.

Lowe, D., *Web system requirements: An overview*. *Requirements Engineering, 8*, 102-113, 2003.

Mäkiö, J., *Designing and Modeling B2B-Markets*, Frontiers of E-Business Research, pp. 292-303, 2005.

Neumann, D., Mäkiö, J. And Weinhardt, C., *CAME – A Tool Set for Configuring Electronic Markets*, Proceedings of the ECIS, 2005.

Nielsen, J., *Designing Web usability: The practice of simplicity*, New Riders Publishing, 1999.

Nielsen, J. and Mack R., Usability Inspection Methods, John Wiley and Sons, 1994.

NIST. *Web Metrics: Technical Overview*, NIST (National Institute of Standards and Technology), http://zing.ncsl.nist.gov/WebTools/tech.html, accessed in March 2007.

Pressman, R.S., Applying Web Engineering, Part 3. *Software Engineering: A Practitioner's Perspective* (6th ed.). New York: McGraw-Hill, 2005.

Strecker, S., Kersten, G., Kim, J. and Law, K. P., *Electronic Negotiation Systems: The Invite Prototype*, Proceedings of the Collaborative Business MKWI'06, Passau, Germany, 2006.

Strobel, M and Weinhardt, C., The Montreal Taxonomy for Electronic Negotiations, Group Decision and Negotiation 12: 143-164, 2003.

Wharton, C. et al, *The Cognitive Walkthrough Method: A Practitioner's Guide*, in J. Nielsen and R. Mack "Usability Inspection Methods", Wiley & Sons, pp. 105-150, 1994.