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GOAL-BASED WEB DESIGN TOWARDS BRIDGING THE GAP BETWEEN REQUIREMENTS AND DESIGN OF WEB APPLICATIONS

Introduction and research questions

In the last five years we have seen a rush in building web sites, sometimes designed just for the reason of being “on the web”. As companies began to realize that keeping a site current, accurate and alive was very expensive, they tried to invest in promotional strategies for increasing site traffic. Some sites (few) succeeded; others (a lot) failed. Now, it is becoming more and more evident that investments in building and promoting web sites will likely have no return if the goals of the site are unclear and, most of all, if the actual relevance of the services offered by the site for all the involved stakeholders (including end users) have not been even investigated. The activity where these issues are explored and investigated is traditionally called “requirements analysis”¹ and it is acknowledged as being the cornerstone of any communication project, as well as of the development of large software systems. Given these premises, relevant research questions that remained as far as now uncovered in web application requirements analysis concern two aspects:

1. *Systematic organization of the requirements.* How can requirements for web application be defined and effectively documented? How can requirements be described in such a way that they do not introduce premature design decision and, at the same time, they are understandable by the design team?

¹ Requirements analysis is different from requirements elicitation, i.e. the phase in which requirements are made surface and gathered. The phase of requirements elicitation is not central to this work.

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2. *Bridging the gap between requirements and design.* How is it possible to take into account the goals of the stakeholders during the design of a web application? What are the reasons behind design decisions?

Taking into account aspects 1) and 2) above, the overall research question to be explored is: *How do the stakeholders' goals reflect onto the actual design of a web site?* Thus, the aim of this research is to define a model for the requirements analysis specific and tailored for web applications. Such general issues about requirements analysis concern any application domain. Thus, they are relevant also for web sites having an educational purpose.

Background

The activity of requirements analysis have been deeply studied in the field of Software Engineering.

Among the large family of techniques developed within this community, the methods that are most promising for dealing with web application requirements are the goal-oriented methods. In general, these methods start considering the goals of the application and of the stakeholders, and then refining them into requirements, which represent the actual input for the design activity. The approach that most systematically considers the goal of the systems under construction is the van Lamsweerde's goal-oriented requirements engineering formal model, known as KAOS [Sutcliffe, 2002]. According to this approach, goals of the system are formally defined and analyzed. Conflicts between goals are pointed out. Goals are systematically decomposed in subgoals through a refinement process. *Goals* are eventually refined into *requirements*, which describe the characteristics the system should match. On the basis of KAOS, other goal-oriented frameworks and notations [Sutcliffe, 2002] (such as NFR and I*) have been developed in order to capture non-functional requirements through a goal-based analysis.

Another approach to requirements analysis is GBRAM (Goal-Based Requirements Analysis Model) [Sutcliffe, 2002], defined specifically for software-intensive information systems. GBRAM combines goal-based approaches (used at a higher level of abstraction) with other techniques common in software engineering (e.g. scenarios). In this way, GBRAM captures most of the complexity characterizing the activity of requirements analysis. A positive features of GBRAM is that it describes the goals and the requirements in an *informal* – but precise – way.

As crucial milestone in the field, the requirements engineering community and industry has adopted a standard modeling language (UML) [Sutcliffe, 2002] which allows to document the entire development process of large software systems. As far as requirements are concerned, UML proposes a set of concepts and a standard notation. However, it seems not to be completely effective for capturing the specific features of web application requirements. Some of the reasons are the following: a) UML *actors* identify anything (object or subject) interacting with the system: we need instead to model *stakeholders* who have goals with respect to the system²; b) UML use cases are effective for the functional analysis: high-level goal-analysis instead remains poorly addressed; (c) Hypermedia (especially navigation requirements) features of web applications need a specific requirements definition that UML does not capture because it is too general.

A further research branch that can be relevant for the research at issue can be found in Human-Computer Interaction studies. In this field, the activity of requirements analysis has been explored through the notion of *scenario* [Sutcliffe, 2002]. As effectively defined by Carroll, a scenario is a “*story about use*”. They describe concretely typical user profiles and their behavior during the interaction of the application. Thus, scenarios are malleable tools that greatly help to envision requirements and explore alternative possible design solutions. They represent a powerful technique widely employed for the elicitation of requirements, for the design and evaluation of interactive artifacts.

AWARE in a nutshell

On the basis of the conceptual background discussed above and on the design experience of real web applications, a model for the Analysis of Web Application Requirements (AWARE) [Bolchini & Paolini, 2002] is being defined and assessed. AWARE enables to capture the activity and the outcome of requirements analysis through the concepts that will be briefly defined in the rest of this section.

Stakeholder. A stakeholder is anyone who has an interest in the building and in the success of the web application. Stakeholders are surely the customers and the buyers on one hand, and the user types on the other.

² Some stakeholders identified in the requirements analysis might not interact with the application.

Stakeholders might also be opinion makers, sponsors, the press, content providers, technological partners, etc. All relevant stakeholders should be taken into account during analysis. However, not every stakeholder has the same importance for the analysis and design team. Thus, a *Priority* value (visible only to the analysis and design team) can be assigned to each stakeholder.

Goal. A goal is a high-level target of achievement owned by one or more stakeholders. A stakeholder might own one or more goals. A goal might be more relevant for a stakeholder and less relevant for another stakeholder. Thus, a *Relevance* value (visible only to the analysis and design team) can be assigned to each relationship Stakeholder-Goal.

Refinement/Decision Process. Goals, for them to be of use, have to be refined into lower-level goals. This refinement process is extremely useful because a high-level goal per se does not say much to the designer. It is too abstract, too high-level and too long-term to be fed directly to hypermedia designers. In addition, refining the goals into sub-goals is invaluable for eliciting new requirements, and assessing existing ones. Identifying sub-goals from goals is a complex task. It is concerned with the decisions of evaluating the trade-offs between the goals stated, the resources available and the constraints identified. Thus, it is not a pure derivation but a process of on-going negotiation.

Requirement. The leaves of the refinement graph are the requirements. A requirement represents the operationalisation of a goal. In other words, a requirement is a possible mean to fulfill one or more goals. This means that a requirement turns one or more goals into a concrete specification that a designer can read and take as input for shaping corresponding design solutions (with any design model or method). Requirements can be functional or non-functional, as a standard RE taxonomy suggests. Each functional requirement is labeled according to the *Design Dimension* it gives indications about. A requirement belongs to exactly one dimension; if it cannot be easily and clearly assigned to exactly one dimension, then it is too general to be a requirement and has to be further refined for facilitating the design activity. The hypermedia Design Dimensions identified so far are: Content (C), Structure of Content (S), Access paths to content (A), Navigation (N), User Operation (U), System Operation (O), Presentation (P).

Scenario. For the acquisition and the refinement of goals, scenarios can be extremely helpful to the analyst to figure out concrete behaviors of the system. Scenarios can be defined in concert with some stakeholders and

elaborated upon by the analysts together with the designers. While goals appear quite abstract and context-independent (since they are valid for many situations of use), scenarios add to goals useful details to understand the implications of a real situation of use and to uncover hidden goals. Scenarios and goal-based analysis are thus mutually supportive for the requirements definition.

The goal-graphs for the requirements analysis of the B121 web application (an e-banking web service) and for the requirements modelling of museum web sites with educational purposes [Bolchini & Paolini, 2002] have been done.

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