

Requirements Elicitation in Web Engineering

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Poor and incomplete design causes web systems to fail to meet users' expectations and business' goals. A major cause of failure of these systems is the non-inclusion of key success factors. These factors are incorporated into a cross-relational structure comprised of three axons: socio-cultural characteristics, user requirements and application domain. The present work identifies key success factors in web engineering and proposes a requirements engineering approach for eliciting requirements. The purpose of this method is to provide a simple way for analysts to identify these hidden requirements which otherwise could be missed or given little attention.

Keywords: Key Success Factors, Socio-Cultural Factors, Web Engineering.

1 Introduction

Researchers have recently demonstrated the importance of human, social and cultural (HSC) factors in web engineering, proving that these constitute significant factors which if ignored will lead to poor system design and a departure from business goals. Examples can be found in Fraser and Zarkada-Fraser [1], who have illustrated that ethnic groups follow different decision-making pathways in determining the web site they prefer to buy from, and that significant differences exist between cultures. Furthermore, Olsina, et al. [2] examined the quality of six academic operational sites to understand the level of fulfillment of essential quality characteristics, given a set of functional and non-functional user requirements from the viewpoint of students. The latter work proposed a quality requirement tree specifically for academic domains, classifying the elements that might be part of a quantitative evaluation, comparison and ranking process. In addition, Mavromoustakos et al. [3] examined the importance of human and socio-cultural factors in engineering quality e-learning applications by developing such a system. Papanikolaou and Mavromoustakos [4] have also identified human and socio-cultural factors in the context of mobile learning applications.

While there is a plethora of research works in web site engineering, there is lack of methods for revealing HSC factors and user requirements, which otherwise stay well hidden within the working environment analyzed. The risk of missing the requirements resulting from these factors leads us to propose a novel method to uncover and analyze HSC factors and user requirements, as well as to translate them into system requirements to provide a quality web application. Taking into consideration the importance of immediacy in deploying web applications, an oriented form of ethnography analysis is introduced, which can be conducted in a non-time consuming manner to identify requirements sourcing from HSC factors, based on a certain informational profile developed via focus questions.

The structure of this paper is as follows: Section 2 describes the socio-cultural characteristics, user requirements

and application domain axons and identifies all the key success factors for web engineering under each axon. Section 3 proposes a requirements elicitation method for these critical factors and introduces a special form of ethnography analysis as an information gathering method for web applications. Section 4 sums up the findings of the paper and provides some concluding remarks.

2 Key Success Factors in Web Engineering

In this section, we identify all the key success factors in web engineering. To better visualize and understand these factors and the specific requirements for developing a quality web application we utilize a 3-axon model indicating the

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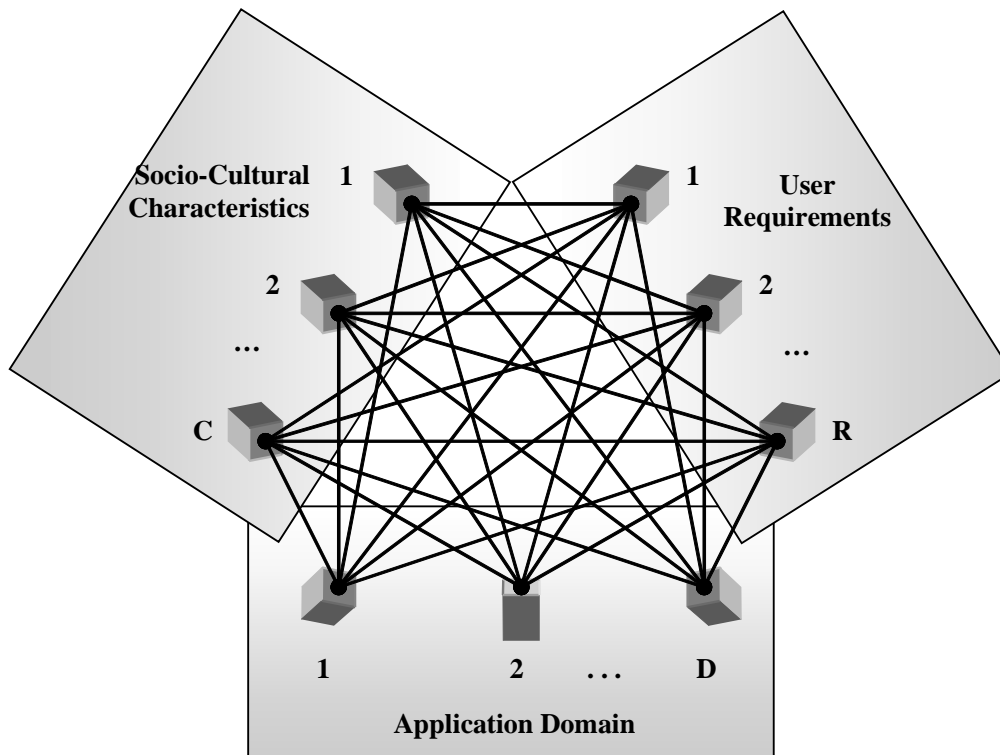


Figure 1: Key Success Factors Interrelationship.

interrelationship. The three axons are: The socio-cultural characteristics, the user requirements, and the application domain axon (Figure 1). Each axon includes certain components, which are directly connected and interrelated. The three axons are also interdependent, allowing the sharing of same, similar, or different characteristics amongst each other (Table 1). A description of each of the axons is presented now.

2.1 Socio-Cultural Characteristics

A web application must be tailored-made for each country or region of countries. In the requirements analysis phase the emphasis should be put on the range of countries which the web application will target and give special attention to the specific characteristics of the region for successful system development. These characteristics include:

Demographics

It is well known that human behavior varies according to gender and age. Therefore, these issues can significantly affect system design. The web engineer or project manager must specify and design the web application based on the targeted population. In addition, when introducing new products and services to a region it is important to have access to the various channels of distribution for achieving short-term and long-term organizational goals.

Social Characteristics

The analyst/developer must examine the educational

system, the literacy level, as well as the languages spoken within the population, in order for the web application to be designed in such a way that will accommodate divergent features. Religion plays a significant role in politics, culture and economy in certain countries. Thus, the analyst must investigate whether religion affects the system design and to what degree.

Legal Characteristics

The political system and legislation among countries vary; therefore one must investigate political stability and all the relevant laws prior to the development of an e-commerce application. National and international laws must be analyzed to guide the system towards alignment and compliance upon full operation.

Technical Characteristics

Identifying the technology level of each targeted country will help the web engineer to decide on the type of technology and resources to use. Countries with advanced technologies and high web usage are excellent candidates for most types of web applications. On the other hand, countries new to the Internet arena will need time to adapt to this challenging electronic environment before taking the risk of doing business on-line.

2.2 User Requirements

The User Requirements axon follows the general software quality standards as defined by ISO 9126 and the web

engineering guidelines proposed by Olsina [2]. Each component is decomposed into several features that must be separately addressed to fulfill these user needs:

Usability

Issues like understandability, learnability, friendliness, operability, playfulness and ethics are vital design factors that web engineers cannot afford to miss. The system must be implemented in such a way to allow for easy understanding of its functioning and behavior even by non-expert Internet users.

Aesthetics of user-interface, consistency and ease-of-use are attributes of easy-to-learn systems with rapid learning curve. web systems, by storing user profiles and taking into consideration human emotions, can provide messages which are tailored to the user, whether this is a welcome message or an order confirmation note, thus enhancing the friendliness of the system. Playfulness is a feature that should be examined to see whether the application requires this characteristic and, if so, to what extent. web systems must reflect useful knowledge which reflects human interactions and decisions.

Functionality

The system must include all the necessary features to accomplish the required task(s). Accuracy, suitability, compliance, interoperability and security are issues that must be investigated in designing a web application to ensure that the system will perform as it is expected to. The web application must have searching and retrieving capabilities, navigation and browsing features and application domain-related features [2].

System Reliability

Producing a reliable system involves understanding issues such as fault tolerance, crash frequency, recoverability and maturity. The system must maintain a specified level of performance in case of software faults with the minimum number of crashes possible. It also must have the ability to re-establish its level of performance.

A system must consistently produce the same results, and meet or even exceed users' expectations. The web application must have correct link recognition, user input validation and recovery mechanisms.

AXON	COMPONENT	DECOMPOSITION
Socio-Cultural Characteristics	Demographics	Gender, age
	Social characteristics	Language, literacy, religion
	Legal characteristics	International and domestic laws
	Technical characteristics	web access, type of technology
User Requirements	Usability	Understandability, learnability, operability, playfulness
	Functionality	Suitability, accuracy, compliance, interoperability, security
	Reliability	Fault tolerance, crash frequency, recoverability, maturity
	Efficiency	Time behavior, resource behavior
	Timeliness	Business goals
	Maintainability	Analyzability, changeability, stability, testability
Application Domain	Informational	Online newspapers, electronic books, newsletters
	Interactive	Registration forms, customized presentations, online games
	E-commerce/Transactional	Electronic shopping, online banking
	Workflow	Online planning and scheduling systems, status monitoring
	Collaborative work environments	Distributed authoring systems, collaborative design tools
	Online communities marketplaces	Chat groups, online auctions
	web portals	Online intermediaries, electronic shopping malls

Table 1. Axon Categorization of the SpiderWeb Model

Country Characteristics	Focus Questions
Demographics	What is the gender and age of the targeted population?
	What are the channels of distribution?
	Are the neighboring countries open for electronic trade of goods and services?
Social Characteristics	What are the main languages spoken in the region?
	What is the religion of the targeted population?
	What is the literacy percentage grouped by gender and age?
	What is the level of efficiency of the educational system with respect to the web?
Legal	Is there political stability in the area?
	Are there any laws that prohibit the electronic sale of certain goods?
Technical	What is the percentage of the targeted population with web access, by gender and age?
	What is the web access rate of increase?
	What is the average transmission speed to browse the Internet?

Table 2: Focus Questions for Collecting Socio-Cultural Characteristics Factors.

Efficiency

A web system’s goal (especially an e-commerce site) is usually to increase productivity, decrease costs, or a combination of both. Users expect the system to run in an efficient manner in order to support their goals. The system’s response-time performance, as well as page and graphics generation speed, must be high enough to satisfy user demands. Fast access to information must be examined also throughout the system life to ensure that users’ requirements are continuously met whilst the system remains competitive and useful.

Maintainability

Some crucial features related to maintaining a web application is its analysability, changeability, stability, and testability. The primary target here is to collect data that will assist designers in conceiving the overall system in the best architectural and modular form from a future maintenance point of view. With the rapid technological changes especially in the area of web engineering, as well as the rigorous users’ requirements for continuous web-site updates, easy system modifications and enhancements, both in content and in the way this content is presented, are also success factors for the development and improvement of a web application. Another important area the researcher must concentrate on is the timeliness of the content (i.e. the information processed within the system), the functionality (i.e. the services offered by the system) and the business targets (i.e. the business goals using the system) the e-commerce system must exhibit. Timeliness is examined through a cultural prism aiming at identifying certain human, social, and organizational needs in all three of its coordinates,

as most of the applications exhibiting a high rate of change often depend highly on the ethos and customs of different people in different countries (i.e. electronic commerce systems).

2.3 Application Domain

The web engineer should investigate users’ satisfaction on existing similar web applications and their expectations on visiting the site. Depending on the type of application (see Table 1) the web engineer should also identify the driving factors users visit, purchase and use the site. Emphasis should also be given on users concerns, feelings, trust and readiness of using a web application. These can be identified through a requirements elicitation process which is proposed in the next section.

3 Requirements Elicitation Process

The description and brief analysis of the axon components presented in the previous section aimed primarily at providing the basic key concepts that developers must utilize to collect proper system requirements. These concepts will be used as guidelines for the significant process of gathering critical information that may affect the functional and non-functional behavior of the system under development. We propose the use of an oriented form of ethnography analysis conducted in a small-scale time-wise manner for collecting and analyzing information for the three axons described before.

Ethnography originates from anthropology where it was primarily used in sociological and anthropological research as an observational analysis technique, during which anthropologists study primitive cultures [5]. Today, this form

of analysis constitutes a valuable tool in the hands of software engineers by utilizing techniques, such as observations, interviews, video analyses, questionnaires and other methods, for collecting human and socio-cultural factors. In a design context, ethnography aims to provide an insight understanding of these factors to support the design of computer systems [6][7][8] [9][10].

This approach offers great advantages in the system development process by investigating these key factors and exploring human activity and behavior that otherwise software engineers would have missed. Examples can be seen in several studies performed in a variety of settings, including underground control rooms [11], air traffic control [12], police [13], banking [14], film industry [5] and emergency medicine [15].

Bearing in mind that ethnography analysis is time consuming by nature and the immediacy constraint in deploying web applications [16], we propose a short-scale form of ethnography analysis, focusing on cognitive factors. Our proposition is based upon examining the existing working procedures of the client organization, either manual or computerized, together with the users' behavior. Specifically, the working environment of the organization and its employees, as well as a group of customers currently doing business transactions with the organization are set as targeted population of the analysis, utilizing this shortened form of ethnography on the three axons of our model. The short-scale ethnography analysis may include observations, in-

terviews, historical and empirical data, as well as questionnaires. Emphasis is given to focus questions produced in the form of questionnaires. These questions are distributed among the targeted group or are used as part of the interviewing process, and the answers are recorded, analyzed and evaluated. Data collection mechanisms, as well as the kind of information for analyzing each primary component in the axons of the proposed model, are defined in the 3-axon approach via a profile shell that web engineers must develop before requirements analysis starts. Each component is associated with suggested focus questions provided in Tables 2 through 4. It must be noted that these are a proposed set of key questions for the analyst to use as guidelines, but he may also enhance the set with other application-specific questions he may regard as equally essential for the application under development.

4 Conclusions

Human, social and cultural factors in web engineering are significant factors which if ignored will lead to poor system design and a departure from business goals. In this paper, we have identified the key success factors for developing a quality web application. These factors are classified into three main axons, namely socio-cultural factors, user requirements and application domain. The 3-axon approach is utilized to better understand their interrelationship. Each axon includes certain components, which are directly connected and interrelated. The three axons are also

User Requirements	Focus Questions
Usability	How do expert and non-expert Internet users understand the system?
	Are easy-to-learn systems too complicated for expert users?
	How do users perceive content layout and how does this affect user retention?
	How does the system handle the conflicting requests for maximum or minimum playfulness?
	How does the content layout (colors, menus, consistency) affect web usage?
	What is the level of sensitivity in ethical issues among the targeted user-group and how does this affect the way they interact with the web?
	What is the level of trust for ensuring privacy?
	How can on-line shopping be more entertaining than in-store shopping?
Functionality	How do users feel with registering to a web application is a prerequisite for accessing its content?
	What is the required level of security of functions, for individuals to provide their credit card for on-line purchases?
	What is the maximum bearable time for users to wait in search for information before dropping the site?
Maintainability	How often will users need to see content updates?
	Are market conditions matured for such a system?
	How do people accept system changes?
Reliability	What is the acceptable fault tolerance that will not drive away existing users?
Efficiency	At what degree users expect to decrease their costs? Can these expectations be met?

Table 3. Focus Questions for Collecting User Requirements.

Focus Questions
Are users satisfied with the current e-commerce sites? What are their recommendations for improvement?
What do users expect to find, shopping in an e-commerce application versus shopping in a traditional store?
How does a user behavior change when using long versus short registration forms?
Are users ready for e-commerce, both in b2b and b2c?
What are the users' feelings and trust on doing business on-line?
What are the users' concerns and doubts on security, product delivery, efficiency, and company legitimacy?
What types of auctions users are accustomed to?
How easily users are affected by outside factors in their shopping decisions?

Table 4: Focus Questions for Collecting Application Domain Factors (e.g. e-Commerce/Transactional System).

interdependent, allowing the sharing of same, similar, or different characteristics among each other. The socio-cultural axon includes demographics, social, legal and technical characteristics of the country or region of countries where the application will be focused. The user requirements axon comprises of all the specific requirements related to usability, functionality, efficiency, reliability and maintainability. Finally, the application domain axon includes all the peculiarities and characteristics of the various types of web applications. In this paper, we also propose a requirements elicitation process for gathering these factors. This process is based on a special form of ethnography analysis which due to the immediacy constraint of developing web applications is performed in a short time-scale. Further work includes the development of a web engineering process incorporating all the key success factors for constructing quality web applications.

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