Improving Web Personalization Re-engineering Processes using Cognitive Knowledge Management

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Abstract

A re-design process implies dealing with complex interactions between stakeholders, especially if we are talking about a personalization re-engineered process, which can be applied to an existing web application. In this context, knowledge becomes a main factor of influence, but the tacit acquisition and application of valuable knowledge is not a simple task. Discovering new ways to achieve, share and re-use available knowledge is a key concern for improving re-design environments. To support this challenge, we address Cognitive Informatics concepts and principles that might help improve knowledge specification and communication.

1. Introduction

Working on web applications arena is not a simple task, in fact, it is still an art. The inherent complexity of these applications faces several problems that some methods, techniques and tendencies help to handle [1][2][3][4]. However, the source of challenges will not run out for a long time. The development of new applications, using software (and web) engineering practices, is only "the tip of the iceberg". To support this statement, it is enough to refer to Internet (and WWW) where thousands of applications, developed with "ad hoc" practices, require substantial evolution. This demand becomes more important in those applications in which the personalization is a key concern. For example, areas like e-commerce are implicitly bounded to web applications fully customizable that completely answer to individual needs of each user or group of users - roles or profiles. Intrinsically, designs of these applications involve diverse issues such as:

- including multiple interfaces, each customized to a specific device
- providing different navigation topologies to different users
- recommending specific products according to user's preferences
- implementing multiple pricing policies

In this sense, good software (re)engineering practices are needed to simplify the critical (re)design decisions in building personalized web applications.

The described situation gave us a motif to develop an approach to carry out a reengineering project for existent web applications. The resulting proposal was a *Reengineering approach for Personalization of existing web applications* [5] made up of two main activities -*Reverse Engineering and Personalization Forward Engineering* - This approach is based on concepts, methods and tools with a forcefulness totally proved by software and web applications engineering [6][7][8][9][10][11][12].

But the fact is that while personalized web applications increasingly require fully and sophisticated kinds of personalization to fulfil user's attention and satisfaction, today's research challenge is discovering new ways and techniques for building good customizable Internet

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applications. A Web application design expects to obtain dynamic software, easily tailored to frequent changes.

When we talk about personalization, two different main perspectives can be taken into account: the first one focuses on technologies as enabling practical and sensible profiles; the second perspective centres their attention on re-design as enabling substantial improvements in Web applications personalization re-engineering processes. This second perspective is our main concern.

At this point, acquiring knowledge is another key concern and the problem of how to acquire knowledge is a central topic of research communities in many software engineering areas. To face this problem, an emerging discipline known as *Cognitive Informatics* is increasingly commonplace. For example, software requirements engineering elicitation - the process of acquiring and discovering preferences and knowledge about the problem domain - can be improved classifying requirements perception [16]. As another example, in a scene where stakeholders are geographically distributed, communication between them can be improved classifying groupware tools by applying learning styles models [17].

Cognitive Informatics (CI) is the transdisciplinary study of cognitive and information sciences that investigates the internal information processing mechanisms and processes of natural intelligence - human brains and minds. Information in CI is defined as "abstract artefacts and their relationships that can be elicited, modelled, represented, stored, and processed by human brains" [13]. CI attempts to solve problems in two connected areas in a bidirectional and multidisciplinary approach. CI uses informatics and computing techniques to investigate cognitive science problems, such as information acquisition, representation, memory, retrieval, generation, and communication.

It is clear that concepts and techniques from this emerging discipline can be applied in all kind of software engineering processes where knowledge discovery from stakeholder's interactions is required (mainly between developers, clients and users). In this direction, currently there are some initial theoretical works and investigation lines. For example, Chiew [14] suggests an approach that introduces a cognitive framework for discovering knowledge; and Walenstein [15] proposes a framework to encourage cognitive support in SE activities.

Applied to our field, re-designing successful personalized web applications requires a dynamic reuse of knowledge from experienced people involved in the processes (current and past ones). To capture this knowledge in a valuable form, cognitive aspects of the personnel must be taken into account, and here is where *Cognitive Informatics* principles might be applied.

This paper is organized as follows. In Section 2, we introduce some basics and motivation for our research line. Finally, conclusions and future work are presented in the last section.

2. Cognition and Personalization: A motivating society

Software development remains mentally challenging not only because of the continual advancement of training approaches, techniques and tools, but also mainly for the complexity of interaction between people during a developing process. Because completely automating software development is currently impossible [15], it makes sense to consider resources and tools to improve the stakeholders' mental activities (especially developers), opening their minds to a productive manner of use and reuse knowledge sources.

Rehäuser [19] defines knowledge as a context (i.e., the personal world of an individual; that is how this individual perceives the real world) which helps individuals and organizations to "understand" the real world. Tochterman [18] states that one can create environments in which knowledge can develop and flourish, and defines knowledge management to deals with: (1) knowledge-friendly environments in witch knowledge can provide individual or organizations, (2) context-sensitive knowledge, and (3) the ability of knowledge workers to apply the knowledge for action. The idea is to derive as much organizational knowledge (i.e., the knowledge stored in an organizational memory) as possible from the knowledge in the minds of the individuals.

Tochterman suggests (see Figure 1) that we should emphasize the process of how individual's knowledge can be best derived from organizational knowledge, integrating personalization concepts in knowledge management on metadata, content and structure.

This could be a great advantage in the way to achieve resources and tools to improve a personalization re-design process, but from our vision, there are main factors that still require to be including in this prescription. The point here is that since the process involves people working together, cognition aspects must been taken into account for discovering, making useful and communicating transferable valuable knowledge. For example, Figure 2 shows a scenario where developers and clients have to talk about an existing application – a current Web site (personalized or not). The clients produce a Re-engineering Directive that they think represent the desired Web site living in their minds. The developers understand these directives according to many factors: previous experiences, personnel preferences, current and desired Web site individual perception, possibility of applying familiar approaches and tools, etc. Simultaneously, accordingly to their business vision, the organization has there own interest in the new application, and two questions become visible: (1) How we recognize that the stakeholders (clients, developers and the organization) are thinking about the same product as a result of the re-engineering process?, and (2) How we can be certain that all helpful available knowledge is shared and understood for an appropriated use and re-use in the process? These kinds of questions are the ones we are trying to give some answers by working with CI concepts.
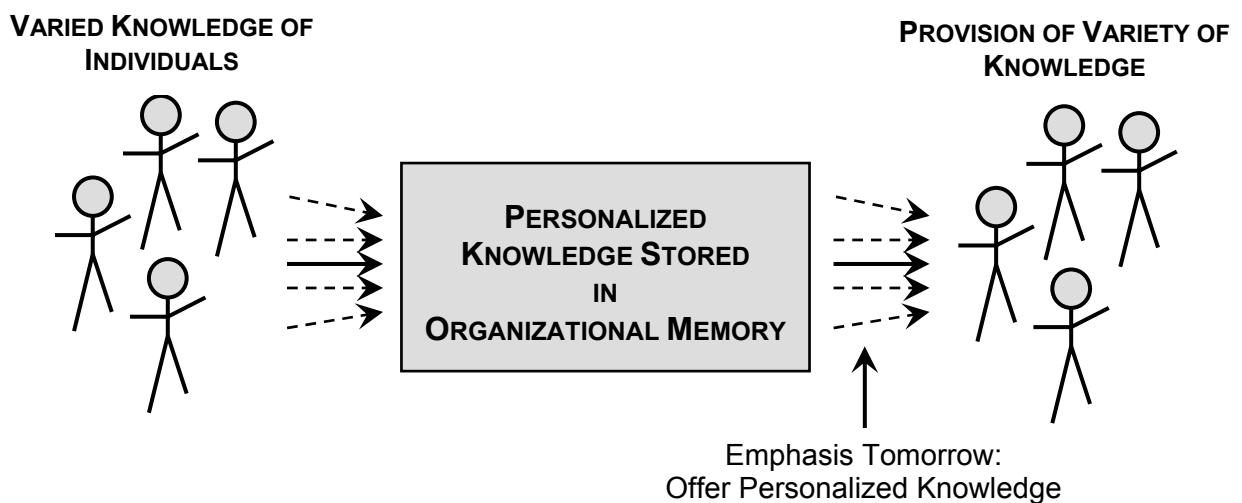

Figure 1 OFFER OF PERSONALIZED KNOWLEDGE AS A CHALLENGE FOR KNOWLEDGE MANAGEMENT
(from [18])

3. Conclusion and Future Work

The scene described in the previous section, gave us a basis and motivation for our research line. We believe that substantial improvements can be achieved discovering ways of applying CI concepts to share and understand knowledge in a personalization re-engineering process.

As we have mentioned, currently exist some works in CI field that presents theoretical cognitive frameworks. For example, Chiew [14] suggests an approach to increase the discovered knowledge value and knowledge intelligence, called "Cognitive Knowledge Discovery Framework". Walenstein [15] introduces a framework intended to seed further systematic study of cognitive support in the field of software engineering tools, named "RODS". This framework imports ideas and methods from a field of cognitive science called "distributed cognition" and their name comes

from the four cognitive support principles the framework describe: task Reduction, algorithmic Optimization, Distribution and Specialization.

In a first step, our future work consists of studying these theoretical works and making some suggestions to help stakeholders in acquiring, sharing and understanding knowledge during a re-design process. The main goal is to provide some answers to the open questions we have previously introduced: (1) How we recognize that the stakeholders (clients, developers and the organization) are thinking about the same product as a result of the re-engineering process?, and (2) How we can be certain that all helpful available knowledge is shared and understood for an appropriated use and re-use in the process?
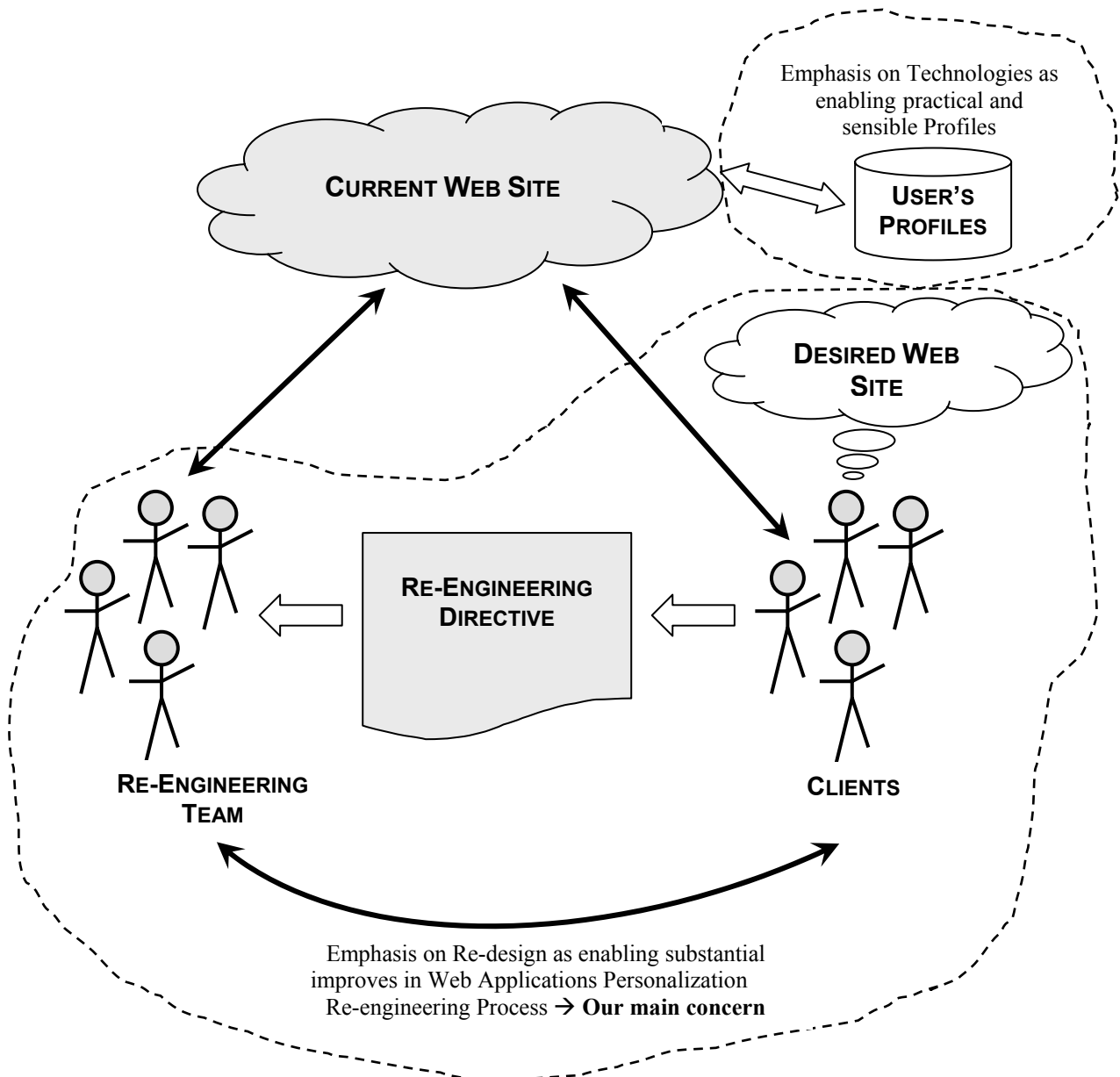

Figure 2. A WEB PERSONALIZATION RE-ENGINEERING PROCESS ESCENARIO

4. Acknowledgments

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