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# Maintaining Requirements using Web Usage Data

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## Abstract

The use of the World Wide Web has had a huge growth and there is a greater variety of web applications with an increasing importance in society and in supporting the development to all kinds of business. Often, most of websites are providing support services that must be maintained and improved over time. This maintenance and upgrade can be difficult because frequently the requirements are no longer actual and/or often not even exist documented. Websites are increasingly monitoring usage data, and this type of information is increasingly abundant. Analyzing the usage of the websites can help identify improvements and help to maintain the website and its software requirements. This paper presents REQAnalytics, a recommender system that collects the information about the usage of a website, processes it and generates recommendations to the requirements specification of the website. This research work also presents an experimental evaluation of a case study based on an online newspaper website. The results showed that REQAnalytics can produce reports in a language closer to the business, identify most and less used functionalities, requirements that can be split in two or more requirements and give support to the maintenance of requirements of the website being analyzed.

*Keywords:* Requirements Engineering, Requirements Management, Recommender Systems for Software Engineering, Web Usage Mining

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## 1. Introduction

Software quality has become a topic of major concern in the field of Software Engineering. Particularly, websites are being used not only for displaying static information but increasingly as core business tools, particularly through web services, intranets and web applications that run as support applications to business development[1,2].

The websites and web applications are a type of software that must be available 24 hours a day. Furthermore, they should please the customer and must be maintained and improved to adjust to needed changes through the website lifecycle[3]. The main reasons of software project failures are the incorrect requirements elicitation, requirements changes and their uncontrolled evolution during the software project lifetime[4]. Uncontrolled requirement changes cause negative impacts in software development, such as, excessive costs and a system unable to answer to stakeholders' needs.

The requirements management allows to maintain stability and agreement among stakeholders' requirements, by means of the analysis of change effect and their monitoring during software lifetime[5]. Software organizations are improving the methods they use to collect, analyze, document, and maintain their requirements in a structured software requirements specification written in natural language. However, a Software Requirements Specification is difficult to keep current, specially when the software project is a website that evolves during its lifetime[6]. Through time, this causes the requirements become outdated and do not reflect the current state of websites. Furthermore, during software lifetime it is difficult to determine what requirements change requests should be answered first and the information of traceability between the requirements and the implementation is frequently lost.

Nowadays, there is little support for websites and web applications evolution, despite the evolution of website accounts for major development costs. The evolution of websites involves the development of new requirements, requirements' updates and implementation changes. These maintenance activities may come from different stakeholders, such as developers, systems engineers, users and service integrators.

There are methods for measurement, data collection and data analysis of websites and web applications throughout their lifetime. These methods are called Web Analytics. The main objective of Web Analytics is to provide the right direction to online users. This can be done by doing required and impactful changes in the web site[7].

Nowadays, existing Web Analytics tools are able to gather diverse data about the usage of a website. The use of websites generates large amounts of information that may be used for different purposes like assessment of quality of web-products[8], pattern recognition or to statistical analysis[7].

It is our belief that information about the usage of websites may help requirements maintenance which can be a contribution to the overall quality of the service provided. Existing approaches and tools do not take advantage of this data. In addition, Web Analytics tools have some limitations relating to services maintenance. Web Analytics tools have focused on analysis and reporting of business metrics, like number visits and traffic sources, which interest is mainly to marketers[9] but analysis directed to the improvement analysis is not currently done. Usage data is disregarded for the improvement of the quality of a web application. So, the potential of web usage data analysis is yet to be explored[10].

Recommendation Systems for Software Engineering (RSSE) can help developers to find alternative decisions in a wide range of software engineering tasks from reusing code to writing effective bug reports. The overall goal is to provide the right information, at the right time, to the right person. This would allow requirements engineers to spend their limited time on more important aspects of the project[17].

This paper presents REQAnalytics, a recommender system that collects the web data usage from a website and suggests requirements' changes. Recommender systems have been widely used in e-commerce websites to provide user personalization[11] like product, content or service recommendations. Recommender Systems for Software Engineering (RSSE) is a novel approach to support developers in decision making.

The remainder of this paper is organized as follows: related work is discussed in Section 2, Section 3 presents an overview of REQAnalytics, the recommender system developed to assist the requirements maintenance. Section 4 presents an experimental evaluation of a case study in an online newspaper and the results achieved. Conclusion and future directions are in Section 5.