



Alignment of Requirements and Services with User Feedback

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Candidate

Muneera Bano

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“Glory be to you, we have no knowledge except what you have taught us. Verily, it is You, the All-Knower, the All-Wise” (Quran 2:32)

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It's supposed to be hard! If it wasn't hard, everyone would do it. The hard is what makes it great !!!

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Muncera Bano

It is good to have an end to a journey; but it is the journey that matters, in the end

PUBLICATIONS

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ACRONYMS AND ABBREVIATIONS

ARISE	<i>Alignment of Requirements and Services</i>
CBSD	<i>Component Based Software Development</i>
KG	<i>Knowledge Graphs</i>
KM	<i>Knowledge Management</i>
MCDA	<i>Multi Criteria Decision Analysis</i>
NFR	<i>Non Functional Requirements</i>
NLP	<i>Natural Language Processing</i>
OOAD	<i>Object Oriented Analysis and Design</i>
RE	<i>Requirements Engineering</i>
SaaS	<i>Software as a Service</i>
SDLC	<i>Software Development Lifecycle</i>
SE	<i>Software Engineering</i>
SLR	<i>Systematic Literature Review</i>
SME	<i>Situational Method Engineering</i>
SOA	<i>Service Oriented Architecture</i>
SOC	<i>Service Oriented Computing</i>
SORE	<i>Service Oriented Requirements Engineering</i>
SOSD	<i>Service Oriented Software Development</i>
SOSE	<i>Service Oriented Software Engineering</i>

ABSTRACT

It is widely acknowledged that software reuse reduces the cost and effort of software development. Over the years many solutions have emerged that propose methodologies to support software reusability. Service oriented software engineering (SOSE) advocates software reuse while aiming to achieve better alignment of software solutions to business requirements. Service orientation has evolved from Object Oriented Analysis and Design (OOAD) and Component Based Software Development (CBSD), the major difference being that reusable artefacts are in the form of services rather than objects or packaged components.

Although SOSE is considered a new architectural style of software development that addresses some of the shortcomings of previous approaches, it has also inherited some of the challenges of CBSD, and OOAD, in particular in the requirements engineering process. In Service Oriented Requirements Engineering (SORE) an analyst has an additional challenging task of aligning requirements and services to select the optimally matched service from an increasingly large set of available online services. Much of the existing empirical research in SORE has focused mainly on the technical aspects while the human related issues are yet to be fully explored and addressed. The lack of empirical evidence to investigate the human related issues in SORE provides the overall motivation for the research covered in this thesis.

User involvement in software development has been the focus of significant research and has been intuitively and axiomatically accepted to play a positive role in users' satisfaction thus leading to system success. More recently, past users' feedback, reviews and comments from online sources are considered a form of user involvement. These offer valuable information to assist analysts in increasing their knowledge for making more informed decision for service selection. In service

oriented paradigm the full extent of the benefits of this form of user involvement has not been empirically investigated.

This thesis addresses three important high level research goals: (1) to investigate and identify the most important challenges of SORE, (2) to design an innovative and flexible method to address the top challenge of SORE, focusing specifically on the important relationship between user involvement and system success, and (3) to evaluate the applicability and effectiveness of the proposed method in an empirical study.

This thesis presents research conducted in three parts for achieving each of the stated goals respectively: *problem analysis*, *solution analysis* and *implementation analysis*. For problem analysis a mixed method approach is used, i.e. literature review, quantitative online survey, and qualitative industrial interview study. For solution analysis a Systematic Literature Review (SLR) is conducted to analyse the existing empirical studies about the relationship between user involvement and system success. Inspired by the results of this SLR, I designed the ARISE (Alignment of Requirement and Services) method, following Situational Method Engineering to make it flexible for adoption in various project contexts. The ARISE method aims to exploit the benefits of experiences of past users for service selection. For implementation analysis, the ARISE method was instantiated in a case study with real life data with two objectives in mind: (1) validation of the effectiveness of ARISE in overcoming the challenges of alignment, and (2) improvement and refinement of the ARISE method. Analysis of the results of this validation revealed the need for automated tool support for the ARISE method. This automation is achieved through the design and implementation of software tools created for supporting the analysts in service selection.

The systematic and mixed method research approach of the problem analysis phase identified that alignment of requirements and services was the top challenge for practitioners in SORE. It also increased our understanding of why this alignment is considered the most challenging task. The findings of the SLR confirmed that the effective user involvement in software development in general,

and in requirements engineering in particular could lead to system success. In SORE, the past users of services can be involved through their feedback and sentiments about the services from online sources. These concepts were the basis for the design of the ARISE method. The results of the case study complemented by the experimentation with the automated tools revealed that past users' feedback and sentiments are indeed valuable sources of information that can assist analysts in overcoming the challenges of alignment between requirements and services thus making a more informed decision in service selection.