A Systematic Classification and Analysis of NFRs

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ABSTRACT
The main agenda of Requirements Engineering (RE) is the development of tools, techniques and languages for the elicitation, specification, negotiation, and validation of software requirements. However, this development has traditionally been focused on functional requirements (FRs), rather than non-functional requirements (NFRs). Consequently, NFR approaches developed over the years have been fragmental and there is a lack of clear understanding of the positions of these approaches in the RE process. This paper provides a systematic classification and analysis of 89 NFR approaches.

Keywords
Non-functional requirements; NFRs; NFR approaches; quality requirements; requirements engineering; systematic classification and analysis of NFRs approaches.

INTRODUCTION
The importance of Requirements Engineering (RE) has long been established both in research and in practice. There is a significant intellectual activity in the RE field as evidenced by the large volume of papers published in journals and conferences c.f. [1] and by the adoption of a variety of techniques by industry c.f. [2]. A number of initiatives have been put forward to support the RE lifecycle, initiatives such as risk-driven methodologies [3], requirements tracing [4, 5], model re-use [6], use of scenarios [7], use of visualization [8], use of business rules [9, 10], enterprise modeling [11] and goal modeling [12, 13] to name but a few.

Historically, there has been a distinction between two classes of requirement, functional requirements (FRs) and non-functional requirements (NFRs), the former referring to the operational properties and the latter to the quality properties that the desired system must posses. It is generally agreed that more emphasis has been placed to date on FRs rather than NFRs. However, the changing landscape of requirements demands an increased attention to those aspects of requirements that deal with quality factors, the NFRs. There is a whole set of new advanced design requirements [14] that demand now more than ever close attention to the effectiveness of the SE process. The field’s focus and scope have shifted from engineering of individual systems and components towards the generation, adaptation and maintenance of software-intensive ecosystems consisting of software, hardware, human and organizational agents, business processes and more. Such software ecosystems require attention in three areas namely those of design and evolution, orchestration and control, and monitoring and assessment [15].

The context and motivation for this paper is the changing landscape of RE that demands now more than ever particular attention to NFRs. Whilst there is ample evidence (c.f. [16]) that NFRs play a significant role in systems, there is surprisingly an absence of an agreed position regarding the definition of NFRs, their classification and presentation [17].

To address this problem, the paper presents a systematic literature review (SLR) of the field of NFRs. Recent years have witnessed an increase in the use of evidence based approaches in SE [18, 19] with

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SLR c.f. [20] being regarded as the most reliable method. To this end procedures for evidence-based SE are presented in [21, 22]. A study of 33 unique studies, carried out between 2004-2007, revealed 35 SLRs in the field of SE [23]. This paper provides an aggregated view about research efforts to date on NFRs.

The paper is organized as follows. First, the methodology adopted for the classification framework is defined, introducing also the classification scheme. Second, using this classification scheme the 89 approaches are defined according to their relevance in each one of the possible classes of evaluation. Third, an analysis is provided in terms of the contribution of the 89 approaches. Finally, the paper concludes with some reflections and a number of observations for future research challenges in the field of NFRs.
REFERENCES

Part I: General References

34. Hillier, B., Musgrove, J., and O’Sullivan, P., Knowledge and design, in Developments in design methodology, N. Cross, Editor. 1984, John Wiley & Sons, Inc. 245-264.

Part II: NFRs-approach Specific References

Pavlovski, C.J. and Zou, J. (2008) Non-HICSS02
Wei, B., Jin, Z., and Liu, L. (2010) A formalism for extending the nfr framework to support the composition of the goal
Testing.
OMG (2009) Umltm profile for modeling quality of service and fault tolerance characteristics and mechanisms specification.formal/2009-04-05
of the International Conference on Coordination Models and Languages


Molina, H. and Olsina, L. (2007) Towards the support of contextual information to a measurement and evaluation


