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Artefact-based Requirements Engineering Improvement: Learning to Walk in Practice

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Abstract. Requirements engineering process improvement (REPI) has gained much attention in research and practice. Most REPI approaches are of solution-driven and activity-based nature. They focus on the assessment of company-specific RE reference models against an external norm of best practices, and they propagate an improvement by forecasting the adaptation of the processes and methods in the RE reference model towards that norm. In recent years, we could develop a first problem-driven RE improvement approach that supports an improvement against individual goals and problems of a company putting primary attention to the quality of the RE artefacts (named *ArtREPI*). In this short paper, we briefly illustrate our resulting approach and report on our initial experiences from ongoing empirical evaluations in practice. We conclude with a summary of planned next steps.

Keywords: Requirements Engineering, Artefact Orientation, Software Process Improvement, Case Study Research

1 Introduction

Requirements engineering (RE) constitutes an important success factor for software development projects. Its interdisciplinary nature, the uncertainty, and the complexity in the process, however, make the discipline hard to investigate and even harder to improve [1]. For such an improvement, process engineers have to decide whether to opt for a *problem-driven* or for a *solution-driven* improvement [2]. In a solution-driven improvement, the engineers assess and adapt their RE reference model, which captures company-specific RE practices and artefacts, against an external norm of best practices. The latter is meant to lead to a high quality RE based on universal, external goals (see, e.g. CMMI for RE [3]). Whereas solution-driven improvement approaches might thus serve the purpose to achieve externally predefined goals (e.g. as part of a certification), they do not necessarily consider company-specific goals that dictate the notion of RE quality within a particular context and, thus, result in an RE reference model that might alien to the organisational culture. A notion of RE quality where individual company-specific goals dictate the improvement is taken by problem-driven approaches. Besides the principle of conducting the improvement, the paradigm in which the targeted RE reference model is structured (and, thus, improved)

plays an important role, too. A reference model can either be *activity-based* or it can be *artefact-based*. An activity-based improvement approach focuses on improving the quality of the RE activities (practices) while an artefact-based one puts focus on improving the quality of the RE artefacts.

In a recent systematic mapping study [4], we revealed that the high number of available RE improvement approaches still remains solution-driven. They focus on assessments and benchmarks of a company-specific RE based on external activity-centric norms of best practices. As the notion of RE quality is relative to its context [5], those approaches encounter problems in practice [6] and are, thus, often rejected by practitioners [1]. In response to this shortcoming, we elaborated concepts of an artefact-based and problem-driven RE improvement. In [6], we presented how we inferred its basic concepts from selected REPI projects we conducted in practice. Since then, we extended our concepts to a holistic tool-supported and seamless approach. We call our approach *ArtREPI*. With ArtREPI, we could make first contributions and experiences to support a problem-driven and artefact-based RE improvement [6], but we still have little empirical evidence on the benefits and limitations. In this paper, we therefore provide an overview of ArtREPI and report on experiences resulting from ongoing evaluations. The purpose is to support the dissemination and evaluation.

2 ArtREPI in a Nutshell

Figure 1 shows the simplified structure of ArtREPI. We distinguish two views on the notion of RE quality: an external one (lower part of the figure) and one where the notion of quality is relative to its socio-economic context (upper part of the figure). The external context comprehends external norms of best practices and is not key to solution-driven improvement approaches, but we postulate its importance also to a problem-driven improvement as technology transfer according to context-specific goals is an important facet. The socio-economic context comprehends a set of disciplines that aim at managing software processes and changes therein. A change is performed as part of an RE process improvement project which is in scope of the (cyclic) ArtREPI phases. During the *preparation* phase, we agree on the general improvement plan, define the goals, and infer a set of metrics and measurements which serve to evaluate the efficacy of an improvement. During the *problem analysis*, we create an artefact model that reflects the current practice in an organisation. We call in practitioners to validate the as-is model and identify potential problems and candidates for an improvement. The *improvement design* is concerned with the actual improvement where we establish a model candidate and a first prototypical implementation (e.g. modelling tools to create the RE artefacts). The *improvement evaluation and transfer preparation* finally comprehends the evaluation of the RE model in realistic environments provided by pilot projects, before preparing its release. The full ArtREPI model including its (EPF) process implementation, document templates, and evaluation instruments can be taken from our online sources [7].

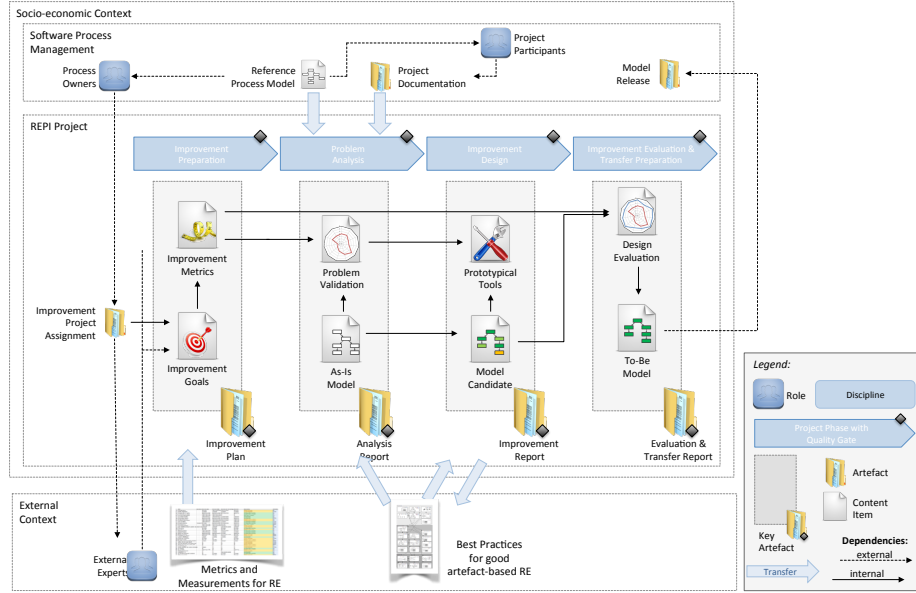


Fig. 1. ArtREPI in a nutshell.

3 Ongoing Evaluations and Next Steps

To effectively evaluate our approach, we implemented the process using the EPF Composer, and we made all models and evaluation instruments publicly available [7]. This supports the dissemination, its (technical) validation, and its evaluation in the long run. As an initial evaluation, we applied ArtREPI in two socio-economic contexts via a series of (technical) action research workshops followed by a rating by process engineers and project participants. Process engineers rated the actual approach and project participants rated the improvement outcome after applying it in a series of pilot projects as only they could decide to which extent the improvement outcome eventually achieves their improvement goals. The instruments can be found in our online material. As cases served the companies Wacker Chemie, a German company and works in the chemical business, and SupplyOn AG, a company that works as a software as a service provider. Of particular interest was to know what general benefits and limitations we can expect when applying ArtREPI in a socio-economic context and whether our approach can be used by others if we are not involved at all. For this reason, we conducted the second case study as an independent replication of the first.

Our results indicate, so far, that ArtREPI is well suited to cover the needs of a structured problem-driven improvement while supporting knowledge transfer. The results from pilot project further suggest that the improvement eventually achieved the improvement goals indicating to the problem-driven nature

of ArtREPI. Out of scope, however, were long-term investigations. A detailed analysis of our case studies and a longitudinal study are in scope of future work.

We see the biggest benefits of case studies, however, not in providing evidence on what works, but in revealing limitations and eventually fail conditions for an ArtREPI. The limitations include, *inter alia*, that we, as researchers involved in the development of ArtREPI, seemed to lower the efficiency and effectivity of an improvement due to long preparation phases to explore the domain and the terminology used. Our initial assumption that the success of ArtREPI strongly depends on us conducting the improvement thereby seems to be wrong.

Also, there are a plethora of subjective (social and political) factors important to the success of an RE improvement of which only some might be tackled by methodological aspects; for instance, by involving project participants early in the improvement process to mitigate a missing organisational willingness to change. However, many factors might not be tackled by an improvement approach, nor by an RE reference model that, by nature, abstracts from those aspects important to RE, such as desires, beliefs, experiences, and expectations.

To elaborate to what extent the application of an artefact-based and problem-driven RE improvement eventually leads to an improvement, and how to measure the success of an improvement, we therefore need to:

1. increase our understanding on the variables as there are many facets that we did not measure, that are not measurable at all, or that do not depend at all on the chosen process model (see also [5] for richer discussions). This also supports conducting longitudinal studies.
2. further scaling up to practice to come close to a generalisation.

We support the latter as we made all our material publicly accessible [7], but we need to take new perspectives and conduct further independent case study replications. We therefore encourage researchers and practitioners to join us to fully understand the broad spectrum of possibilities and limitations in ArtREPI.

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