A Systematic Approach to Requirements Engineering Process Improvement in Small and Medium Enterprises: An Exploratory Study

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Abstract. Requirements Engineering (RE) studies have demonstrated that requirements errors affect the quality of software developed, making software requirements critical determinants of software quality. Requirements Engineering Process Improvement (REPI) models have been provided by different authors to improve the RE process. However, little success has been achieved in Small and Medium Enterprises (SMEs) software companies especially in transitional countries such as Uganda. This study reports on an exploratory study which provides insights into current RE practices in four Ugandan SME software companies, critical success factors and challenges that impede REPI. As a result a Systematic Approach to REPI has been designed following the design science approach. It provides guidelines and steps for SMEs in improving their RE processes.

Keywords: Requirements Engineering, Process Improvement, Software Process Improvement.

1 Introduction

Fast changing technology coupled with increased competition is placing a lot of pressure on software development process [9]. One of the most crucial parts of the software development process is requirements engineering (RE); and the process of developing new software products always starts with some kind of needs or wishes. The wishes and needs can be of help in finding the requirements that describe the properties and functions of the new software product. Discovering, documenting and maintaining requirements are often described as *requirements engineering* [31]. Effective RE lies at the heart of an organization's ability to produce software products that can meet the needs of the customers yet keeping pace with the rising wave of complexity [9]. The software industry in most countries is composed of Small and Medium Enterprises (SMEs) [18]. This study focused on SMEs mainly because they form the biggest number of software companies in developing countries and yet they produce important products for their clients [24]. Because SMEs are small in nature, then process improvement can easily be achieved through SMEs' flexibility, fast

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reaction time and enhanced communication between members. In the Ugandan context a *Small Enterprise* is defined "as an enterprise employing maximum 50 people, annual sales/revenue turnover of maximum Ugandan Shillings 360 million and total assets of maximum Ugandan Shillings 360 million"; while a *Medium Enterprise* is defined as an "enterprise employing more than 50 people, annual sales/revenue turnover of more than Ugandan shillings 360 million and total assets of more than Ugandan Shillings 360 million" [29]. In the software industry, a *small organization* is defined as one with fewer than 50 software developers and a *small project* is one with fewer than 20 developers [18]. RE is a very important phase of the software process as errors at this phase inevitably lead to later problems in the system design and implementation [15]. RE can lead to better quality in software and systems development processes [16, 26]. It's only with efficient RE that the development process can be controlled and directed in terms of appropriateness and cost-effectiveness of the solution produced [9]. The main aim of a RE process is to come up with a set of necessary, verifiable and attainable requirements, which are acceptable to all the relevant stakeholders [26, 19].

The need to improve the RE process has been recognized for some time now and RE community has witnessed the emergency of models and standards for Requirements Engineering Process Improvement (REPI) and assessment. For example, the *Good practice guide* [27] gives basic guidelines on how to improve the RE process. However, even when the framework has been useful, it was intended for safety-critical domain project, hence lacking adaptation to different domains [30]. It is also too general and complex for SME software companies. The *Flexible and Pragmatic RE* framework for SMEs [22] aimed at providing a framework for RE improvement in SMEs that is more adaptable to support more domains and improve support for small, incremental improvements of the RE process. The *Requirements-Capability Maturity Model* [1] suggests key requirements practices within a maturity framework. Its main objective is to guide software practitioners to relate processes to goals in order to prioritize their requirements process improvement activities. However little progress has been registered in SMEs using these models in improving their RE process as witnessed by the continued failures in these companies

To this end there is a need for SMEs to access a systematic and reliable approach to REPI. In other words, what are the challenges for REPI in SME software companies, and how can these be used to derive recommendations and requirements that can be used to design a systematic approach to REPI in SME software companies? [33] define *Systematic process improvement* as a goal-oriented measurement and controlled way of introducing process change, with predictable outcome in terms of quality, time and productivity

Thus, to put our research in context, we looked at the state of art of SMEs in section 2. In section 3, we describe the research approach followed in order to undertake the exploratory study and later the design of the systematic approach. . In section 4, we describe the exploratory study in which the current practices with respect to REPI in Ugandan SME software companies were investigated and analyzed. We also present the derived requirements that lead to the design of the actual systematic approach to REPI for SMEs in section 5, and finally provide a way forward on future prospects of this research.