

Shedding Light on How Intelligent Techniques can Support Technical Debt Management and Influence Software Quality Attributes

Danyllo Albuquerque
Federal University of Campina Grande
(UFCG)
Campina Grande, Paraiba - Brazil
danyllo@copin.ufcg.edu.br

Ferdinandy Chagas
Federal Rural University of the
Semi-Arid (UFERSA)
Pau dos Ferros, Rio Grande do Norte -
Brazil
ferdinandy@ufersa.edu.br

Everton Guimaraes
The Pennsylvania State University
Malvern, Pennsylvania - USA
ezt157@psu.edu

Graziela Tonin
Federal University of Fronteira Sul
(UFFS)
Chapecó, Santa Catarina - Brazil
graziela.tonin@uffs.edu.br

Mirko Perkusich
Federal University of Campina Grande
Campina Grande, Paraiba - Brazil
mirko@embedded.ufcg.edu.br

Hyggo Almeida and Angelo
Perkusich
Federal University of Campina Grande
Campina Grande, Paraiba - Brazil
(hyggo,angelo@embedded.ufcg.edu.br)

ABSTRACT

Technical Debt (TD) is a consequence of decision-making in the development process that can negatively impact Software Quality Attributes (SQA) in the long term. Technical Debt Management (TDM) is a complex task to minimize TD that relies on a decision process based on multiple and heterogeneous data that are not straightforward to synthesize. Recent studies show that Intelligent Techniques can be a promising opportunity to support TDM activities since they explore data for knowledge discovery, reasoning, learning, or supporting decision-making. Although these techniques can improve TDM activities, there is a need to identify and analyze solutions based on Intelligent Techniques to support TDM activities and their impact on SQA. For doing so, a Systematic Mapping Study was performed, covering publications between 2010 and 2020. From 2276 extracted studies, we selected 111 unique studies. We found a positive trend in applying Intelligent Techniques to support TDM activities being Machine Learning and Reasoning Under Uncertainty the most recurrent ones. Design and Code were the most frequently investigated TD types. TDM activities supported by intelligent techniques impact different characteristics of SQA, mainly Maintainability, Reliability, and Security. Although the research area is up-and-coming, it is still in its infancy, and this study provides a baseline for future research.

CCS CONCEPTS

• **General and reference** → Empirical studies.

KEYWORDS

Technical Debt, Intelligent Techniques, Systematic Mapping Study, Software Quality Attributes

1 INTRODUCTION

Technical debt (TD) is a metaphor reflecting technical compromises that can yield short-term benefits but may hurt the long-term health of a software system [5]. TD accumulation can negatively impact

several types of Software Quality Attributes (SQA) [24], a critical success factor in software projects. Managing its impact includes identifying, monitoring, and measuring TD symptoms [7]. Even though Technical Debt Management (TDM) is a critical activity [5], many organizations do not have established TDM practices.

Given the diversity of everyday practices for software development, managing TD and SQA can be complex since it relies on a decision process based on multiple and heterogeneous data, which are hard to be gathered and synthesized [7][3]. In this context, there is a promising opportunity to use Intelligent Techniques to support TDM activities and SQA management. These techniques explore data for knowledge discovery, reasoning, learning, planning, natural language processing, perception, or supporting decision-making [17]. We conjecture that these techniques can use the data produced in software development tasks to improve existing support for various TDM activities. Although intelligent techniques can be used for this purpose, there is a lack of knowledge of how researchers and practitioners can use them to improve TDM-associated activities and their impact on SQA.

This paper is an extension of a study originally presented at the International Conference on Technical Debt 2022 (TechDebt'22) [1]. However, the present study version contributes to the relationship between TDM and SQA. Cutting the results from the SQA perspective was the path to present an extra analysis outside the original scope. The remainder of this paper is structured as follows. Section 2 describes the main concepts required to understand this study, and existing related studies. Section 3 presents the methodology used to conduct the study. Section 4 discusses the results and findings. Section 5 presents the threats to validity whereas Section 6 presents the final remarks and future work.

2 BACKGROUND AND RELATED WORK

This section describes the main concepts to understand this study and reports some related work.

2.1 Technical Debt

Definition. The term was coined by Cunningham [8] when discussing with stakeholders the consequences of releasing poorly written code snippets to accelerate the development process. TD

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