Toward Automated Change Impact Analysis of Financial Regulations

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ABSTRACT

Regulation changes over time due to amending or repealing existing legal provisions as well as introducing new ones. The finance field provides a concrete example of heavily regulated area which has seen continuous regulatory changes in the aftermath of the 2008 crisis. Software financial services like online banking or trading must constantly comply with the regulations. Monitoring and analyzing the regulatory change is essential to ensure that such services remain compliant. Regulatory changes can significantly affect existing software systems that were compliant at a certain point in time. However, tracing the regulatory changes entirely manually is time consuming and error-prone. In this position paper, we introduce our vision for automated financial regulations change impact analysis. We aim at characterizing the regulatory changes pertinent to financial regulations, and further providing automated support for both identifying and classifying the regulatory changes as well as analyzing the impact of such changes on existing (potentially compliant) software systems.

KEYWORDS

FinTech, Regulatory Compliance, Regulatory Change, Change Impact Analysis

1 INTRODUCTION

Financial regulations have seen extensive changes over the past decade. For instance, the alternative investment fund managers 2011/61/EU directive (AIFMD) [5] has been amended by several other directives, resulting in different articles being amended, introduced, or repealed. Such regulatory changes can affect both fund management organizations and processes, including their automated systems involving asset management, risk calculation or reporting. Consequently, when a regulatory change occurs, it is

essential that these systems are also adapted, when necessary, to remain compliant and avoid serious consequences of non-compliance such as large fines and loss of reputation. Regulatory compliance has been widely studied in the requirements engineering (RE) literature [4, 9]. Change impact analysis of requirements is another core interest in RE [2].

However, investigating the impact of regulatory changes on existing compliant systems is, to our knowledge, not a well exploited research topic, due to the complexity of the legal framework. Manual navigation through multiple legal documents to identify regulatory changes impacting the compliance of existing systems is laborious and error prone. Building automated approaches for this task is desirable, yet challenging due to several reasons. First, regulatory amendments often involve concurrent and simultaneous modifications that require interpretation of the legal text. Second, traceability links between the components of an existing system and the current version of legal requirements might not be readily available. Third, change impact analysis must not only identify the components of the system directly affected by the regulatory change but it must also identify those inter-dependent components that are indirectly impacted.

In this position paper, we introduce our vision toward automated change impact analysis of financial regulations. To address the above challenges, we define three main objectives: **(O1)** Describing the regulatory changes pertinent to the financial domain; **(O2)** Tracing the identified regulatory changes, interpreted as legal requirements, to the software requirements of existing systems; and **(O3)** Analyzing the impact of regulatory changes on existing software requirements and providing automated recommendations on how requirements can be adjusted to ensure that the system remains legally-compliant. To achieve the objectives, we plan to leverage a combination of techniques from the requirements engineering (RE) [1], natural language process (NLP) [8], and knowledge representation (KR) [7] domains. This work is part of a multi-disciplinary project where we contribute with our expertise in software engineering and join hands with experts from the financial domain.

2 RESEARCH AGENDA

Fig. 1 depicts the four activities we plan to pursue.

(1) Identification of regulatory change types in the financial domain. We will build, through iterative qualitative studies, a taxonomy characterizing the changes in financial regulations. To address the complexity of the legal landscape, we propose describing the changes at different abstraction levels, designed into multiple layers in the taxonomy. The layers will capture the mere textual

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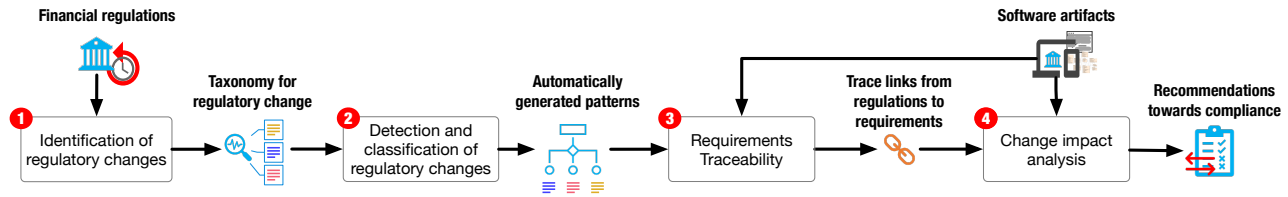

Figure 1: Our vision toward automated change impact analysis of financial regulations

changes (e.g., addition or deletion of some text) as well as the legal interpretation of the regulatory change (e.g., what the change means for a fund management and how shout it be implemented). We plan to investigate the following *research questions (RQs):* RQ1.1. To what extent can we cover the changes in legal documents with our multi-layer taxonomy? RQ1.2. How can we build a taxonomy that describes the changes in a detailed view but is still generic enough to be applicable across domains?

(2) Detection and classification of regulatory change. The second activity involves developing approaches that are able to (semi-) automatically identify and classify the regulatory change with respect to our taxonomy. To do this, we will leverage recent NLP technologies such as large language models (LLMs), e.g., Chat-GPT [3]. The goal of this activity is to build an automated support which assists human analysts in analyzing regulatory changes and their impact on compliance. To evaluate our approaches, we plan to curate a dataset of manual analysis of regulatory changes of regulations that are currently relevant to the financial industry, e.g., AIFMD. We will investigate the following RQs: RQ2.1. How accurate are recent NLP technologies in identifying and classifying the regulatory changes? RQ2.2. Which prompting strategies enable LLMs to provide meaningful support to human analysts?

(3) Requirements traceability. We plan to devise methods to automatically build trace links [6] between the legal provisions and software requirements. Traceability in this case will help us identify the requirements that are affected by the regulatory change. In this activity, we will investigate to which extent NLP and ML technologies enable the automation of traceability and change impact analysis for financial regulations. This activity aims to answer the following RQ: RQ3. How accurate are NLP technologies in tracing legal statements to software requirements?

(4) Change impact analysis. The final activity is concerned with analyzing the impact of the identified regulatory changes. We will tackle the change impact analysis task at two levels. The first level aims to analyze the impact of the changes in the regulation on existing requirements. Based on this analysis, we will then provide automated recommendations for adjusting the requirements toward achieving compliance. The second level of the change impact analysis is to analyze the implication of applying the recommended changes on other inter-dependent requirements that were not directly affected by the change. The goal is to avoid introducing inconsistency due to the recommended changes. Specifically, we will tackle the following RQs: RQ4.1. How accurate are NLP technologies in analyzing the impact of regulatory changes on existing requirements? RQ4.2. How accurate are these technologies in identifying inter-dependencies between requirements?

3 CURRENT WORK AND OUTLOOK

Investigating the regulatory landscape, we defined a set of existing legislative acts that have been through various consecutive changes. We mainly focus on AIFMD, AIFMR, and MIFID II. Currently, we are pursuing two research activities. The first one involves building a taxonomy of regulatory changes at three levels, namely "textual" capturing changes in text, "semantic" capturing changes in meaning, and "deontic" capturing changes in legal interpretation.On parallel, we are investigating the requirements traceability task.

In the future, we will devise automated support to assist human analysts in analyzing and understanding regulatory changes and their impact on existing software systems.

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