

A Family of Case Studies on Business Process Mining

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Abstract. Business processes, most of which are automated by information systems, have become a key asset in organizations. Unfortunately, uncontrolled maintenance implies that information systems age over time until they need to be modernized. During software modernization, ageing systems cannot be entirely discarded because they gradually embed meaningful business knowledge, which is not present in any other artifact. This paper presents a technique for recovering business processes from legacy systems in order to preserve that knowledge. The technique statically analyzes source code and generates a code model, which is later transformed by pattern matching into a business process model. This technique has been validated over a two year period in several industrial modernization projects. This paper reports the results of a family of case studies that were performed to empirically validate the technique using analysis and meta-analysis techniques. The study demonstrates the effectiveness and efficiency of the technique.

Keywords. Business Process, Static Analysis, Case Study, Meta-Analysis.

1 Motivation

Business processes are increasingly becoming an essential asset for organizations since they create value for customers and reflect all operations of an organization. Organizations adopt business process management through their enterprise information systems. Unfortunately, during software maintenance, the organizations' business processes do not reflect all changes that have occurred in legacy systems. Thereby, legacy information systems cannot be entirely discarded during its modernization since it might contain a considerable amount of latent meaningful business knowledge, which is not present anywhere else. As a result, all embedded business processes must be explicitly recovered in order to preserve this meaningful asset in the modernized information systems. The evolved system will thus support the current business processes and will also improve the ROI (*Return Of Investment*) of the legacy system, since it extends its lifespan.

2 Proposal

This paper proposes MARBLE¹ (*Modernization Approach for Recovering Business processes from Legacy Systems*) is a framework that facilitates business process recovery through a path of three model transformations between four different abstraction levels. The first transformation takes legacy source code in the real world (level 0) and obtains a set of platform-specific models at level 1. The second transformation integrates every code model into a platform-independent KDM (Knowledge Discovery Metamodel) repository at level 2. Finally, the last transformation applies a pattern matching technique to detect business patterns in KDM models and builds business process models at level 3.

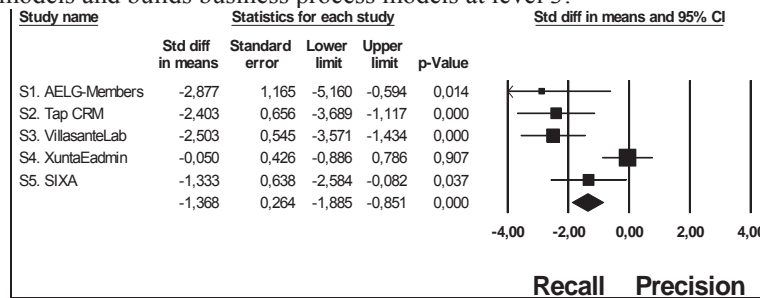


Fig. 1. Meta-Analysis results for recall and precision obtained by applying MARBLE

3 Empirical Validation Results

This work presents a family of case studies carried out over the last two years to validate the effectiveness and efficiency of MARBLE. The family was performed in five different industrial information systems: (i) a system managing a Spanish author organization; (ii) an open source CRM (Customer Relationship Management) system; (iii) an enterprise information system of the water and waste industry; (iv) an e-government system used in a Spanish local e-administration; (v) a high school LMS (Learning Management System). The study evaluates the effectiveness by means of the *precision* and *recall*, which measure the similarity between a mined business process M and a reference business process R . Precision indicates what proportion of M matches R (i.e., how exact M is), while recall indicates what proportion of R is present in M (i.e., how complete M is). The efficiency was assessed by considering the transformation time. A part from statistical methods, this study uses meta-analysis to quantify the difference in means for the recall and precision measures obtained in each particular system under study. The result obtained shows that the technique is suitable to recover business processes in an effective and efficient manner. However, according to the effectiveness, the recall values were better than the precision values. We believe that these results were obtained because much of the work was, in several cases, basically recovered from technical code.

¹ Pérez-Castillo, R., J. A. Cruz-Lemus, I. García-Rodríguez de Guzmán and M. Piattini (2012). "A Family of Case Studies on Business Process Mining using MARBLE." *Journal of Systems and Software* 86(6): 1370–1385.

Evolución de Sistemas Auto-Adaptables mediante Modelos en Tiempo de Ejecución*

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Resumen La auto-adaptación se está convirtiendo en un requisito indispensable en los sistemas software. Los sistemas auto-adaptables son capaces de adaptar dinámicamente su comportamiento y estructura en ejecución en respuesta a variaciones en el sistema y el entorno. Los enfoques actuales de auto-adaptación tienden a asumir un mundo cerrado, en el que todos los fenómenos de interés son previstos en tiempo de diseño. Sin embargo, algunos comportamientos adaptativos no se pueden prever a priori. En este ámbito, se requieren técnicas que den soporte a la evolución en tiempo de ejecución de sistemas auto-adaptables. Este artículo propone una aproximación dirigida por modelos para desarrollar y evolucionar de forma sistemática sistemas auto-adaptables mientras están en ejecución. Específicamente, la aproximación utiliza *Modelos en Tiempo de Ejecución* para incorporar nuevas capacidades que no fueron previstas en el diseño inicial del sistema.

Keywords: Modelos en Tiempo de Ejecución; Evolución; Adaptación Dinámica

1. Introducción

Existe una creciente demanda de sistemas software que sean capaces de adaptarse, sin intervención humana, a cambios en las necesidades de los usuarios, variaciones en el entorno de ejecución, fallos y falta de disponibilidad de partes del sistema. La auto-adaptación se ha convertido en una de las principales aproximaciones para hacer frente a estas situaciones. La auto-adaptación proporciona a un sistema software la capacidad de adaptar su comportamiento y/o estructura en ejecución en respuesta a cambios en el entorno y en el propio sistema [10].

La *Ingeniería Dirigida por Modelos* (MDE) se ha centrado principalmente en la utilización de modelos durante el proceso de desarrollo software. Los modelos producidos en un proceso MDE también pueden jugar un papel importante en tiempo de ejecución, esta iniciativa se conoce como *Modelos en Tiempo de Ejecución* (*Models@run.time* [3]). Los modelos no sólo constituyen artefactos de primer orden en el proceso de desarrollo, también permiten monitorizar, validar y adaptar el comportamiento de un sistema

* This work has been supported by Conselleria d'Educació of Generalitat Valenciana under the program VALi+d and by Ministerio de Ciencia e Innovación (MICINN) under the project EVERYWARE TIN2010-18011.