Measuring the Effect of Enabling Traces Generation in ATL Model Transformations

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Abstract. The benefits that proper management of traceability information can bring to any given (software development) project are beyond any doubt. These benefits become even more appealing when dealing with traceability does not imply additional efforts. This is the case of Model-Driven Engineering (MDE). As a matter of fact, since model transformations are the wheel that drives MDE proposals forward, traceability data can be automatically available in MDE projects. To that end, the implicit traceability relationships contained in any model transformation have to be made explicit by enriching the model transformation with traces generation capabilities. However, this refinement process implies a cost in terms of quality: enriched transformations are intuitively more complex. To back such intuition, this work presents an empirical study to assess the impact over the quality of the automatic enrichment of model transformations.

Keywords: Model-driven Engineering, Model Transformations, Traceability, Quality Metrics.

1 Introduction

The management of traceability in software development projects implies keeping track of the relationships between the different software artifacts produced along the process. This way, appropriate management of traceability helps to monitor the evolution of system components and carry out different software activities such as change impact assessment, requirements validation, maintenance tasks, etc. [1].

Unfortunately, generating and maintaining links among different software artifacts is a tedious, time-consuming and error prone task if no tooling support is provided to that end [2]. In this sense, the advent of the Model-Driven Engineering (MDE) paradigm, which principles are to enhance the role of models and to increase the level of automation all along the development process [3], provides a new landscape that can positively influence the management of traceability [4]. Indeed, MDE brings new scenarios where appropriate management of traceability is almost mandatory, such as model synchronization or incremental model changes [5], all of them particular scenarios of software evolution.

J. Filipe and L.A. Maciaszek (Eds.): ENASE 2013, CCIS 417, pp. 229–240, 2013.

The key to foster automation in MDE projects are the model transformations that connect the different models involved in the proposal [6]. Simply put, a model transformation defines a set of relationships between the elements of source and target metamodels that must hold between the elements of the models conforming to such metamodels [7]. Therefore, a model transformation contains implicit information from which trace-links (traces) can be derived. Actually, such links can be seen as instances of the relationships defined at metamodel-level. Therefore, if we made explicit this information in the model transformation itself, it could generate, apart from the corresponding target models, an *extra* model which contains the traces between the elements of the models involved in the transformation.

Nevertheless, the enrichment of model transformations to support the production of traces model might have an impact over the quality of the transformation. This paper focuses on the assessment of such impact. To that end, it leans on some previous works by van Amstel and van den Brand [8,9] who defined a set of quality metrics for model transformations and tried to relate them with some quality attributes; such as understandability, modifiability, reusability, completeness, consistency and conciseness.

In particular, this work provides an empirical study of the impact of enriching ATL (*Atlas Transformation Language*) [10] model transformations. To that end, an heuristic to obtain quantitative indicator to assess the quality of model transformations is introduced. Such indicator is then used to compare standard and enriched versions of 7 model transformations with different levels of complexity.

The rest of this work is structured as follows: Section 2 describes the enrichment process for ATL model transformations supported by `iTrace` [11]; Section 3 introduces the proposal from van Amstel and van den Brand for the quality assessment of model transformations; Section 4 presents the empirical study performed in this work and the analysis of results; and finally Section 5 concludes by highlighting the main findings and providing directions for further work.

2 Enriching ATL Model Transformations with iTrace

The first step towards the appropriate management of traceability is the existence of traces. However, since many projects do not provide such traces, mechanisms are needed to support the production of traces. In order to avoid accidental complexity, such mechanisms should be completely automatic and transparent for the user.

To fulfill these requirements in the context of MDE, `iTrace` [11] supports the production of trace models in two different scenarios. On the one hand, it supports the enrichment of model transformations that were developed with model transformation languages which do not support the generation of traces. On the other hand, it bundles a set of transformations to normalize existing traces models to a common metamodel: the `iTrace` metamodel. In this paper, only the first scenario is considered, i.e., the production of trace models by enriching existing model transformations. More specifically, we focus on the generation of trace models from enriched ATL transformations.

ATL provides limited access to the target elements generated by running a transformation, e.g. in the current version of the ATL virtual machine (ATL-VM), target elements cannot be selected according to their type. Besides, the ATL-VM discards