Pontifícia Universidade Católica
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Empirical Evaluation of Effort on Composing Design Models

TESE DE DOUTORADO

Thesis presented to the Programa de Pós-Graduação em Informática of the Departamento de Informática, PUC-Rio as partial fulfillment of the requirements for the degree of Doutor em Informática

Advisor: Prof. Alessandro Garcia
Co-Advisor: Prof. Carlos José Pereira de Lucena

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To my family

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Resumo

Oliveira, Kleinner Silva Farias; Garcia, Alessandro Fabricio, Advisor; Lucena, Carlos José Pereira de, Co-Advisor. **Avaliação Empírica de Esforço em Composição de Modelos de Projeto.** Rio de Janeiro, 2012. 282p. Tese de Doutorado – Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

Composição de modelos desempenha um papel fundamental em muitas atividades de engenharia de software como, por exemplo, evolução e reconciliação de modelos conflitantes desenvolvido em paralelo por diferentes times de desenvolvimento. Porém, os desenvolvedores têm dificuldades de realizar análises de custos e benefícios, bem como entender o real esforço de composição. Sendo assim, eles são deixados sem qualquer conhecimento prático sobre quanto é investido; além das estimativas de evangelistas que frequentemente divergem. Se o esforço de composição é alto, então os potenciais benefícios tais como aumento de produtividade podem ser comprometidos. Esta incapacidade de avaliar esforço de composição é motivada por três problemas: (i) as abordagens de avaliação atuais são inadequadas para mensurar os conceitos encontrados em composição, por exemplo, esforço e conflito; (ii) pesquisadores não sabem quais fatores podem influenciar o esforço de composição na prática. Exemplos de tais fatores seriam linguagem de modelagem e técnicas de composição que são responsáveis para manipular os modelos; (iii) a falta de conhecimento sobre como tais fatores desconhecidos afetam o esforço de composição. Esta tese, portanto, apresenta uma abordagem de avaliação de esforço de composição de modelos derivada de um conjunto de estudos experimentais. As principais contribuições são: (i) um modelo de qualidade para auxiliar a avaliação de esforço em composição de modelos; (ii) conhecimento prático sobre o esforço de composição e o impacto de fatores que afetam tal esforço; e (iii) diretivas sobre como avaliar esforço de composição, minimizar a propensão a erros, e reduzir os efeitos negativos dos fatores na prática de composição de modelos.

Palavras-chave

Composição de modelos, esforço de desenvolvimento, estudos empíricos.

Abstract

Oliveira, Kleinner Silva Farias; Garcia, Alessandro Fabricio, Advisor; Lucena, Carlos José Pereira de, Co-Advisor. **Empirical Evaluation of Effort on Composing Design Models**. Rio de Janeiro, 2012. 282p. DSc Thesis – Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

Model composition plays a central role in many software engineering activities such as evolving models to add new features and reconciling conflicting design models developed in parallel by different development teams. As model composition is usually an error-prone and effort-consuming task, its potential benefits, such as gains in productivity can be compromised. However, there is no empirical knowledge nowadays about the effort required to compose design models. Only feedbacks of model composition evangelists are available, and they often diverge. Consequently, developers are unable to conduct any cost-effectiveness analysis as well as identify, predict, or reduce composition effort. The inability of evaluating composition effort is due to three key problems. First, the current evaluation frameworks do not consider fundamental concepts in model composition such as conflicts and inconsistencies. Second, researchers and developers do not know what factors can influence the composition effort in practice. Third, practical knowledge about how such influential factors may affect the developers' effort is severely lacking. In this context, the contributions of this thesis are threefold: (i) a quality model for supporting the evaluation of model composition effort, (ii) practical knowledge, derived from a family of quantitative and qualitative empirical studies, about model composition effort and its influential factors, and (iii) insight about how to evaluate model composition efforts and tame the side effects of such influential factors.

Keywords

Model composition, development effort, empirical studies.

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List of Acronyms and Abbreviations

IBM – International Business Machine

UML – Unified Modeling Language

AO – Aspect-Oriented

AOM – Aspect-Oriented Modeling

CBO – Coupling Between Object Classes

EMF – Eclipse Modeling Framework

GQM – Goal Question Metric

IBM – International Business Machine

IDE – Integrated Development Environment

LCOM – Lack of Cohesion in Methods

MDD – Model Driven Development

MVC – Model View Controller

OCL – Object Constraint Language

OMG – Object Management Group

OO – Object-Oriented

RQ – Research Question

SPL – Software Product Line

UML – Unified Modeling Language

ECL – Epsilon Comparison Language

EML – Epsilon Merge Language

Believe in your dreams

Kleinner Farias