



Elder José Reoli Cirilo

**Supporting Heterogeneous Configuration
Knowledge of Software Product Lines**

Tese de Doutorado

Thesis presented to the Programa de Pós-Graduação em Informática of the Departamento de Informática do Centro Técnico Científico da PUC-Rio, as partial fulfillment of the requirements for the degree of Doutor.

Advisor: Prof. Carlos José Pereira de Lucena

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Resumo

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Softwares personalizados para as necessidades de um cliente proveem vantagem competitiva quando comparados aos softwares de propósito geral. Linhas de produtos de softwares tem como objetivo a produção de produtos personalizados a partir de um conjunto de *features* reutilizáveis. É conhecido que o reuso sistemático de *features* potencialmente leva a ganhos significativos como rápida produção de software a um baixo custo e com maior qualidade. Na prática, a construção de linhas de produtos de softwares empresariais pode se tornar uma tarefa arriscada e sujeita a erros quando se leva em consideração o uso das técnicas atuais de implementação de *features*. O desenvolvimento de linhas de produtos de software empresariais de fato requer a convergência coordenada de várias visões (ex., especialistas de domínio, projetistas de interface, e desenvolvedores). Neste caso, cada participante do processo de desenvolvimento tem uma linguagem particular para resolver o problema específico a sua especialidade. Os desafios para integração de diferentes linguagens, evitando uma potencial cacofonia, é o problema do conhecimento de configuração heterogêneo. Nesta tese, nos examinamos as dificuldades atuais na especificação do conhecimento de configuração heterogêneo e como solução nos propomos a noção de Linguagens de Modelagem do Conhecimento do Domínio (LMCD). O propósito das LMCDs é evidenciar os conceitos do domínio e suas interfaces de programação, o que ajuda reduzir o ofuscamento do código fonte e aumentar a compreensão. Além disso, evidenciando os conceitos específicos de domínio, somos aptos a prevenir inconsistências em produtos pela detecção de erros em toda a linha de produto de software. Outro resultado deste trabalho de pesquisa é GenArch⁺, uma ferramenta extensível que suporta de forma flexível a incorporação de LMCDs na engenharia de linhas de produtos de softwares tradicional. Nos enfatizamos os benefícios da ferramenta, incluindo simplicidade, expressividade, e a capacidade de ser independente de qualquer tecnologia de implementação do domínio. Finalmente, nos ilustramos e avaliamos o uso de LMCDs em três diferentes linhas de produtos de software.

Palavras-chave

Linhas de Produtos de Software; Frameworks Orientados a Objetos; Linguagens Específicas de Domínio; Ferramentas para Linhas de Produtos de Software;

Abstract

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Customer-specific software can provide a competitive advantage compared to general-purpose software. A software product line (SPL) aims at tailoring customer-specific products from a set of reusable features. It is well known that systematic reuse of features potentially leads to significant gains such as faster production with low costs and high quality. In practice, building enterprise software product lines might become a laborious and error-prone task when we take into account the use of current implementation techniques. Successful development of modern enterprise software product lines requires the convergence of multiple views (e.g., domain experts, interface designers, and developers), which are usually managed via domain-specific concepts. In this case, each participant of the development process has a particular working language to solve specific problems to its expertise. The challenge of integrating these differences into the engineering process, avoiding the potential cacophony of multiple different languages, is the heterogeneous configuration knowledge problem. In this thesis, we examine the current shortcomings on the specification of heterogeneous configuration knowledge and as a solution we propose the notion of Domain Knowledge Modeling Languages (DKMLs). The purpose of DKMLs is to put in evidence the domain concepts and their programming interfaces, which help to reduce source code obfuscation and increase feature comprehension. Moreover, evidencing the domain-specific concepts, we are also able to prevent inconsistencies on products by detecting errors in the entire software product line. Another result of this research is the GenArch⁺, an extensible tool that supports the flexible incorporation of DKMLs in traditional software product line engineering. We emphasize the benefits of GenArch⁺, including simplicity, expressiveness, and being framework independent. Finally, we illustrate and evaluate the use of DKMLs in three different product lines.

Keywords

Software Product Lines; Object-oriented Frameworks; Domain-specific Languages; Software Product Lines Tools;

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