An Extreme Approach to Automating Software Development with CBD, PLE and MDA Integrated*

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Abstract. Component based development (CBD), product line engineering (PLE), and model driven architecture (MDA) are representative approaches for software reuse. CBD and PLE focus on reusable assets of components and core assets, MDA focuses on transforming reusable models into implementation. Although these approaches are orthogonal, they can be integrated into a comprehensive and extremely effective framework for software development. In this paper, we first present our strategies of integrating CBD, PLE and MDA, and propose an integrated process that adopts reuse engineering and automation paradigm. By applying the proposed approach, it becomes feasible to semi-automatically develop a number of applications in a domain.

1 Introduction

Component based development (CBD), product line engineering (PLE), and model driven architecture (MDA) are representative approaches for software reuse [1][2][3]. CBD emphasizes engineering and reusing independent and customizable components. PLE focuses on modeling commonality and variability into a core asset and deriving applications by instantiating the asset. MDA centers on specifying platform independent model (PIM) and transforming the model into more concrete models and implementations. Although these approaches are orthogonal, we observe that they complement one another. Hence, they can be integrated into a single reuse framework for developing applications efficiently.

In this paper, we first present strategies of integrating CBD, PLE, and MDA to clarify rationales for the integration. Then, we propose an integrated methodology that adopts the components of CBD, the key activities of PLE, and model transformation feature of MDA. By applying the proposed methodology, it becomes feasible to semi-automatically develop a number of applications in a domain. As the result, we can achieve higher reusability and productivity for software development.

2 Strategies for Integrating CBD, PLE, and MDA

An ideal development methodology should have high levels of three quality criteria; *reusability, productivity,* and *standardization*, as shown in Fig. 1 The figure also shows

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what constructs/mechanisms of CBD, PLE and MDA potentially contribute to achieving the quality criteria. Based on this observation, we now present how each quality criterion can be achieved using the three technologies.

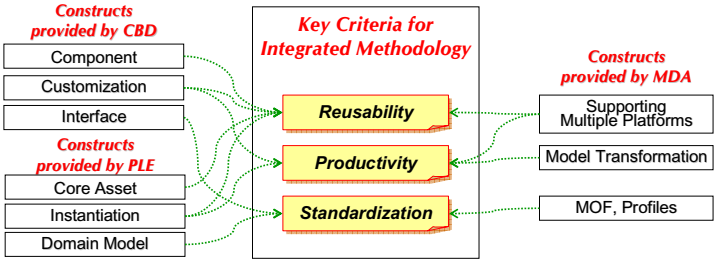

Fig. 1. Key Criteria for Integrated Methodology

Strategy for High Reusability: PLE emphasizes the reusability of core assets, i.e. domain level or architecture level reusability. However, current PLE processes do not address how the core asset can be implemented for specific programming language and platform. MDA can complement this with mechanisms to transform PIM to Platform Specific Model (PSM) which is a detailed design model for a particular platform such as Java, EJB, and .NET. By this, the scope of reusability is extended over different platforms as well as family applications in a domain.

Strategy for High Productivity: Current PLE application engineering includes a phase for core asset instantiation, but concrete instructions to instantiate the given core asset are not provided. The model transformation mechanism of MDA can be used to map core asset to instantiated core asset by specifying decision models and decision resolution models in MOF. By this transformation/automation, the productivity of development is greatly increased.

Strategy for High Standardization: PLE does not provide templates or standards for representing core assets but it provides domain commonality. The PIM, PSM and meta object facility (MOF) of MDA can be used to represent the generic architecture, components, and their interactions of core assets. Hence, this integration enforces standardization on the domain and artifact representations.

3 The Integrated Process

In this section, we present the overall process with instructions. Fig. 2 shows the 13 phases of the process, the associated artifacts in CBD and PLE, and representations in MDA. The phases of application specific design and component customization can be performed in parallel. If appropriate commercial-of-the-shelf (COTS) components are available, component customization activity can be performed with core asset instantiation.