

KOPLE— Knowledge-Oriented Product Line Engineering

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Abstract

The maturity of Knowledge Engineering (KE) theory and practice presents a real opportunity for advancing the state-of-the-art and state-of-the-practice in software Product-line Engineering (PLE). Several challenges that face the adoption and implementation of PLE in practice can be addressed by exploiting advanced techniques from KE. This paper introduces the concept of KOPLE and describes the related one-day workshop that will be held in conjunction with SPLASH 2010.

Categories and Subject Descriptors D.2.13 [Software Engineering]: Reusable Software, Domain Engineering

General Terms Design

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1. The Concept of Knowledge-Oriented PLE

Software Product Line Engineering (PLE) has emerged as an effective and practical technology to exploit systematic reuse in developing software applications. PLE exploits systematic reuse by identifying and methodically reusing software artifacts to develop different but related software systems. A software product-line can be defined as “*a set of software-intensive systems sharing a common, managed set of features that satisfy the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a particular way*” [1].

To reap the real benefits of PLEs, organizations must adopt methods and techniques to identify reusable artifacts and reuse them in an orderly and systematic fashion. Methods and techniques that can be used to identify common features of different products in a domain and craft their com-

monalities into reusable assets are known as Domain Engineering and analysis [3] [4].

Developing product lines requires analysis skills to identify, model, and encode domain and product knowledge into artifacts that can be systematically reused across the development life-cycle. Practical implementations of PLE show that the intensive activities for PLE can be very beneficial for understanding the business domain. Indeed, analysis and modeling activities during the engineering of a product line serve as a base to distill and codify the *tacit business and technical knowledge* within the organization and the domain. As such, knowledge plays a fundamental role in the development of PLEs. Unfortunately, this role is not explicitly addressed in the PLE community.

The PLE community has been focusing mostly on the technical issues related to the modeling, analysis, and development of product-lines. However, less attention has been devoted to explore the knowledge aspects of PLE. Several practical challenges and problems that hinder the adoption of PLE in practice can be effectively addressed if viewed from knowledge perspective. Examples of challenges that can be addressed from a knowledge perspective include: domain knowledge identification and structuring, and product features modeling and analysis.

The above *knowledge-oriented* perspective of PLEs calls for new techniques to deal effectively and efficiently with the knowledge in the context of PLEs. Accordingly, we introduce the concept of *Knowledge-Oriented Product Line Engineering* (KOPLE) that refers to *research activities that extends and/or exploits knowledge engineering theories, techniques, and methods to address key challenges related to the development and implementation of PLEs*.

As a first step towards the assembly of a KOPLE research community and to bring the attention of the PLE community to this overlooked issue, we organize the first KOPLE workshop that will be held in conjunction with SPLASH 2010. The KOPLE workshop aims at exploring the interplay between KE and PLE. The workshop investigates how knowledge engineering can improve the theory and practice of PLE and vice versa.

2. Overview of KOPLE Related Research

Over the last decade, there have been an increasing research efforts in exploiting the potential of various knowledge engineering techniques in PLE and visa versa (see for example: [2], [5] – [12]). In [2], a lightweight product line engineering method is used along with agile techniques to develop tool that supports the visual composition of web services. In [5], the asset mining for product lines is described with focus on architecture reconstruction which can be used, in return, to support product line evolution.

In [8], an ontology-based approach is proposed for analyzing commonality and variability of features in PLE. Also, in [10], ontologies are used to enhance the reuse of domain and enterprise engineering assets. Source code mining is proposed in [12] in order to enhance the maintainability of product lines. In [9], a semantic modeling approach for PLE is proposed and demonstrated. Other studies also focused on feature asset mining and service identification in product lines using various techniques such as formal concept analysis and concept lattice.

These research efforts; however, are scattered, and thus they have a limited impact on advancing both the PLE and the KE research community. Workshops and other research forums are needed in order to jointly identify key challenges and problems in both communities, and explore how each community can benefit from the other. This workshop presents one of the early starts in this direction.

3. Workshop Objectives and Scope

The goals of this workshop are to identify and exchange research and industrial experiences related to the use of knowledge engineering in various aspects of PLE and visa versa; jump start a research community that focus on KOPLE; form focus groups to investigate key challenges identified and raised in the presented papers; and initiate a *Working Group* that focuses on knowledge issues related to PLE to further develop this area and its practice.

The workshop examines various issues and challenges related to KOPLE via the following venues: (1) Full papers describing theoretical and practical ideas and concepts, (2) Experience reports from industry that implement KOPLE or address its challenges in practical settings, (3) Position papers presenting work in progress or novel ideas at high level, and (4) Demonstration of practical implementation, tool support, etc. The results of the work groups, along with presentation slides will be made available on the workshop website [14].

The workshop focuses on various topics related to both PLE and KE communities such as:

- Mining knowledge from existing assets
- Use of ontology in developing PLE
- Use of PLE concepts for semantic web and web services

- KE techniques for PLE scoping and testing
- Knowledge-based commonality and variability modeling languages and techniques
- Industry case studies and experience reports in developing knowledge-oriented PLE
- Tool support for knowledge-oriented PLE
- Economical aspects of adopting knowledge-oriented PLE

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