

# Building Software Process Line Architectures from Bottom Up

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**Abstract.** In this paper, we propose a technique for establishing process lines, which are sets of common processes in particular problem domains, and process line architectures that incorporate commonality and variability. Process line architectures are used as a basis for deriving process lines from the perspective of overall optimization. The proposed technique includes some extensions to the Software Process Engineering Metamodel for clearly expressing the commonality and variability in the process workflows described as UML activity diagrams. As a result of applying the proposed technique to hardware/software co-design processes in an embedded system domain, it is found that the proposed technique is useful for defining consistent and project-specific processes efficiently.

## 1 Introduction

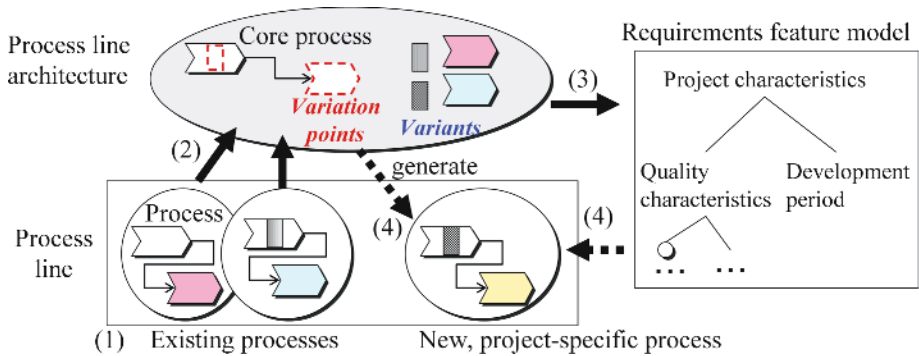
Process tailoring is an approach for defining project-specific processes by adding, removing or modifying the activities and the required inputs/outputs of a base process model to develop high-quality system/software efficiently. Project-specific processes are a collection of interrelated, concrete activities along the time line of the project, which take into consideration the characteristics of the specific project. Conventional tailoring approaches can be divided into two major types[1]: component-based approaches and generator approaches. The former tries to build a project-specific process based on existing process parts, but it lacks a way to address the overall compatibility and consistency of the derived processes. The latter tries to build a project-specific process by instantiating a typical process architecture, but it lacks a way to reuse process fragments.

In this paper, we propose a new process-tailoring technique which solves the problems with component-based and generator approaches by building a *Process-Line Architecture* (hereafter *PLA*) and deriving project-specific processes from the PLA. A process line is a set of similar processes within a particular domain, and is an application of the idea of product lines to processes. Process lines were proposed by Romback[2] and Jaufman[1], but parts of the definition and technical system are still not well-defined, and not sufficient for creating a concrete framework. Other similar ideas have also been proposed, including process libraries[3] and families[4]; however, these are not always oriented toward overall optimization, and do not lead to generally-applicable process-model structures.

## 2 Process Line Architecture

We define a *Process Line* as “a set of processes in a particular domain or for a particular purpose, having common characteristics and built based upon common, reusable process assets (such as PLAs, requirements)” . The relationship between process lines and PLA is shown in Figure 1.

A PLA is “a process structure which reflects the commonality and variability in a collection of processes that make up a process line from the perspective of overall optimization”. We mean “overall optimization” as preparing a PLA with general utility rather than defining separate but similar optimized processes. By deriving individual process from the PLA, the fixed amount of additional effort required in the future can be reduced, and timeliness of completion can be improved. Commonality in a PLA is represented by the core process, which is made up of the common parts of the set of processes. Variability is represented by the variation points and process variants. Variation points are activities (or the inputs/outputs or roles that effect activities) which can be changed according to the characteristics of a specific project. Process variants are the concrete candidate activities (or inputs/outputs, etc.) that are applied to the variation points. Processes that are specialized for a particular but similar project can be defined and applied effectively by combining, extending and reusing the core process and variants in a particular problem domain.



**Fig. 1.** Process line framework and bottom-up building activities

It is difficult to adequately analyze commonality and variability in a domain from scratch without missing anything; this is to say a “top-down” approach. So we propose the following “bottom-up” technique (shown in Figure 1) for building a PLA using existing knowledge on process definitions and applications in the well-known problem domain. We define *Process Line Engineering* as “a system of interrelated strategic and systematic approaches for building, applying and managing process lines”. Based on this concept, the following activities (1)–(3) are in the domain engineering, and (4) is in the application engineering.