A Metamodel for Assessable Software Development Methodologies

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Abstract. Software development methodologies usually contain guidance on what steps to follow in order to obtain the desired product. At the same time, capability assessment frameworks usually assess the process that is followed on a project in practice in the context of a process reference model, defined separately and independently of any particular methodology. This results in the need for extra effort when trying to match a given process reference model with an organisation’s enacted processes. This paper introduces a metamodel for the definition of assessable methodologies, that is, methodologies that are constructed with assessment in mind and that contain a built-in process reference model. Organisations using methodologies built from this metamodel will benefit from automatically ensuring that their executed work conforms to the appropriate assessment model.

Keywords: capability assessment, metamodelling, software development methodologies, process assessment, SPICE/OOSPICE

1. Introduction

While process modelling has a long history, many authors (e.g., Curtis et al., 1992) express concern about the inadequacies of existing software lifecycle models which, among other things, lack the rigour required by automated and automatable processes and do not offer any facility by which to reason about the process itself in order to know whether or not a changed process is improved by the change. More recently, metamodels have been proposed (e.g., Conradi et al., 1994; Henderson-Sellers and Bulthuis, 1997) as a means of creating additional rigour for methodology/process modelling. In essence, using metamodels means modelling a methodology as if it were any other system, applying the same modelling ideas and procedures that are usually applied to business applications or other software-intensive systems.

A metamodel is, therefore, in this context, a model of a methodology or, indeed, of a family of related methodologies. Methodologies constructed from a metamodel usually offer a higher degree of formalisation and better support for consistent extension and customisation, since the concepts that make their foundations are explicitly defined. Some metamodels are available as independent standards (such as SPEM, see (OMG, 2002)) while others are provided together with a broader methodological framework that may include a methodology (such as the OPEN Process Framework, (Firesmith and Henderson-Sellers, 2002) or OPEN/Metis, (Gonzalez-Perez, 2003), respectively).

Once a methodology is in place and an organisation uses it, steps are followed and some work is actually carried out. The organisation may want to assess the quality of the execution
of such work; in this context, “assessment” means determining the quality of the work execution which, in turn, can be related to the quality of the resulting products. \(^2\) The results of the assessment are often used to ascertain the capability of the organisation, either for internal purposes (such as process improvement or quality monitoring) or in a client/provider context, perhaps to meet a contractual requirement. These capability assessments are usually conducted using some well-established standard such as CMMI (SEI, 2002) or ISO/IEC 15504: 1998 (ISO, 1998), which define specific assessment methods and *process reference models*.

A process reference model usually defines the abstract properties that some formal or informal process must comply with in order to be assessable, for example in terms of *purpose* and *outcomes*. Assessors in charge of performing the capability assessment must check and ensure that the work carried out by the organisation conforms to the requirements of the process reference model as a preliminary step before the actual assessment takes place.

OOSPICE (Object-Oriented and Component-Based Software Process Improvement and Capability Determination) is an international project funded by the European Union that pursues, among other objectives, the delivery of a software development methodology (the OOSPICE methodology) oriented toward component-based development (CBD), plus an assessment methodology which, in turn, must include a specific process reference model (see Henderson-Sellers et al. (2002) and http://www.oospice.com for additional information). One of the deliverables of the project is a *unified metamodel* that aims to allow for the definition of all CBD methodologies that are assessable. An *assessable methodology* is a methodology that incorporates the necessary formal properties so that no external process reference model is needed, because it contains a built-in process reference model. The following sections show why a metamodel for assessable methodologies is necessary and how one has been built under the auspices of the OOSPICE project. We have chosen an iterative and incremental approach to discuss the metamodel, showing it at different stages of completeness and complexity. It must be noted that the metamodel is coherent and consistent at every single iteration, although later iterations support richer expressiveness.

### 2. Motivation

In order to reason about software process modelling, Curtis et al. (1992, p. 77) considered the different information people normally want to extract from a process model. Process modelling languages usually present one or more perspectives related to the sought information. Curtis et al. have hypothesized that a process model that addresses the four perspectives of Functional, Behavioural, Organisational and Informational will produce an integrated, consistent and complete model of the process. That is, a methodology will be better if it can represent several of these perspectives. During its development, the OOSPICE project requested the creation of a methodology that dealt primarily with the Functional perspective. Since this methodology was intended to be deployable and useable, and indeed has already been trialled in a small number of companies in Austria,\(^3\) we recognize that its usefulness would have been enhanced if it also dealt with the Informational, Behavioural and Organisational perspectives—organizations that are users of the OOSPICE methodology are currently expected to determine local tailoring of requirements. This permits the OOSPICE methodology to remain context independent, yet customizable to specific circumstances.