

Measuring the Functional Size of Conceptual Models in an MDA Environment¹

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Abstract. The measurement of the functional size of applications generated in MDA environments is a challenge for the software development industry. This paper presents the OO-Method COSMIC Function Points (OOmCFP), a measurement procedure that has been designed to measure the functional size of object-oriented applications generated from their conceptual models by means of model transformations.

Keywords: Conceptual modeling, Object orientation, Functional size measurement, COSMIC, MDA.

1 Introduction

The MDA approach separates application and business logic from the platform technology, allowing code generation by means of model transformations. This is the case of the OO-Method approach [7], which is an object-oriented method that provides the semantic formalization needed to define complete and unambiguous conceptual models, allowing the automatic generation of software products using a MDA-based technology.

The adoption of MDA-based technology has presented new challenges, such as measuring the size of the generated products. The COSMIC measurement method [5] can be used to perform this task. Currently, there are some approaches that apply COSMIC to estimate the functional size of future software applications from high-level specifications [2] [3]. Since the functionality to be measured using these proposals is not detailed enough to generate the final application, the definition of an FSM procedure that allows the measure of the correct size of applications is needed.

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In practical settings, it is very important to know the correct size of the conceptual models that are built with the MDA-based approaches, since the functional size of the models must be known in order to estimate the cost of the software product that is generated automatically. This paper presents the OOmCFP proposal, which is a procedure based on COSMIC that allows the measurement of the functional size of the OO-Method conceptual models from which the applications will be generated.

The rest of the paper is organized as follows: section 2 presents the design of the OOmCFP, and section 3 presents some conclusions and suggestions for further work.

2 Design of a Measurement Procedure

According to the process model for software measurement proposed by Jacquet and Abran [6], the design phase of a measurement procedure is related to the definition of the concept to be measured and the rules to measure this concept. This relevant phase is divided into four sub-steps: the definition of the objectives, the characterization of the concept to be measured, the selection of the metamodel, and the definition of the numerical assignment rules.

In the sub-step *definition of the objectives*, the objective of OOmCFP is to design a procedure in accordance with the COSMIC functional size measurement method for measuring the functional size of software applications that are generated using an MDA approach from their conceptual models which are built with OO-Method.

In the sub-step *characterization of the concept to be measured*, we define the entity and the attribute to be measured. The input artefact used to measure the functional size of the OO-Method applications is the Conceptual Model. This model is comprised of four models (Object, Dynamic, Functional, and Presentation) that allow the generation of a fully working software application. The conceptual model of OO-Method is described in detail in [7]. Therefore, the *entity* to be measured by OOmCFP will be an OO-Method conceptual model, and the *attribute* to be measured will be the functional size, which is defined by the ISO/IEC 14143-1 standard as the size of software derived by quantifying the functional user requirements [4].

In the sub-step *selection of the metamodel*, we have selected the COSMIC standard because, in contrast to other FSM standards like IFPG FPA, NESMA FPA or MARK II FPA, it allows the functional size measurement of multi-layer applications (like OO-Method) from different viewpoints. Figure 1 shows the COSMIC metamodel according to the COSMIC measurement manual version 3.0 [1], which illustrates the information that should be represented by the software artefact to be measured.

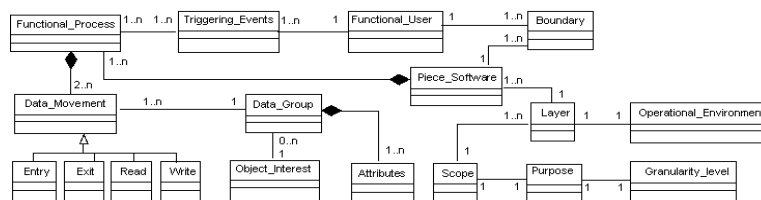


Fig. 1. Metamodel of COSMIC.

The *purpose* of the measurement in OOmCFP is to measure the functional size of the OO-Method conceptual models to estimate the cost of the applications generated by the OlivaNova Suite.

The *scope* of the measurement in OOmCFP is the OO-Method Conceptual Model from which the final software application will be built.

The *granularity level* of the measurement is low because all the details in the OO-Method conceptual model are needed to generate the applications.

The OO-Method software applications are generated according to a three-tier software architecture: the presentation tier (Client layer), the logic tier (Server layer), and database tier (Database layer) – see Figure 2. Each tier can be developed for different software environments.

As Figure 2 shows, the human user is a *functional user* of the client layer of the software and is separated from that layer by a *boundary*. In turn, the client layer of the software is a *functional user* of the server layer and is separated from that layer by a *boundary*. The server layer of the software is both a *functional user* of the client layer and a *functional user* of the database layer of the software and is separated from these layers by a *boundary*. In addition, the legacy systems are functional users of the server layer and are separated from that layer by a *boundary*.

The human user carries out the *triggering events* that occur in the real world. This user starts the *functional processes* that are direct successors of the hierarchy action tree (HAT) of the presentation model of OO-Method conceptual model. Each child represents a single functional process. The ‘client user’ starts the *functional processes*, which are the actions that the server layer carries out in response to the functional processes that occur in the client layer. The ‘server user’ starts the *functional processes*, which are the actions related to the database layer in response to the functional processes that occur in the server layer. The ‘legacy user’ starts the *functional processes*, which are the actions that the server layer carries out in response to the functional processes that occur in the legacy systems.

Every functional process has a set of *data movements* that can be entry data movements (E), exit data movements (X), read data movements (R) or write data movements (W). In the measurement guide² we have defined 69 mapping rules for the data movements that can occur in the OO-Method applications – see Figure 2.

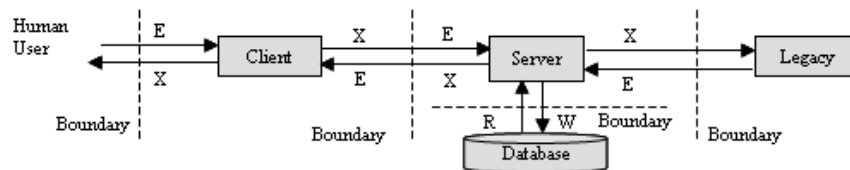


Fig. 2. Data movements that could occur in an OO-Method application.

Each single data movement moves one data group. The *data groups* are the classes of the object model of OO-Method that participate in a functional process. Every class has a set of attributes that will be the *data attributes* of a data group.

² <http://oomethod.dsic.upv.es/labs/images/OOmCFP/guide.pdf>

In the sub-step *definition of the numerical assignment rules*, we have determined the measurement rules for the data movements that can occur in an OO-Method application. One size unit, referred to as 1 *cfp*, will be assigned to each data movement. Thus, the functional size of a functional process will be the addition of the data movements that occur in that functional process. Next, the functional size of a layer will be the addition of the functional sizes of the functional processes that are contained in that layer. Last, the functional size of a generated OO-Method application will be the addition of the functional size of every layer of the application.

In terms of the validation of the OOmCFP procedure, we have verified how the measurement process works in practice using some predefined OO-Method conceptual models. In addition, we can infer that OOmCFP has been theoretically validated because the theoretical validation of COSMIC was carried out successfully in [2] using the DISTANCE framework. Moreover, an expert³ has validated the conformity of the OOmCFP procedure with the COSMIC version 3.0.

3 Conclusions and Further Work

In this paper, we have presented OOmCFP, which is an FSM procedure based on COSMIC for object-oriented applications generated in MDA environments from their conceptual models. The design of OOmCFP was presented using a generic process model for software measurement. We consider that OOmCFP specifies the issues that must be considered for the development of a tool to automate the measurement of the functional size of applications generated in MDA environments. Further work includes empirical studies of the reproducibility and the repeatability of OOmCFP, and the creation of a tool that automatically implements OOmCFP.

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