7. EVALUATION

> Anyone who attempts to generate random numbers by deterministic means is, of course, living in a state of sin.
>
> *(John von Neumann)*

Contents

In this chapter, the evaluation of the conceptual approach and the tool support, described on chapter five and six respectively, are covered.

7.1. Concept

The conceptual approach used for the representation of organizational wide defined metrics and their tailoring is made of several components, which prove to have some benefits. These components and their respective advantages are listed below:

Consistent definition of metric. The metric concept used by the approach is sustained on the Measurement Information Model (see Section 2.1.2). Thus, a defined structure for relating different metric concepts and terms and a link between the metrics and their information needs is established. Additional to this, the visualization means are also included. Therefore, a well-defined analysis path that supports the conception of the approach was provided.

Metric metamodeling. The usage of a metric meta-model allowed to formalize the definition of metric. All the concepts and terms from the metric concept were integrated in the meta-model as entities (see Section 2.2.1). The consistent definition of metric permits to establish a boundary between the entities conforming the metric meta-model. It provided the grammar and syntax.

Metric framework. The usage of a metric framework as solution for the representation or organizational wide defined metrics enabled the possibility to assemble the collection of metrics as a best practice library that is available for the different projects (see Section 5.2.1). Each project can select the metrics and adjust them to comply with its requirements. A metric framework will keep the stake-

holders focused on their information needs, rather than spending time on the definition of the metrics. Finally, a metric framework promotes metrics reuse within an organization and allows a better organized collaborative metric environment. In order to interconnect the metric frames, the metricframework uses interfaces.

Metric frame. The representation of organizational wide defined metrics as metric frames allows grouping several entities from the metric meta-model; facilitating the disctinction of the metrics from the rest (see Section 5.3). A metric frame can improve the quality. This differentiation reduces the time spent during the tailoring process.

Variability model. The internal structure from a metric frame contains variant and common parts that can be used to specify the boundaries from the tailoring, what is possible to be tailored and what remains unmodified. The variability model is also used to validate the consistency on the metric frames and their relations and constraints (see Section 5.4.1). The variation points are those spots where the tailoring is possible and the variants represent the available choices. In some cases, the creation of new variants is allowed.

Tailoring process. Tailoring of metrics is achieved by following some activities, which require as input the information needs and result in a project specific metric (see Section 5.4). The activities permit the systematic adjustment of the metrics.

The conceptual approach also presented some issues and problems. The issues and problems that were identified are described below followed by an example:

Repetition of metric frame definition. Despite the reuse effort, the definition of every metric frame implies duplication of effort. During the tailoring of metrics, the metrics expert must define every metric frame including its variation points, variants and other elements from the variability model.
Example: The definition of the metric frame Cost Performance Index (CPI) contains at least two variation points. These variation points are Data Storage Information and Measure Interval. The creation of the metric frames Schedule Performance Index (SPI) and Earned Value (EV) also requires the definition of the same variation points.

Complexity of the metric frames. One issue identified is the complexity of the metric frame in terms of number of variation points and variants contained in its variability model.
Example: The definition of the variability model from the metric frame Planned Value (PV) contains 10 variation points and more than 25 variants.

Hierarchical organization of the metric frames. Another issue observed is the implicit classification scheme of the metric frames. This classification is related to the metrics types: base and derived. A metric frame used to represent a derived metric requires at least another metric frame. As a consequence, dur-

ing the tailoring of the metrics, the users that select a metric frame (containing a derived metric) are required to deal with the tailoring of at least two metric frames. This implies to deal with the variation points that are either not relevant at all from the metric frame that is currently being tailored, or that refer to the selection of the same level of variants. This issue is only observed in the case where the required metric frames have not been tailored.
Example: The tailoring of metric frame Cost Performance Index (CPI) requires the tailoring of metric frames Earned Value (EV) and Actual Cost (AC).

7.2. Tool Support

The conceptual approach developed on this work established the basis for an adequate tool support. The idea of a metric framework enables tool support that may reduce the time spent on tailoring of metrics and increase the efficiency and quality of project specific metrics. Some of the benefits observed are listed below:

Quality improved during tailoring of metrics. A metric framework used for tailoring of metrics represents a reference from the organizational wide defined metrics. Even when every project adjusts the metric frames to fit specific conditions, all of them reference to the same collection of metrics

Separation of Concerns. In the context of tool support, the views (or modes) can be divided in terms of expert mode and user mode. The expert mode view deals with the creation and maintenance of the metric framework. This view includes the definition of the metric frames and their variability model. These tasks belong to the metrics expert. The user mode view displays the metric frames that can be selected in order to be adjusted. This activity corresponds to the different users that require project specific metrics.

Use of design patterns. The tool support makes use of certain design patterns, like "decorator" [GV02]. The Decorator design pattern that enables the allocation of responsibilities to an object's method dynamically, it is used to work with different types of parameters.

The technique used to design the tool support was paper prototyping. This allowed communication between people involved and feedback on aspects related to ergonomics and design. Besides communication and feedback, paper prototyping showed other advantages as rapid prototyping and low effort required in the skecth of the Graphic User Interface (GUI) from the tool. The lack of real appearance of the GUI can be mentioned as a disadvantage. Moreover, paper prototyping is a technique that shows horizontal prototypes and nothing related to the internal functionality is covered.

7.3. Discussion

To conclude the evaluation, some questions were formulated to illustrate the overall course of action followed during this master thesis.

1. **What was the procedure followed?**

   The procedure that was followed included literature research, analysis of a small study case, the development of the conceptual approach, the design of the tool support and finally the evaluation. For a detailed explanation on the course of action see Section 1.2.

2. **What were the first ideas? What changed during the research?**

   The first idea was to develop a conceptual approach inspired by Software Product Line Engineering (SPLE). However, an approach entirely based on SPLE will not suffice the requirements. SPLE only covered the variability aspect that the organizational wide defined metrics demanded.

   Later on, the idea of an abstract interpretation from the metrics was suggested. The abstract interpretation should have two domains: an abstract and a concrete. The abstract domain should represent the collection of metrics from the organization, whereas the concrete domain should represent the project specific metrics. In order to move from one domain to the other, two functions will be used: concretization for the tailoring that goes from the abstract to the concrete domain; and the abstraction function that promotes reuse taking project specific metrics to the abstract domain. Due to time constraints and according to the objectives, the abstraction function was discarded from the scope of this work.

   Parallel to the conception of the abstract interpretation, a paper from Mendonça et al. provided the idea of creating a metric framework [MB00]. Although the metric framework found in the literature described a metric repository, our idea was sustained on the object oriented frameworks. This way, and considering SPLE and the abstract interpretation, a metric framework should be contained in the abstract domain. The elements from the metric framework should be the metric frames, which use a variability model that permits their adjustment to meet project specific needs.

   The initial plan considered the implementation of the tool support. Again, due to time constraints, it was discarded. The use of EMF [Ecl10] for the implementation was analyzed. EMF facilitates the use of the metric meta-model. However, the User Interface used to represent the metric framework would require dynamic view. This kind of business applications are better supported by EJB [Ora10].

3. **What were the alternatives?**

   One of the alternatives was to include the variability model in the metric meta-

model. Nevertheless, this would imply more complexity and less flexibility. With the framework used as an intermediate layer between the metric meta-model and the metric instance layer, a scenario where the metric framework is not used is still possible.

4. **What worked well during the research? What did not work well?**

   The conceptual approach developed on this work proves to be feasible for the representation of the organizational wide defined metrics. The metric framework allows the tailoring of metrics along with the management of variation.

   Regarding the concretization function, the first idea suggested that a metric frame will reach the concrete domain straight ahead. But it was demonstrated, that a metric frame can remain in the abstract domain during concretization, until all its variation points are assigned to a variant