

6. TOOL SUPPORT

The machine does not isolate man from the great problems of nature but plunges him more deeply into them.

(Antoine de Saint-Exupery)

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Tailoring of metrics can, if defined from sound engineering principles, be tool supported. This chapter describes the principles on which a tool support is based, provides an application scenario and a horizontal prototype of the tool. The tool support allows users to define new metric frames (including their variation points and variants) through a user interface and to integrated them to the metric framework. Moreover, to tailor metric frames (their multiple variation points) at various levels and to apply them to project specific metrics.

6.1. Concept

A metric framework can be used to enable tool support during tailoring of metrics in a systematic way. In the context of variability modeling and in accordance to the *separation of concerns*¹ (SoC), the tool support can be divided in terms of creation and maintenance of the metric framework (a task that belongs to the metrics expert) on the one side and the use of this metric framework on the other side. Looking at these tasks and the tool support, there are specific aspects to consider.

View. The tool support should provide a user interface that presents an overview of the metric framework containing a collection of metrics and their respective variability. This overview consists of one or more metric frames, where each metric frame has a set of variation points and each variation point has variants with a specific focus and purpose.

Configuration guidance. A second characteristic is to provide guidance through the wide range of choices during the selection of metric frames and their tailoring,

¹Separation of concerns (SoC) is the process of separating a computer program into distinct features that overlap in functionality as little as possible.

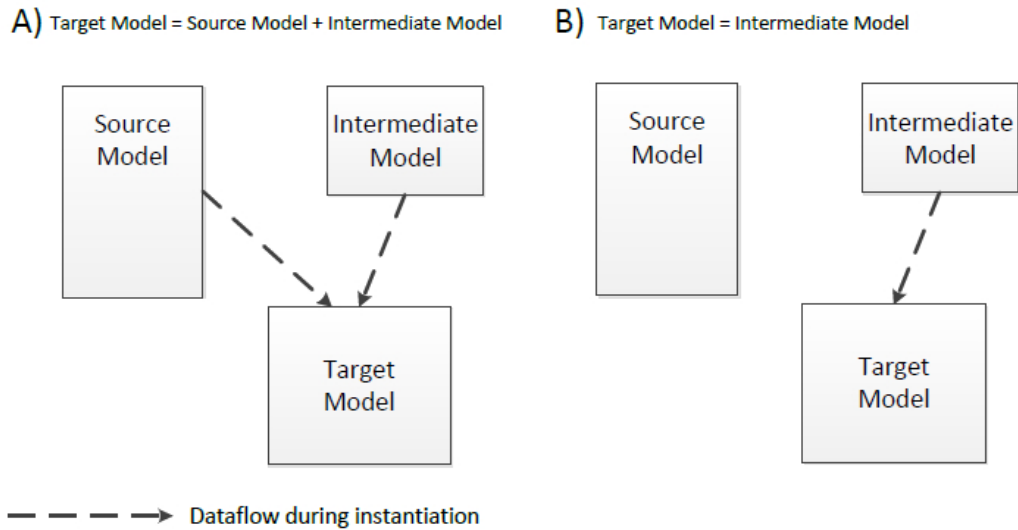


Figure 6.1.: Creation of the target model: A) Using the target and the intermediate models B) Using only the intermediate model

e.g. by presenting the variation points in a particular sequence. Guidance is important as it provides focus during choices and it prevents inconsistencies. Since the metric framework is able to model its variability, this guidance can be provided.

Metric generation. Finally, the decisions that are taken during the tailoring should result in project specific metrics.

An approach regarding the internal composition of the tool is proposed. The underlying structure of the tool is separated in three models: source, intermediate and target. The **source model** contains all the metric elements that represent a metric framework. The **intermediate model** acts as a copy of the metric frames that were adjusted during the tailoring process. When a user selects a metric frame and finishes the tailoring of the same, the tool puts the outcome of the tailoring process in the intermediate model. Regarding the data that are stored on this model, there are at least two alternatives to follow. The first alternative is that the intermediate model stores certain data regarding the metric frames that were tailored. For example, these data are made of a reference to the metric frame, a list of its variation points and their selected variants. The idea of storing certain information is understood as keeping deltas. The second alternative is to keep a local copy of all the information from the metric frame that was tailored. This second alternative is achieved by using the *decorator pattern*². The decorator is used as a reference to the additional attributes. The alternative that is chosen influences the mode how the target model is created. The **target model** represents the result of a successful tailoring process. The creation of the target model follows two scenarios relying in the stored information of the intermediate model. Both scenarios are depicted

²The decorator allows to add new/additional behavior to an existing object dynamically [GV02].

ID	Nr. 1 - Tailor Metrics
Goal	The user wants to tailor a collection of organizational wide metrics based on his information needs.
Classification	Main Task
Precondition	The metric framework exists.
Postcondition	Project specific metrics are generated.
Postcondition on error	The project specific metrics are not generated.
Actors	User (primary), Metric framework
Trigger	The User wants to tailor a metric.
Main flow	<p>1. <i>loop</i></p> <p>1.1 The User selects a metric by pressing the button "tailor metric".</p> <p>1.2 The Metric Framework provides the metric with its respective variability (variation points and their respective variants).</p> <p>1.3 <i>loop</i></p> <p>1.4 <i>if</i> choices are available</p> <p>1.4.1 The User tailors by selecting existing choices (variants).</p> <p>1.5 <i>else</i></p> <p>1.5.1 The User tailors by adding new choices (variants).</p> <p>1.5.2 The Metric Framework stores the created choice (new variant).</p> <p><i>Endif</i></p> <p><i>until</i> The User finishes tailoring all the Variation Points (<i>loop</i> 1.3).</p> <p>1.6 The User finishes the tailoring by pressing the button "finish".</p> <p>1.7 The Metrics Tool stores a copy from the tailored metric.</p> <p><i>until</i> The User finishes the work by pressing the button "done" (<i>loop</i> 1).</p> <p>2. The Metrics Tool generates a copy from all the tailored metrics (Nr. 2 - Generate Metrics).</p>
Deviations	

Figure 6.2.: UML Use Case Template for Tailor Metrics

in Figure 6.1. (A) If the intermediate model keeps only deltas, then the target model is an instantiation that requires the source and intermediate models. (B) For the case where all the information is contained in the intermediate model, the instantiation of the target model is a one-to-one copy. After the creation of the target model, the semantic copy used during instantiation is lost. In order to avoid the lost of information used during instantiation (like the variability defined in the target model), some generic work mechanisms for traceability are required. An example of such mechanisms is a `key=value` properties file. A more complex solution may integrate the traceability into the variability model.

The component adaptation techniques that the tool can use are Black-box and White-Box library reuse (see Section 2.3). Black-box reuse is used to represent metric frames and White-box reuse is used when a preview visualization of the metrics is generated. Preview visualization means displaying a collection of metrics that the user adjusted during the tailoring process.

6.2. Application Scenario

Since the use cases diagram only provides a rough overview of the modeled system, to provide a textual description other means are used here. A use case template is used (depicted on Figure 6.2). A *Business Process Modeling Notation (BPMN)*³ is used to illustrate the process of tailoring metrics in Figure 6.3. The goal of the user is to have a collection of metrics meeting project specific needs. The goal is divided in two main processes, which are the **tailoring process** and the **creation of project specific metrics**. The *tailoring process* is an iterative process that starts with the selection of a metric. The next activity is based in the selection of choices (variants) for each varying attribute (variation point) in the metric. There are cases where providing a choice in the tool cannot satisfy project specific conditions. For these cases, the possibility to create a new choice is allowed. The tailoring process is repeat it for every metric that requires to be part of the project. The next and final process, is the *creation of project specific metrics*. This is indicated by the user that requests the creation of project specific metrics once that he is done with the tailoring process.

6.3. Horizontal Prototype

Paper prototyping (see Section 2.5) was chosen to design the Graphical User Interface (GUI) of the tool supporting the tailoring of organizational wide defined metrics. The advantages gained of applying this technique were rapid prototyping and communication. Rapid prototyping allowed creating in a short time an initial sketch of the GUI. It also allowed applying suggested changes to the GUI in an easy manner. Regarding the communication, the feedback received permitted to have a better understanding on the interaction between the user and the GUI. The feedback also enabled changing some elements of the GUI used to navigate around the tool.

6.3.1. Tool Support Motivation

The technique followed during the design of the GUI was conducted by the objectives established at the beginning of this work. For this reason, the introduction of the GUI is decomposed by objectives. Each objective includes the theory from chapter five supporting it and the rationale explaining the composition of the GUI elements.

Objective: Create organizational wide defined metrics supporting tailoring.

Theory behind the tool: Metric frame and its variability model.

GUI prototype: The first step was to select the main elements from the GUI and integrate them into the environment in such way that the look and feel is kept clear and simple as possible. Figure 6.4 depicts a prototype from GUI that simulates the creation of metrics frames (A) by introducing the name of the metric frame, a description

³BPMN is a graphical representation for specifying business processes [Obj09].

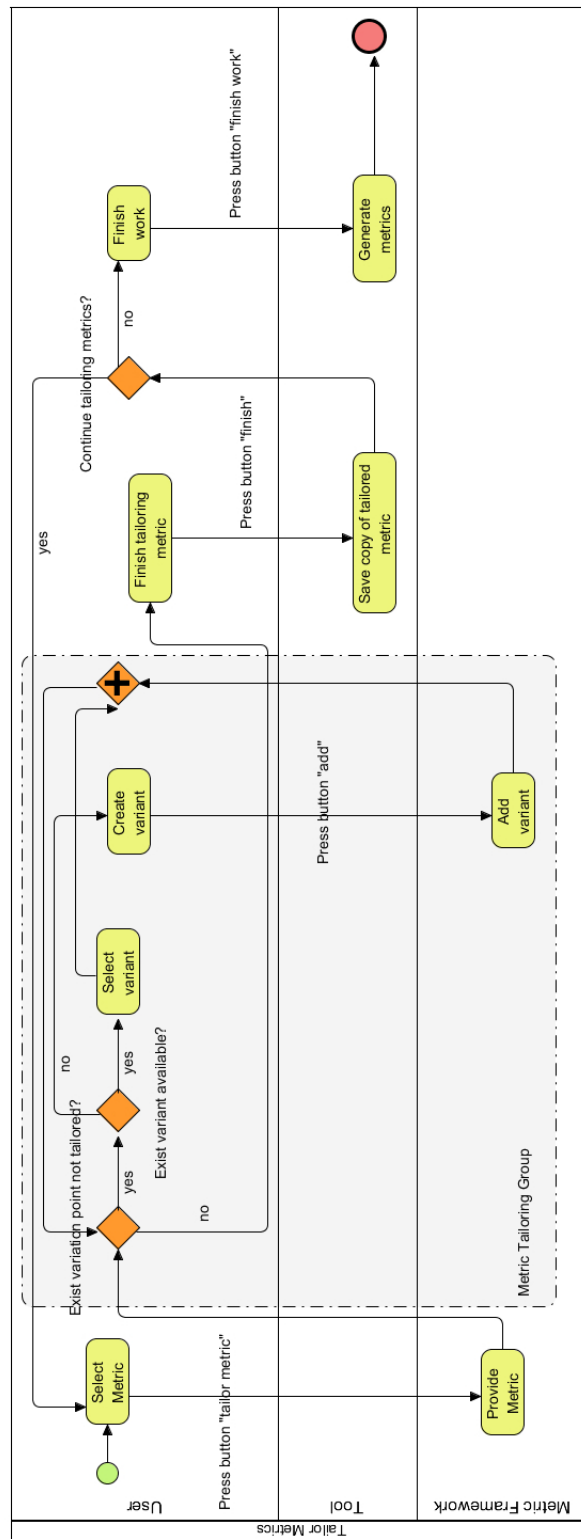


Figure 6.3.: BPMN Tailor of Metrics

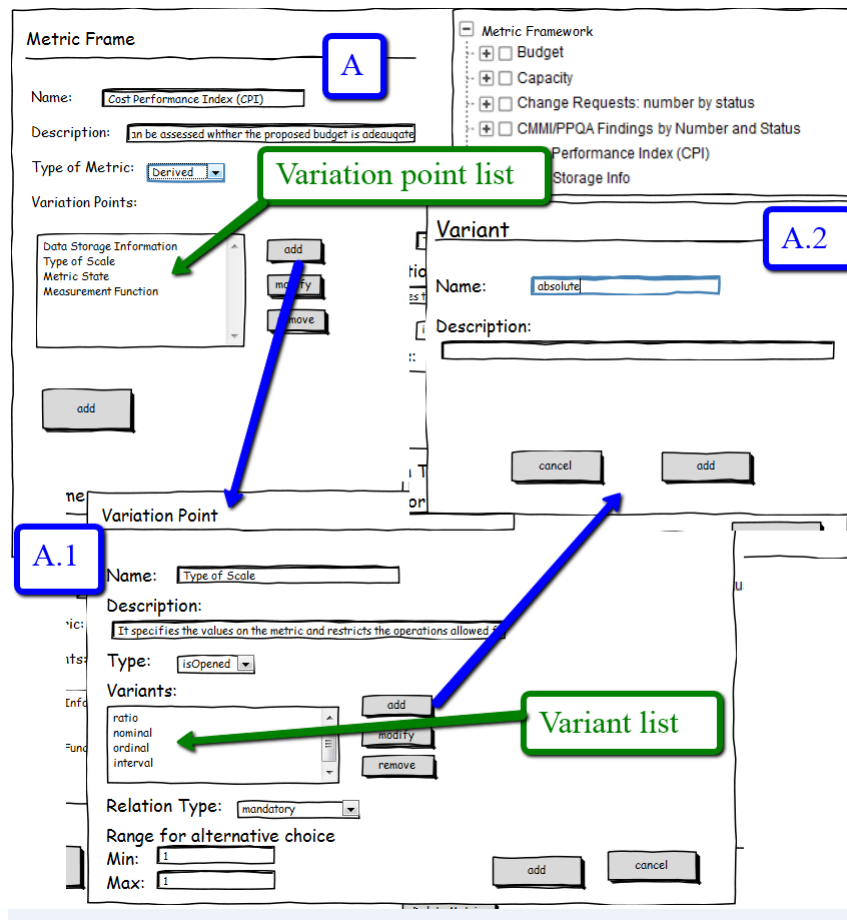


Figure 6.4.: Creation of a metric frame

and variation point list among other elements that constitute its variability model. In order to create more variation points, the button "add" is pressed. A new window is displayed (A.1). The variation point contains a variant list and allows the creation of more variants by pressing the button "add". A third window is *opened* (A.2). The definition of variants occurs right here. However, if the type of a variation point is set to opened (A.1), it is possible to create variants during tailoring of metrics. The main point of creating a metric frame with its respective variability model is to make metrics available. These metrics can be adjusted during the tailoring process to meet specific needs.

Objective: Use of organizational wide defined metrics.

Theory behind the tool: Metric framework.

GUI prototype: Figure 6.5 depicts the prototype of the GUI from the Tool, which is composed by two main panels. The panel from the right side displays the metric framework containing the metric frames that had been previously defined. Each metric frame is represented with a box, e.g. Cost Performance Index (CPI). The scroll bar from the right side allows to view all the available metric frames of the metric framework. The project specific metrics are contained on the panel from the left side. The

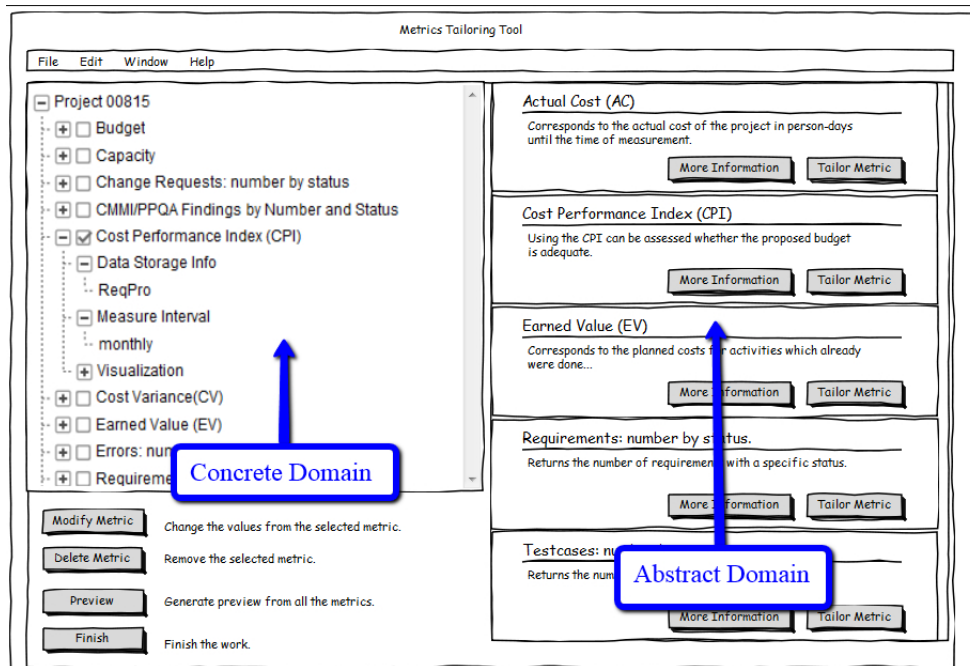


Figure 6.5.: Paper prototype of the Graphical User Interface (GUI) from the tool

metrics are displayed as a tree, where only the variation points and variants, that were previously selected, are visible. The lower part includes a control panel. The buttons from the control panel are used to manipulate the project specific metrics.

Objective: Describe a organizational wide defined metric.

Theory behind the tool: Metric frame and its description.

GUI prototype: The first step consists in the selection of a metric frame from the metric framework. Each metric frame is contained on a single box as depicted in Figure 6.6. The composition of the box includes the name of the metric located in the upper part, e.g. *Actual Cost (AC)*; a brief description about the metric located in the middle from the box. The point of having a description in the box is to inform about the purpose of the metric. The lower part from the box consists of two buttons. One button (1) is used to display detailed information about the metric and the other button (2) is used to open a window that will be used to tailor the selected metric. If the button "More Information" is pressed, a new window with more information about the metric is open.

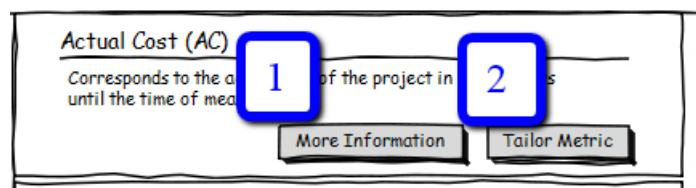


Figure 6.6.: Box displaying the metric frame *Actual Cost (AC)*

Objective: Communicate the parts of a metric that can be adjusted during the tailoring process.

Theory behind the tool: Description of each variation point contained in its variability model.

GUI prototype: The window depicted in Figure 6.7 displays a list of the possible attributes to be adjusted during the tailoring. This list contains the name of the attribute and a description of these attributes. According to the variability model (see Section 5.4.1), every metric frame has a list of variation points and each of those include a textual annotation used to record the rationales for introducing the element. The metric frame from Figure 6.7 contains variation points "type of project", "metric classification", "measure interval" and "data storage information" among others. The next possible action is either to close the window or to press the button "Tailor", which is used to open the wizard that is used to tailor the current metric frame. If the window is closed, the wizard for tailoring can be opened from the box depicted in Figure 6.6 by pressing the button "Tailor metric".

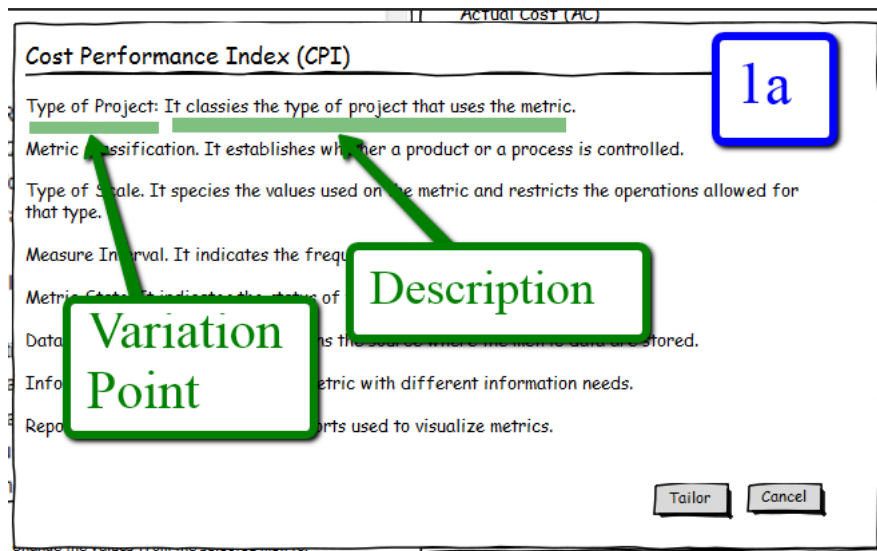


Figure 6.7.: List of variation points and their rationales

The remaining objective follows the use case template described in Figure 6.2 and the BPMN of Figure 6.3. Since the metric frame *Cost Performance Index (CPI)* is used to illustrate the elements from the GUI, a brief summary on some of its variation points is provided.

Type of Project. It classifies the type of project that uses the metric. Example of variants: large and small.

Metric Classification. It establishes whether a product or a process is controlled. Example of variants: product and process.

Type of Scale. It specifies the values used on the metric and restricts the operations allowed for that type. Example of variants: nominal, ordinal, ratio, absolute and

interval.

Measure Interval. It indicates the frequency for the metric to be calculated. Example of variants: daily, weekly, monthly, quarterly and yearly.

Metric State. It indicates the status of the metric. Example of variants: isMeasured, isArchived, isNew and isEvaluated.

Data Storage Information. It contains the source where the metric data are stored. Example of variants: project cockpit, project cvs and project datasheet.

Reporting. It contains visualization reports used to visualize metrics. Example of variants: graphic report a and graphic report b.

Figure 6.8.: Wizard from the metric frame *Cost Performance Index (CPI)*

Objective: Tailor organizational wide defined metrics to reflect project specific needs.

Theory behind the tool: Metric frame and the tailoring process.

GUI prototype: The design of the wizard used to tailor the metric frames consists of four parts. This is based on the structure from the metric frame, which has four categories: metric, information needs, interpretation aids and reporting. The wizard starts with the metric category as Figure 6.8 shows. The composition of the windows follows the pattern of displaying (*VariationPointName*), (*variants*). The purpose of show the variations points is to communicate the parts from the metric that are possible to adjust. The variants represent the available choices that can be selected to reflect specific needs during the tailoring process. The variants can be represented either as checkbox, drop down list, or text input field. The selection criteria from one or another element should be established on the *type of variation point*⁴ (opened or closed) and the number of variants allowed to select. For example, the next criteria were followed on the design of the current paper prototype:

⁴The variation point type states whether is possible to add variants or not. For more information see Section 5.4.1.

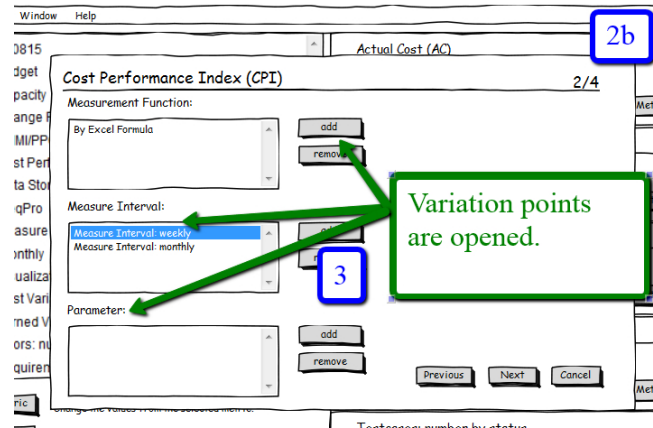


Figure 6.9.: Variation points of type opened

- Variation point is closed and only one variant to select: drop down list, e.g. variation point "type of scale" and "metric state" depicted on Figure 6.8.
- Variation point is closed and many variants to select: checkbox, e.g. variation point "metric classification" depicted on Figure 6.8.
- Variation point is opened and only one variant to select: text input field, e.g. variation point "value range" depicted on Figure 6.8.
- Variation point is opened and many variants to select: text container, e.g. variation point "measurement function" and "measurement interval" depicted on Figure 6.9.

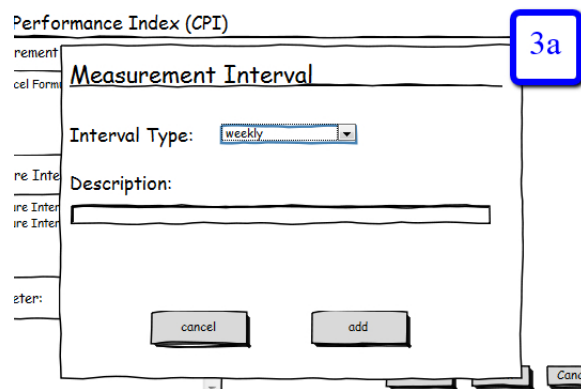


Figure 6.10.: Interface used to create a new variant

Figure 6.9 illustrates the sequence from the metric category, where three variation points are listed. The three of them are of type open and the category of their variants is complex. The purpose of a variation point of type opened is to allow the users to provide their own choices. Each variation point allows adding new variants by pressing the button "add", which will display another window guiding the creation of the new variant. For example, the creation of a new variant for the variation point "measure

interval" is performed by filling the data from the window depicted on Figure 6.10.

The next part of the wizard, depicted on Figure 6.11, is constituted by the information needs and interpretations aids categories. Information needs have one variation point of type closed with variants that belong to alternative choice. This implies that multiple variants can be selected; the range is specified with the minimum and maximum values from the variability model used in the metric frame. The interpretation aids category consists of one variation point that is closed and two of type opened. If the user wants to add a new "decision entry", the sequence 4 → 4a illustrated on Figure 6.11 is followed.

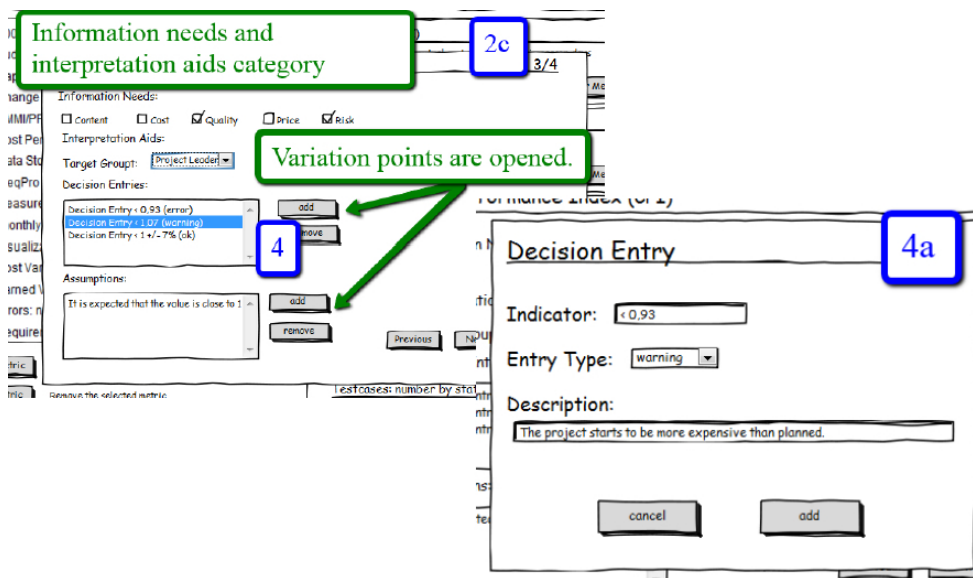


Figure 6.11.: Variation points of type opened

The last section from the wizard refers to the reporting category, depicted on Figure 6.12. The variation point is closed and it has a relation of alternative choice. This means that it is not possible to create variants; it is only allowed to select them. Since this is the last category, pressing the button "finish" will close the wizard from the metric frame. This action returns the control to the main window, depicted on Figure 6.5.

A copy of the tailored metric will be temporarily saved and the information from the variation points is visible on the left panel, where the project specific metrics are listed. The process is repeated until the required metrics have been tailored. It is also possible to modify the data from the project specific metrics. In order to do this, a metric must be selected from the tree, then it is required to press the button "Modify metric" and the wizard used to tailor the metric frame will be opened. Finally, the tailoring is concluded by pressing the button "finish" (located on the left panel from the GUI depicted on Figure 6.5).

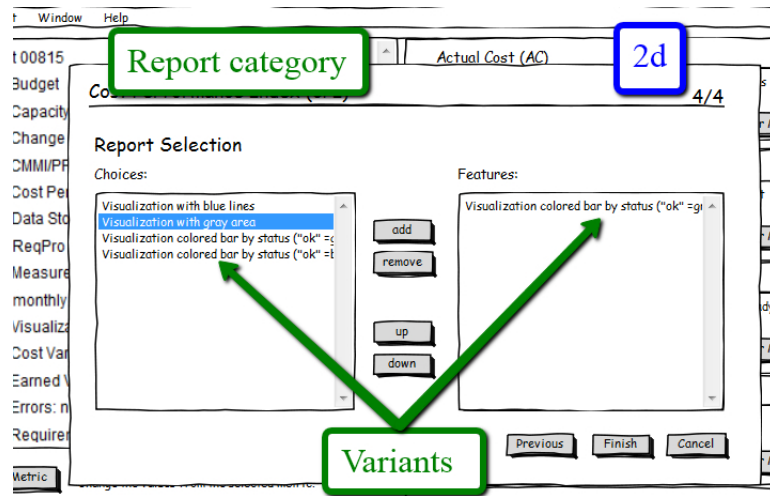


Figure 6.12.: Variation point of type closed and alternative choice variability

6.3.2. Tool Mode View

The view-mode of the tool is classified in two types. The reason of that is the Separation of Concerns (SoC) which is explained at the beginning of this chapter. The two views are expert mode and user mode, explained below:

Expert mode. This mode is used to create the metric frames and include their variation points with their respective variants. The metric frames altogether form the metric framework. The metrics experts uses this mode.

User mode. This mode uses the metric framework for the tailoring of metric frames. A common user of this mode is represented by people involved in a project. In this mode, metric frames cannot be created. However, the creation of new variants is possible in some cases.