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Consistency in multi-viewpoint design of enterprise information systems

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Abstract

Different stakeholders in the design of an enterprise information system have their own view on that design. To help produce a coherent design this paper presents a framework that aids in specifying relations and consistency rules between such views. The contribution of our framework is that it provides a collection of basic concepts. These basic concepts aid in relating viewpoints by providing: (i) a common terminology that helps stakeholders to understand each others concepts; and (ii) re-usable consistency rules. We show that our framework can be applied, by performing a case study in which we specify the relations and consistency rules between three RM-ODP viewpoints.

Keywords: Multi-viewpoint design; Enterprise information systems; Viewpoint consistency; Conceptual modelling; View integration

1. Introduction

In any large-scale design, different people with different interests are involved. These people, or *stakeholders* as we call them, have their own way of looking at a system, for which they use their own modelling languages, techniques and tools. Informally, we call the way in which a stakeholder looks at a system the *viewpoint* of that stakeholder. From his viewpoint, each stakeholder constructs his own design part, or *view*. However, because views are parts of the same multi-viewpoint design, we must preserve the coherence and consistency between the different views.

In this paper, we propose a framework that aids in preserving the consistency in a multi-viewpoint design of Enterprise Information Systems. To this end the framework provides:

- a collection of basic concepts that is common to all viewpoints;
- a means to specify relations between different views;
- a means to specify consistency rules that apply to these relations;
- re-usable relations; and
- re-usable consistency rules.

The framework focuses on the architectural design of enterprise information systems, which focuses on higher levels of abstraction in the design process. The highest level of abstraction that we consider is the level at which the system is described in its enterprise environment (e.g. by means of a business process in which the system is used). The lowest level of abstraction that we consider is the level at which the system parts correspond to parts that can be deployed on some middleware system (e.g. J2EE or Web Services).

The problems of coherency and consistency in multi-viewpoint design are well-known and several frameworks are proposed to address these problems [1,16,15,7,28,12,14,13,3,2,29,19,10,20,17]. This paper contributes to this work by providing a common collection

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of basic concepts to specify consistency rules and by providing re-usable viewpoint relations and consistency rules. The benefit of using common, basic concepts are that these concepts:

- provide a common terminology to all stakeholders, helping them to understand each others concepts more easily; and
- provide a basis for specifying re-usable relations and rules, something that has, to the best of our knowledge, not been attempted before.

By providing these techniques, we claim that our framework reduces the time and effort needed to specify and check relations and consistency between viewpoints.

We derived the elements of our framework in two steps. Firstly, we analyse existing frameworks for multi-viewpoint design and sets of concepts for design from the viewpoints. From these frameworks and concepts, we generalize to develop a common collection of basic concepts. We also use these frameworks and concepts to derive frequently occurring inter-viewpoint relations for re-use. Secondly, we apply the basic concepts and relations in a case study to evaluate them.

This paper is further structured as follows. Section 2 presents related work and, based on an analysis of the related work, motivates the contribution of our framework. Section 3 presents the framework. Also, it explains and justifies the re-usable relations and consistency rules that we define further on. Section 4 presents the common collection of basic concepts that supports the specification of (re-usable) relations and consistency rules between views. Section 5 formally defines the re-usable consistency rules, such that they can be checked. Section 6 presents an example in which the framework is used. Section 7concludes.

2. Related work

In Fig. 1, we plotted the support that existing frameworks in the area of architectural design provide for defining view relations and checking consistency in multi-viewpoint design. We compared the frameworks with respect to two aspects of viewpoint relations: (i) the expressiveness of the viewpoint relations; and (ii) the conceptual support to represent the viewpoint relations.

We distinguish three levels of expressiveness of viewpoint relations. At the lowest level, a framework supports the definition of relations between views, but not the (consistency) rules that apply to these relations. At the next level, a framework supports the definition of consistency guidelines that each stakeholder in a multi-viewpoint design must follow. These guidelines are defined informally and no automated support is available to check them. At the highest level, a framework supports the definition of consistency rules and their automated checking.

A framework can provide conceptual support to represent relations between the viewpoints, by defining a set of concepts that crosses the boundaries between the viewpoints and relations between these concepts. For example, consider a set of concepts that includes an 'Action' concept and an 'Information Item' concept and a relation that relates an 'Action' to the 'Information Items'. This set crosses the boundaries between a viewpoint that focuses on behavioural aspects and a viewpoint that focuses on information aspects, allowing a designer to relate those viewpoints. We discovered three different forms of conceptual support in the literature. *Abstract concepts* provide abstractions of concepts that are used in the viewpoints covered by the framework. They have relations with each other, which allow a designer to represent relations between views from the viewpoints in the framework. Abstract concepts are developed with the sole purpose of representing the relations between views and cannot be used to represent the views themselves in detail. *Common abstract concepts* have the additional property that they are shared between the views, where regular abstract concepts are different for each of the views. Like abstract concepts, *(Common) basic concepts* have relations that allow a designer to represent relations between views. However, unlike abstract concepts, basic concepts can represent some aspects from the views in detail. In theory, this makes it possible to design some (part of the) views with basic concepts rather than viewpoint concepts. But typically a composition of basic concepts or a specialization of a basic concept is necessary to represent a single viewpoint concept. This makes a view designed with basic concepts harder to develop and understand than a view designed with viewpoint concepts. For that reason, viewpoint concepts are more frequently used for viewpoint design.

Fig. 1 illustrates the potential for a framework that combines the highest level of expressiveness with conceptual

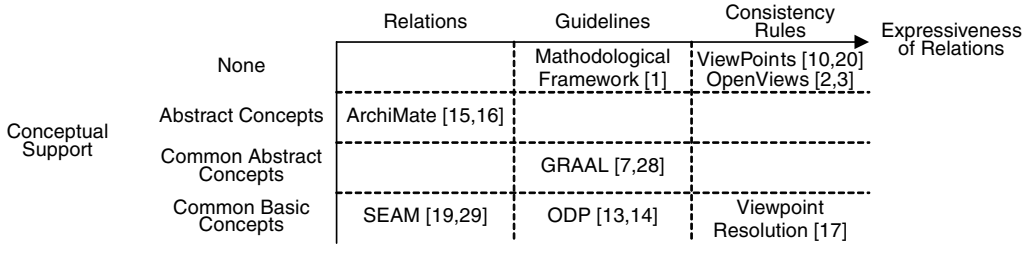

Fig. 1. Existing frameworks and their support for consistency checks.