Chapter 11
Data Warehouse Support for Policy Enforcement Rule Formulation

Deepika Prakash
NIIT University, India

ABSTRACT

It is believed that a data warehouse is for operational decision making. Recently, a proposal was made to support decision making for formulating policy enforcement rules that enforce policies. These rules are expressed in the WHEN-IF-THEN form. Guidelines are proposed to elicit two types of actions, triggering actions that cause the policy violation and the corresponding correcting actions. The decision-making problem is that of selecting the most appropriate correcting action in the event of a policy violation. This selection requires information. The elicited information is unstructured and is "early." This work is extended by proposing a method to directly convert early information into its multi-dimensional form. For this, an early information mode is proposed. The proposed conversion process is a fully automated one. Further, the tool support is extended to accommodate the conversion process. The authors also apply the method to a health domain.

INTRODUCTION

Traditionally a data warehouse (DW) supports operational work related decision-making (Inmon, 2005). Recent proposals address the full range of corporate decision making. (Prakash and Prakash, 2015) address the issue of providing support for policy formulation decisions. (Prakash and Gupta, 2014) support decision making for formulating policy enforcement rules (PER).

(Prakash, 2010) showed that there is in fact a decision continuum that exists in the decision making environment of an organization. The outer most layer of the continuum is where policy formulation decisions are taken. Once policies have been formulated, policy enforcement rules are formulated. PER formulation decisions form the next inner layer. PERs enforce policies in the organization. Once the policy enforcement rules are formulated, operational decisions are taken. Operational decision form

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the inner most layer of the continuum. It is possible to move from the policy decision layer to the PER layer and from the PER layer to the operational layer. A DW is required to support the three layers of decision making.

Based on this view, the data warehouse requirements engineering (DWRE) process has three main steps (a) identifying the set of decisions, (b) eliciting information to support the decisions, and (c) converting information into multi-dimensional structure.

A number of techniques exist to convert information to multi-dimensional structure. They can be classified based on the number of steps required to complete this conversion. The one-step approach identifies facts and dimensions as a one shot activity. The two and the three step approaches break the requirements engineering task into smaller pieces and therefore techniques are developed for each piece.

Techniques of (Giorgini, 2005; Giorgini, 2009; Salinesi and Gam, 2006; Mazon, 2007) follow the one step approach where the moment information is determined, by the stakeholder, facts and dimensions are identified. This process of identification is unguided and completely based on the experience of the requirements engineer/developer.

Two-step approaches have been proposed by (Boehnlein, 1999; Boehnlein, 2000; Bonifati, 2001; Corr and Stagnitto, 2012). The first step in the two-steps is usually a generic representation of information. (Boehnlein, 1999; Boehnlein, 2000) map service measures, from stakeholders, to SERM. In the next step multi-dimensional structures are obtained from SERM diagram. In the case of (Bonifati, 2001), abstraction sheets capture quality, variation factors among others. This is treated as information which is converted to the MD structure in the second step. (Corr and Stagnitto, 2012) obtains MD structure from tables. It is in the tables that information is captured. In all the three techniques, the intermediate step can be used to guide the process of identifying the MD structure.

Three-step processes include (Prakash and Gupta, 2014). Here the identified information is 'early', which is defined as unstructured information. In the second step, early information is converted to ER diagram which in the third step is converted into the multi-dimensional form. For the third step the authors rely on the work by (Golfarelli, 1998; Moody, 2000).

Broadly speaking, the number of steps is an indication of the complexity of the process. Therefore, it is good to reduce the number of steps. The difficulty with reducing the number of steps is that the properties of information like aggregation required, historical period is lost.

We propose to solve this problem by first introducing an early information model. This model gives us the flexibility to explore further properties of information. Subsequently we propose an algorithmic approach to directly move from early information to multi-dimensional model.

Our technique can be applied to a three-step proposal thereby converting the three step process into a two-step process. It can also be applied to a two-step process where, while the number of steps remains the same, properties of information are explored.

Further, since our conversion process is algorithmic, it is fully automated, systematic and does not require intervention by the requirements engineer. Thus, our process is much faster than the other processes with manual intervention. This process was first outlined in (Prakash, 2018) and is fully detailed here. Additionally, a tool has been developed in this paper that uses this algorithm.

The layout of this paper is as follows. In the next section, we present an overview of the approach of (Prakash and Gupta, 2014). Here policy enforcement rules are formulated, and the set of decisions are identified. Thereafter, we discuss our early information model. Subsequently, we discuss the early information elicitation techniques. This is followed by our algorithmic approach to convert early information into multi-dimensional form. Subsequently, we discuss our tool support for the same. We apply

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