

Augmenting processes with decision intelligence: Principles for integrated modelling

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ABSTRACT

Until recently decisions were mostly modelled within the process. Such an approach was shown to impair the maintainability, scalability, and flexibility of both processes and decisions. Lately, literature is moving towards a separation of concerns between the process and decision model. Most notably, the introduction of the Decision Model and Notation (DMN) standard provides a suitable solution for filling the void of decision representation. This raises the question whether decisions and processes can easily be separated and consistently integrated. We introduce an integrated way of modelling the process, while providing a decision model which encompasses the process in its entirety, rather than focusing on local decision points only. Specifically, this paper contributes formal definitions for decision models and for the integration of processes and decisions. Additionally, inconsistencies between process and decision models are identified and we remedy those inconsistencies by establishing **Five Principles** for integrated **Process and Decision Modelling (5PDM)**. The principles are subsequently illustrated and validated on a case of a Belgian accounting company.

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1. Introduction

The prevalence of new works on decision modelling and mining, as witnessed by the vast amount of new works on Decision Model and Notation [1–5], shows an increasing interest in documenting, modelling, and analysing the decision dimension of processes. DMN has two levels that are to be used in conjunction. Firstly, there is the decision requirement level, represented by the Decision Requirement Diagram (DRD), which depicts the requirements of decisions and the dependencies between elements involved in the decision model. Secondly, there is the decision logic level, which presents ways to specify the underlying decision logic. Usually, the decision logic is specified in decision table form. An example of a DRD is given in Fig. 1. DMN is designed as a declarative decision language. As a result DMN provides no decision resolution mechanism, as this is left to the invoking context (e.g. a process). The same holds for the processing and storage of outputs and intermediate results. Besides DMN, also the Product Data Model (PDM) [6] is a well-known language to capture the dependencies that exist between decisions and

their input in workflows. DMN, however, is more driven by the decision and its rationale compared to PDM, which rather focuses on the data and its impact on the workflow.

Organisations use Business Process Management (BPM) and Decision Management (DM) to analyse, and improve their processes. The new DMN standard has the clear intention to be used in conjunction with Business Process Modelling and Notation (BPMN) [5,7–10]. Since the introduction of DMN, the general consensus is to model decisions outside processes. BPM is moving towards this *separation of concerns* paradigm [11] by externalising the decisions from the process flow.

The contribution of this paper is fourfold: (1) a formal definition of decision models and their relation to process models is established; (2) a list of inconsistencies between process and decision models is provided based on existing literature and on the formal definitions formulated in this paper; (3) a set of modelling guidelines is instituted to remedy the inconsistencies between process and decision models. The guidelines are contributed in the form of **Five Principles** for integrated **Process and Decision Modelling (5PDM)**, in analogy with [12]; (4) the proposed modelling principles are applied and tested on a real life industry case.

This paper is structured as follows. In Section 2 the design science approach used in this paper is explained, while Section 3 handles the necessities for integrated modelling and decision modelling. In

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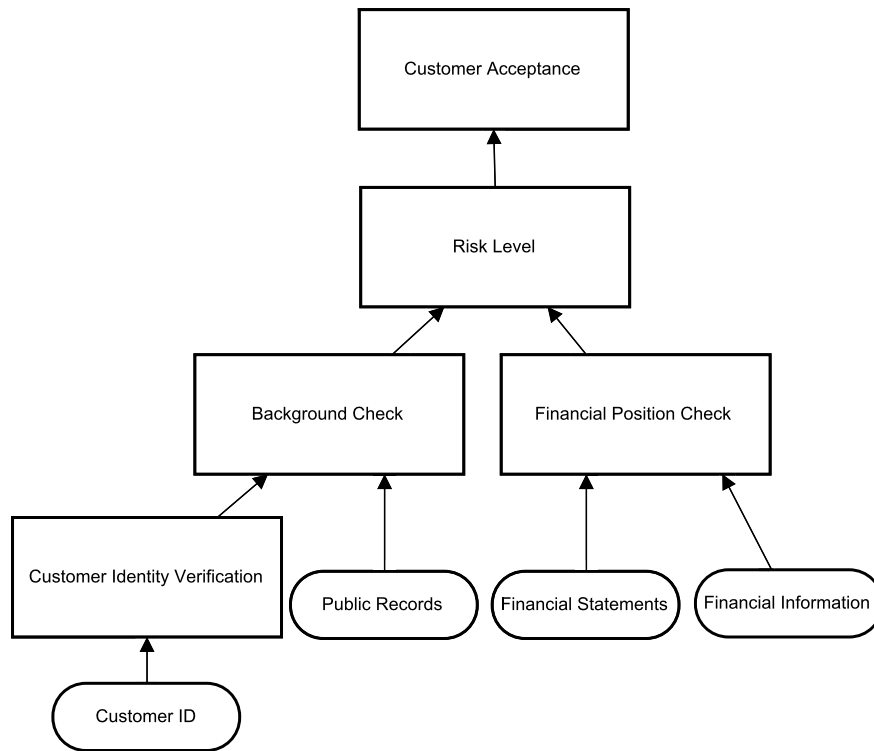


Fig. 1. Decision model for customer acceptance at a Belgian accounting firm.

Section 4 a formalisation of the DMN standard and related constructs is provided which will serve as the basis for the approach of integrated modelling. Section 5 outlines challenges of integration by providing scenarios containing inconsistency concerns, followed by Section 6 which extracts principles for integrated process and decision modelling from the previous sections. In Section 7, the modelling principles are illustrated on a case from industry, and in Section 8 a systematic approach to mitigate inconsistencies is provided. Finally, Section 9 discusses the contributions and future work.

2. Methodology

This paper follows a design science approach [13], structured along three different cycles to obtain an artifact, being the **5PDM**. First of all, the *application domain* and *population* was delineated as practitioners who develop models for integrating decisions into processes for process-aware information systems during the *relevance cycle*. Next, we have identified the *problem of inconsistent use of decisions within processes* and hence the issues that arise regarding maintainability, scalability, flexibility, understandability and reusability of decisions and processes in Sections 1 and 3. We have argued that these are the *relevant issues* tackled when separating concerns in modelling endeavours through the use of the separation of concerns and Service-Oriented Architecture paradigms in Sections 4 and 5. Based on the previous work of the authors, a literature review, and insights from industry (i.e. the case study environment), it was noted that there are *no suitable guidelines*, and that from previously produced models in research *no streamlined approach* was suggested. Next, an initial set of guidelines, i.e. the proposed *solution artifact*, were built in Section 6, according to examples from practice and research. They were *validated by practitioners*, as illustrated in Section 7, and previous work [5], during the design cycle. Finally, this work aims at *formalising the procedure*

to adhere to the guidelines in Section 8 and bringing them to the body of literature on decision and process modelling. Note that these cycles work like cogs, and the *relevance cycle* was influenced both by insights from literature, as well as practice and design iterations, while the *rigor cycle* produced initial findings which were reflected in the design.

3. Why integrated decision and process modelling?

This section provides a motivation and related work for separating and integrating process and decision models. Additionally, we provide a running example that will be used throughout this paper.

3.1. Motivation and related work

In the trend towards integration several situations can be identified. Basic solutions see processes represented using only BPMN, or decisions using only DMN. This approach works only in the most straightforward cases, where no decisions are made during the process, or where only the result of a single decision is needed respectively. Slightly more evolved situations see a complete decision model represented by a single activity in a business process. This approach will only be valid for straightforward processes and decisions. Decisions are often emulated using intricate control flows, which can result in cascading gateways. These hidden decisions must be identified in the process. After identifying and modelling these decisions the resulting model must be integrated consistently with the process model. This insufficient separation of concerns results in maintainability issues [5,14–16]. In more complex processes several decisions might influence both the flow and the result. Representing these decisions and invoking them correctly in the process is crucial for a proper understanding of the process. However, these

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