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Towards Assessing the Theoretical Complexity of the Decision Model and Notation (DMN)

Research-in-Progress

Faruk Hasić*[1], Johannes De Smedt[2] and Jan Vanthienen[1]

[1] Leuven Institute for Research on Information Systems, KU Leuven
faruk.hasic;jan.vanthienen@kuleuven.be
[2] Management Science and Business Economics Group, University of Edinburgh Business School
johannes.desmedt@ed.ac.uk

Abstract. Motivated by the need for holistic decision modelling, the OMG consortium developed a new decision modelling standard, the Decision Model and Notation (DMN). DMN has two levels. Firstly, the decision requirement level depicts the requirements of decisions and the dependencies between elements involved in the decision. Secondly, the decision logic level presents ways to specify the underlying decision logic. DMN enables the separation of process and decision logic, thus enabling complexity reductions, flexibility, and maintainability of process models. Extensive research exists on the complexity of conceptual modelling methods such as UML, CMMN, and BPMN. However, the complexity of DMN has not yet been addressed in scientific literature. In this paper, we will assess the complexity of DMN and compare the outcome with the results obtained in previous studies for other modelling notations, such as BPMN and CMMN, hence emphasizing the broader picture of consistent integration of processes, cases, and decisions. Using BPMN, CMMN, and DMN alongside each other provides a holistic approach in business process management, as it enables the representation of both procedural and declarative processes, as well as a separate yet integrated representation of the underlying business logic.

Keywords. Decision Modelling, Decision Model and Notation, DMN, Complexity

1 Decision modelling

The Decision Model and Notation (DMN) 1.0 [1] was published in September 2015, while the DMN 1.1 [2] version was made available in June 2016. Numerous tool developers, such as Signavio, already incorporated DMN modelling in their software packages, making the standard available for industry applications. DMN has two levels that can be used in conjunction. Firstly, there is the decision requirement level, represented by the decision requirement diagram (DRD),

* Corresponding author.

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. The DMN standard provides an expression language S-FEEL (Simple Friendly Enough Expression Language), as well as boxed expressions and decision tables for the notation of the decision logic. Representing decision logic in decision tables is not a new concept, as it has extensively been adapted in previous studies, such as illustrated in [3] and [4]. DMN was meant mainly for business users and both the scientific and business communities have given quite some attention to the DMN standard: [5,6,7]. So the modelling method is supposed to be easily understandable and easily learnable. DMN uses rectangles to depict decisions, corner-cut rectangles for business knowledge models, and ovals to represent data input. The decision logic is usually represented in decision tables. A link can be made between a decision activity in the process model and the actual decision model. Figure 1 gives an example of a decision model for credit eligibility, while Figure 2 depicts the corresponding credit eligibility process.

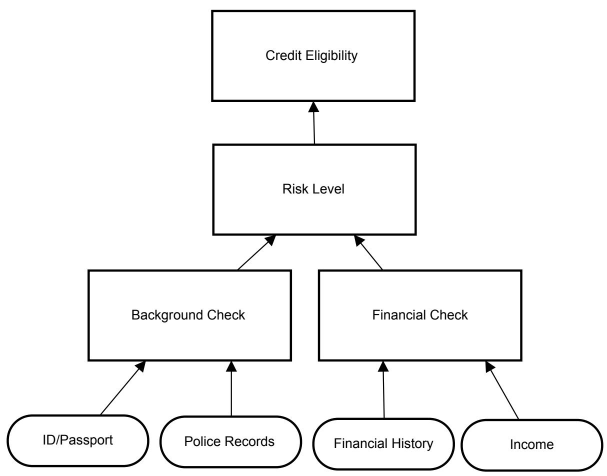

Fig. 1: A decision model for credit eligibility

Unlike for UML, BPMN, and CMMN, the complexity of DMN models has not yet been addressed in scientific literature. In the remainder of this paper, we will assess the complexity of the Decision Model and Notation and compare the results of this assessment with the results obtained in previous studies for other modelling notations, such as UML activity diagrams, BPMN, and CMMN. Following this comparison, conclusions regarding the complexity of DMN will be drawn and recommendations for future research will be provided. Additionally, some attention will be given to the broader picture of consistent integration of business processes, cases, and business decisions. A light will be shed on some obstacles and opportunities concerning this integration.

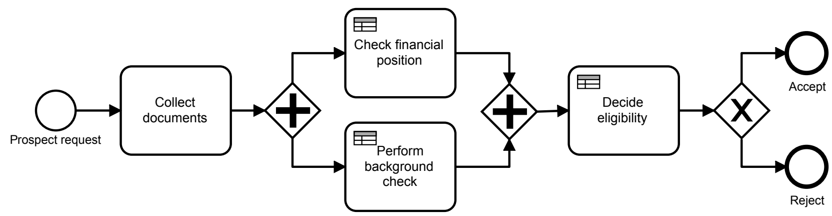

Fig. 2: Credit eligibility process

2 Related work

Extensive research exists on the complexity of conceptual modelling methods. Several approaches have been developed throughout the years and these approaches have been adapted to well-known modelling methods such as UML and BPMN. Assessing method complexity is of paramount importance, since the method complexity is viewed to be an indication of the ease of use, the learnability, and the interpretability of a method, as illustrated by [8] and [9]. A method that is widely applied in research is the meta-model-based metric approach developed by [8]. They introduce metrics based on the meta-model of a conceptual modelling approach, enabling to a certain degree to compare the method complexity of several different modelling paradigms. Meta-models of modelling methods illustrate the expressive power of that method through its concepts, properties, relationships, and roles [8]. Most modelling standards are described by formally introducing a UML-based meta-model. [10] and [11] apply the [8] method to judge the method complexity of UML 1.4 [12]. Similarly, [13] implement the method on the BPMN 1.2 version [14]. [9] consolidate the existing research by comparing the complexity of BPMN 1.2 and UML 1.4 activity diagrams. Equivalently, [15] add Case Management Model and Notation, or CMMN 1.0 [16], to the list of modelling methods evaluated by [8] metrics. Additionally, they compare the complexity of CMMN to the complexity of previously researched methods.

3 Methodology

The DMN standard is designed to be used in conjunction with BPMN. This is an excellent proposition since BPMN is widely used in both industry and academia. To determine the complexity of the DMN model, we will use the meta-model-based method developed by [8], as this method was adapted to numerous other modelling methods. This should facilitate the interpretation of the results by making comparisons possible. [17] address the theoretical part of determining the complexity of modelling languages. They distinguish between empirical and non-empirical techniques. In the category of empirical assessment techniques they mention case studies, field experiments, laboratory experiments, and surveys, among others. Ontological analysis, metrics analysis and meta-model-based analysis are part of the non-empirical techniques category. The method proposed by [8] is a metrics analysis and hence falls in the category of non-empirical complexity assessment techniques. They claim that modelling methods can possibly have multiple techniques. For instance, UML is a method with techniques such as UML class diagrams and UML activity diagrams. Contrarily, methods with a single technique exist as well. CMMN is a method with one technique, namely the case plan model. DMN too is a method with only one technique, the decision model, existing of two sub-models: the decision requirements diagram (DRD) and the decision table. Furthermore, the authors argue that the complexity of a method is a critical measurement, as they believe complexity to be intimately related to the usability and learnability of a method. The metric proposed by [8] is a metric based on the underlying meta-model of the method. The metric relies on the count of objects, relationships, and properties in the meta-model. To fully illustrate this, it is advised to take a look at the formalisation of the model of a technique, as provided by [8].

As stated earlier, a modelling method can have multiple techniques, hence, the complexity of a method is the aggregate complexity of the methods techniques. [8] developed a vast array of metrics. Practical research, such as in [9] and [13] is focused around a small number of metrics. In analogy with the complexity analysis performed for other modelling methods, we will use the same [8] metrics to evaluate DMN:

- $n(O_{\mathcal{M}})$ corresponds with the count of objects in the method. This equals the count of objects in all the possible techniques of the given method.
- $n(R_{\mathcal{M}})$ counts the relationships in the method. This equals the count of relationships in all the possible techniques of the given method.
- $n(P_{\mathcal{M}})$ coincides with the count of properties in the method. This too corresponds with the count of properties in all the possible techniques of the considered method.
- The cumulative complexity of the method is defined as the norm of the vector of the counts of objects, relationships, and properties of the method as a whole. This can be represented as a vector in three-dimensional space, with on the axes the counts of objects, relationships, and properties.

[8] base their calculations on the OPRR meta-model. However, more recent research such as [10,9,13] focuses on UML meta-models. It has become common practice to use UML to depict meta-models of modelling methods. Counting the objects, properties, and relationships in the meta-model should be done carefully. [15] specify some counting principles in their complexity analysis study of CMMN. We too shall adhere to these principles:

- All abstract classes should be included in the count of the objects.
- Enumerations are not included in the count.
- Tool-generated properties are excluded from the count of properties.
- Properties of classes referring to other classes are not counted.
- All other properties of objects and relationships are included in the count of properties.

4 DMN Analysis

Table 1 gives an overview of the complexities of different modelling methods based on the meta-model metrics analysis of [8]. The final column indicates the source of the data. We added DMN 1.1 to the list of modelling methods that have been assessed by this analysis technique. The data for the calculation of the DMN complexity are extracted from the meta-model provided in the OMG DMN 1.1 standard. The objects, relationships, and properties in the meta-model were counted by taking into consideration the counting principles as enumerated in the previous section. The DMN meta-model shows 40 object types, 3 relationship types, and 16 property types. From this data, the cumulative complexity was calculated as the norm of the vector of the counts.

Method	**O**	**R**	**P**	**CC**	**Source**
BPMN 1.2	90	6	143	169.07	[13]
BPMN 1.2 DoD	59	4	112	126.65	[13]
BPMN 1.2 Case Study	36	5	81	88.78	[13,18]
BPMN 1.2 Frequent Use	21	4	59	62.75	[13,19]
CMMN 1.0	39	4	28	48.18	[15]
DMN 1.1	**40**	**3**	**16**	**43.19**	
EPC	15	5	11	19.26	[13]
UML 1.4 Activity Diagrams	8	5	6	11.18	[10]

Table 1: Method complexity of some modelling methods (O=object count; R=relationship count; P=property count; CC=Cumulative Complexity)

Table 1 shows DMN method complexity next to the complexities of other popular modelling methods. The table represents the different methods in decreasing order of cumulative method complexity. To represent this data in a more visual way, Figure 3 depicts a scatterplot in the form of a three dimensional cube. On the axes the counts of objects, relationships, and properties are portrayed, while the data points are labelled with the names of the modelling methods. To enhance the readability of the three dimensional scatterplot vertical lines are inserted that project the data points on the (properties, relationships) plane. The closer the data points are to the origin of the three dimensional cube, the less complex the method. Similarly, the farther the data points are from the origin, the more complex the method. DMN shows to be relatively close to the origin, especially thanks to the low number of relationship types and property types. Meanwhile, the BPMN 1.2 data point exhibits the highest degree of complexity and is situated in the top right of the cube, far away from the origin.

The results in Table 1 indicate that the cumulative complexity of DMN 1.1 is relatively low, yet close the cumulative complexity of CMMN 1.0. Meanwhile, BPMN 1.2 exhibits by far the highest cumulative complexity as a result of an extensive use of objects, properties, and relationships. As stated by [8], a high cumulative complexity might be an indicator of expressive power of a method.

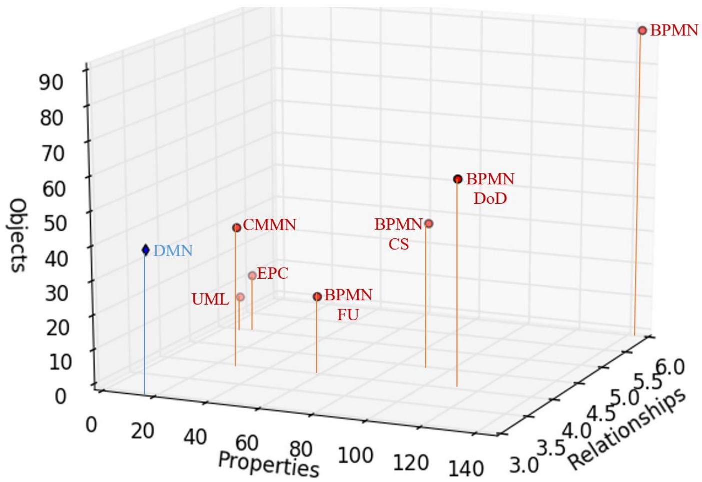

Fig. 3: Three-dimensional cube showing an object-relationship-property scatter-plot for the modelling notations represented in Table 1.

As a consequence, one can argue that the expressive power of BPMN 1.2 is far greater than the expressive power of BPMN 1.2 Frequent Use. As for DMN 1.1, the cumulative complexity is rather low, indicating that DMN should be simple to learn and understand. However, this is just a theoretical approach and these claims should be validated through empirical research. Only empirical research can truly assess the practical modelling complexity. The importance of empirical validation of the theoretical complexity is stressed by both [8] and [20].

Furthermore, the results suggest an integration of BPMN and DMN models, as the meta-model-based complexity of DMN is only a fraction of the complexity of BPMN. Incorporating DMN in BPMN models would not necessarily increase the combined modelling complexity, since the decision logic is separated from the process flow logic. In this fashion, the complexity of the process models decreases as the process is reduced to its essence, i.e. without hard-coding the decision logic within the process. A seminal study on the integration of BPMN and DMN models is provided by [6]. Moreover, a number of studies, including [15,21] similarly argue to integrate BPMN and CMMN models. [15] base their suggestion on the measurement of the method complexity of CMMN. They claim that an integration of BPMN and CMMN should prove beneficial to modelling complexity, as the cumulative method complexity of CMMN is far lower than that of BPMN. Similarly, on the basis of modelling complexity, we advocate an integration of BPMN and DMN. Lastly, one can argue to integrate CMMN and DMN models to close this circle, enabling an integrated modelling approach between BPMN, CMMN, and DMN. This should enable representing both procedural and declarative process models, as well as provide a separate yet integrated representation of the underlying business logic. Hence, such an adaptation would contribute to a holistic business process management approach. Another advantage of modelling decisions holistically with DMN is that it enables the separation of process and decision logic. This permits complexity reductions of the process models, as the decision logic is extracted from the process model and modelled in DMN. Next to complexity reductions, process flexibility is also enhanced by this separation of decision and control flow logic. If the decision logic changes, one needs not change the process model anymore. A simple change in the decision model will leave the process model unharmed and functioning. Hence, this separation of concerns [22] strengthens the maintainability and flexibility of process models, as explained and elaborated upon by [23].

5 Future research

As stated by [8], a theoretical approach to model complexity is not sufficient. The meta-model-based approach only provides an analysis of the syntactical complexity of the method. Hence, this metrics approach should be backed up and complemented by empirical validation research. For future research we plan to empirically test DMN method complexity through a survey with both modellers from the business world, as well as people who are not familiar with conceptual modelling on a professional level. Additionally, research on complexity of individual models and integrated process and decision models is a compelling field of study, as well as other complexity dimensions such as semantic and cognitive complexity. Furthermore, we will focus on providing additional modelling rules to consistently integrate BPMN, DMN, and CMMN models.

6 Conclusion

This paper is the first contribution towards analysing DMN modelling complexity. The analysis performed on the DMN 1.1 standard was a theoretical meta-model-based metrics approach devised by [8]. The method was slightly adjusted according to [13] to enhance comparisons with more contemporary studies. The meta-model complexity of DMN 1.1 closely compares to the model complexity of CMMN, while it is seems far less complex than BPMN. Using DMN and BPMN together would suggest integrating the two models. This paper only focuses on the conceptual complexity of the underlying meta-model and additional empirical research is necessary to validate the findings.

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