LUND UNIVERSITY
School of Economics and Management

Department of Informatics

Business Decisions or Rules – Why not Both?

The Views of Three Decision Modelling Experts

Master thesis 15 HEC, course INFM10 in Information Systems

Author: Oskar Hall

Supervisor: Odd Steen

Examiners: Miranda Kajtazi
Nicklas Holmberg

Business Decisions or Rules – Why not Both? The Views of Three Decision Modelling Experts

AUTHORS: Oskar Hall

PUBLISHER: Department of Informatics, Lund School of Economics and Management, Lund University

PRESENTED: June, 2018

DOCUMENT TYPE: Master Thesis

NUMBER OF PAGES: 65

KEY WORDS: DMN, SBVR, Business Rules, Business Decisions, IS Standards

ABSTRACT (MAX. 200 WORDS):

IS analysis and design processes rely on models for communicating requirements between business and IS professionals. Modelling standards are universally recognisable notations/languages for constructing these models. An emerging approach is to capture business decisions intended for decision automation in models. The Object Management Group has recently released a standard for this purpose, the Decision Model and Notation (DMN). The concept of business decisions relies heavily on business rules for defining decision outcomes. Object Management Group also have a standard for business rules, SBVR. However, there is no formal approach defined for integrating SBVR rules in DMN, even though they are published by the same organisation. This thesis investigated the relationship between business rules and business decisions through SBVR and DMN. Three interviews with decision modelling experts directly or indirectly involved in the development of DMN were conducted. Results indicate rules and decisions are kept in different standards because of a separation of concerns as rules and decisions have separate roles rules and tries to appeal to different audiences. Combining the two concepts in one standard, either through integration or merging would create unnecessary complexity, depending on the organisational level where it is applied.

Acknowledgements

I would like to thank my supervisor Odd Steen for insightful comments and guidance throughout the writing process.

Further, I want to express my deepest gratitude toward the interview participants for taking time out of their busy schedules to contribute to this thesis.

Thanks to the master students in design of information systems at Lund university 2017/18 who helped peer review this thesis for helping me improve the final version of this thesis.

A special thanks to friends and family for supporting me throughout the writing process with encouraging words and proofreading.

Content

Figures

Tables

List of Abbreviations

- Business Rules (BR)
- Business Rules Management (BRM)
- Semantics of Business Vocabulary and Rules (SBVR)
- Business Decisions (BD)
- Business Decision Management (BDM)
- Decision Model and Notation (DMN)
- Decision Requirement Diagram (DRD)
- Decision Logic (DL)
- Information System (IS)
- Business Processes (BP)

1 Introduction

In the academic field, easy explanations and representations of the real world are desired. It is customary practice that the simplest explanation or representation of real world phenomena should be adopted. In the context of Information Systems (IS), this is no different. IS development processes rely on models to reflect the real world. To communicate IS requirements between business and IS-professionals, modelling standards representing the real world have been developed to be understandable both by business and IS (Wand & Weber, 1993). Models adopted for IS development must provide simple representations of the real world. IS models are used for communication of requirements between business and IS-professionals. As the lines between business and IS continue to blur, effective communication methods in IS development will be increasingly prioritized (Selic, 2003). These communication methods between IS and business can be models aiming to be both implementable in systems and reflect the business reality. Model driven development is an advantageous approach to systems development and design. Selic (2003) claim IS development benefits from modelling as in construction and engineering, where models are used to predict the behaviour and characteristics of the final solution.

IS have always existed in the locus between business and IT, which require IS to accurately reflect business operations. In business governance, rules play a significant part. These rules must be reflected in the information systems of businesses. Unfortunately, rules often have been and still are hidden in code and not defined in directories accessible by all parts of the business (Morgan, 2002). To manage the rules governing a business, the concepts of Business Rules (BR) and Business Rules Management (BRM) were introduced. The practice of BRM aim to capture the BR governing business operation unambiguously (Morgan, 2002).

The purpose of BR is formalized in the business rules manifesto authored by the Business Rules Group (2003). With this manifesto, the importance of BR in the operation of businesses is emphasized as primary requirements in a business. Further, the aim of BR is to address ambiguity in businesses and to capture the knowledge underlying business operations. This knowledge, when captured unambiguously and comprehensibly enables continuous improvement of operations and automation of the operational level of businesses (Taylor & Raden, 2007). To capture BR in a way understandable by all members of a business, several standards for modelling them exist. These are often text oriented with natural language representation of BR (zur Muehlen & Indulska, 2010). These standards are key in BRM as part of methodologies for benefiting from BR, which are not solely related to achieving operational efficiency through process automation. BRM aid in capturing knowledge in an organisation by extracting the knowledge from the individual level to the organisational level. An example of this is presented by Ross (2017). Ross mentions the retirement of subject matter experts as an important concern to address in organisations and that BR can help capture this knowledge, thus securing it for future use in the organisation.

An emerging approach related to BRM for managing knowledge and process automation is Business Decision Management (BDM), focusing on capturing and specifying Business Decisions (BD). BDM relies heavily on using BR for specifying the underlying logic for BD for automation of decision making (Taylor & Purchase, 2016). BDM has been heavily advocated by authors like Taylor and Purchase (2016). What many consider business decisions and decisions driven organisations is often related to strategical decisions and utilising business intelligence systems for decision support (Blenko, Mankins & Rogers, 2010). However, the objectives of BDM encompass mapping strategic and operational decisions. Operational decisions can be automated with the use of decision logic (DL). The decision logic relies on business rules for its formulation (Taylor & Purchase, 2016). Automating operational decisions is quoted as one of the main benefits of the BDM approach (Taylor & Purchase, 2016). Strategic decisions rely less on BR than operational decisions but are nonetheless an important part of the collective knowledge a business possess. BDM can aid in capturing strategic decisions and the knowledge required to make accurate repeatable decisions. This supports business governance and knowledge management (Taylor, 2013, p.2)

Business decision management is defined in the business decision management manifesto. BDM aims to further increase the usability of business rules by putting them into an extended context and specific decision situation (Taylor, 2013). As in the BR manifesto, the BDM manifesto sees decisions as a first-class citizen in businesses and systems development. Further, BD can utilize BR for definition of the underlying logic of a decision, the decision logic (DL) (Taylor & Purchase, 2016). A clear link exists between BD and BR as they often aim to accomplish the same goals. However, in the most recent standard for decision modelling, no formal approach for integrating business rules is defined.

1.1 Problem Area

Whether the integration of BR in modelling standards for business processes (BP) it is beneficial or not to is an ongoing debate. Numerous studies have tried to examine factors supporting integration, or separation of BR from BP in modelling standards. The possibilities of using BR with BP has been widely examined (Cheng, Sadiq & Indulska, 2011; Wang, Indulska & Sadiq, 2014; Zoet et al., 2011; zur Muehlen & Indulska, 2010; Zur Muehlen, Indulska & Kittel, 2008). Integration and alignment of business rules and business processes is important, as the business rules contains knowledge governing the workflow the business process embodies (Kovacic, 2004).

With the rise of business decision management and standards for decision modelling the interrelation of BD and BP modelling has been the focus of researchers. BD modelling rely on BP for its context (Taylor & Purchase, 2016). The paradigms for management of rules, processes, and decisions can be used separately, and combined usage has proven more proficient for representing business operations in its entirety. Especially within rule and process modelling, their combined usage has been examined, and the possibilities for either integrating or not integrating BR into BP. This is an ongoing debate on whether BR integration provides benefits for BP-modelling (Wang, Indulska & Sadiq, 2017). It seems that even after the introduction of BD-modelling, usage of BR together with processes is still widespread, even though the possibilities offered by decision modelling for separation of concerns of process and decision logic into separate models (Taylor & Purchase, 2016).

The international not for profit organisation, Object Management Group(OMG) recently published a standard for modelling business decisions, the Decision Model and Notation (DMN) and have a standard for formulation of Business Rules, the Semantics of Business Vocabulary and Rules (SBVR). DMN is dependent on BR for defining the underlying Decision Logic (DL) of the decision. This does not always have to be the case, but business rules often predetermine how DL should operate. Even though this dependence exists, there is no element for representing BR in DMN.

There exist scarce research on how rules and decisions are used together, but there are practical implications of how these approaches can be used in tandem represented in the standards SBVR and DMN (Linehan & de Sainte Marie, 2011). In decision modelling, the executable expressions are represented in Decision Logic which in turn depends on business rules for its formulation. The business rules serve as the source for decision logic. In short, a business rule can represent a specific way to reach an outcome in a decision. However, the relationship between business rules and decision logic is unclear as business rules are not required for creating decision logic (Taylor & Purchase, 2016). SBVR and DMN have their own strengths and weaknesses in their representative power, a combination of usage of both is beneficial to gain ontological completeness in the representation of reality (Wand & Weber, 1993).

1.2 Research Question

BR and BD are highly interrelated. Much of the implementable logic of decisions are based on business rules to govern why the logic should look the way it does (Linehan & de Sainte Marie, 2011). The integration of BR in BP standards has been explored. Yet, the available standards for BR and BD have scarce indications of their relationship. No research on this topic exists to the best of my knowledge. It is important to understand the interaction between these system components on both a conceptual and systems level. Hence, the adopted research question is:

Why are business rules and business decisions kept in separate standards?

1.3 Purpose

By examining the reasons behind separation of BR and BD into distinct modelling standards, the findings will be used to clarify why business rules and decisions are separated. This will increase the knowledge about how these concepts can be used to manage the knowledge in a business or reach decision automation. Decision Management is an emerging approach with a recently introduced standard (DMN), its interaction with business rules management and standards for business rules is largely unexplored. Focus in previous studies has been on the potential for integration with process modelling(Hasic, De Smedt & Vanthienen, 2017a; Janssens et al., 2016). As rules and decisions have a clear link, an increased understanding of why they are separated into different standards can help clarify roles that decisions and rules have in modelling in information systems analysis and design. This is especially important in regulatory compliance applications where rules and decisions are required for traceability. Finding the right balance between the two will avoid capturing unnecessary levels of detail.

1.4 Delimitation

There are many standards for BR (zur Muehlen & Indulska, 2010) and at least two for modelling of BD. This study is limited through only investigating the interaction between the standards Semantics of Business Vocabulary and Rules (SBVR) along with the Decision Model and Notation (DMN). Both standards are published by the same organisation, the Object Management Group (OMG). OMG is a not- for profit organisation publishing standards for IS analysis and design. As the standards published the OMG are open standards, they are free to use and implemented in several software tools for modelling and have widespread use in practice. Further, OMG standards gain legitimacy through being developed by industry, academia, and subject matter experts alike, making their standards more likely to be adopted in practice.

2 Literature Review

2.1 Business Rules

The concept of business rules has been used in systems development extensively since the 1980's. During this era BR were often part of what is called expert systems containing explicit knowledge about some business concern, which is used to produce a specific output from a set of inputs (Morgan, 2002). However, this rigid approach to rules governing business operations has since been discovered to provide little benefit as it is proven to be an inflexible approach to manage knowledge in a business (Taylor & Raden, 2007). A definition of business rules is provided in the SBVR standard publication, where a BR is defined as:

A rule that is practicable and under business jurisdiction - (Object Management Group, 2017, p.98)

Hence, the business rule is a statement governing how a specific process or action should be conducted and what its output should be (Morgan, 2002). An example could be: a business rule can be a definition of at what age you are eligible to acquire a driver's licence. In Sweden this rule could look like: "A person must be at least 18 years old to be eligible for a driver's license". This rule is a condition which must be fulfilled to be eligible. Of course, a multitude of other rules would apply to this scenario as well. The definition provided by OMG is not technology oriented. This business oriented definition of a business rule is reflected in the business rule manifesto (2003) where it is clearly elaborated that business rules are not a technical concern but a concern of how a business should operate. Another statement made in the business rules manifesto is that to establish BR capabilities, tools for business people to formulate and manage rules are required. This is where a standard for rule modelling, for instance, SBVR is applied.

2.1.1 SBVR

SVBR is published by OMG and aims to formulate a business vocabulary to overcome business term ambiguity which can then be applied in a BR to formulate them unambiguously and clearly. The rule formulation in SBVR follows a natural language pattern and is intended more for business than it is for IT, as it should facilitate business transformation independently of IS design (Object Management Group, 2017). However, several technologies exist allowing formulation of natural language rules that can then be implemented in runnable systems. Although, technologies like this do not exist not for SBVR yet (Chapin, 2017).

SBVR consist of two parts, the dictionary and the rulebook. The dictionary represents the business vocabulary of SBVR and the rulebook the BR part (Object Management Group, 2017). The business vocabulary provides capabilities for formulating the terms used in business documents by being the sole source of the terms, thus preventing ambiguity. The terms and concepts defined in the business vocabulary provide the language used in the natural language formulation of BR. Figure 2.1 presents an example of a business rule formulated in SBVR. SBVR divide rules into two categories, behavioural and definitional rules. The definitional rules can also be described as structural rules, meaning they define the overall structure of a business and the relationship between the concepts used in businesses (Bajwa, Lee &

Bordbar, 2011; Object Management Group, 2017). Behavioural rules can also be described as operational rules, which dictate how an activity should be conducted (Bajwa, Lee & Bordbar, 2011; Object Management Group, 2017). The definition of behavioural rules is similar to the purpose defined for decision logic in DMN as decision logic provide the source for how decisions should be executed (Taylor & Purchase, 2016).

Vehicle Usage Rule

A vehicle may *use* an ice road only if the use *is authorized by* a Vehicle Usage Advice.

Arctic Circle Exemption

Any ice road that *is north of the Arctic Circle* may *be used by* any vehicle.

The Arctic Circle Exemption *is a* Vehicle Usage Advice.

Figure 2.1. SBVR Business rule example, Adopted from: Object Management Group, 2017, p.105

2.1.2 Business Rules in Business Context

It is not uncommon for BR to go unmanaged and to be hidden in source code of systems (Morgan, 2002). This is a concern that has been raised continuously since the introduction of the concept of BR. Lifting rules from source code and making them visible to business users are the most commonly mentioned benefits derived from adopting a business rules approach (Bajec & Krisper, 2005). The enterprise model in figure 2.2 by Bajec and Krisper (2005) elaborates how BR fits into the enterprise architecture by showing its interaction with other models commonly adopted in businesses on a conceptual level. Four types of models are presented as supporting or requiring business rules. In relation to business vision modelling, BR support or hinder the goals defined within this model. Business vision models also motivate why a BR is required. In relation to business process modelling a BR can constrain or trigger process flows and be a fundamental requirement for a business process. With the help of this enterprise model Bajec and Krisper emphasizes the central role of BR in a business and how to manage them in alignment with other models in a business architecture.

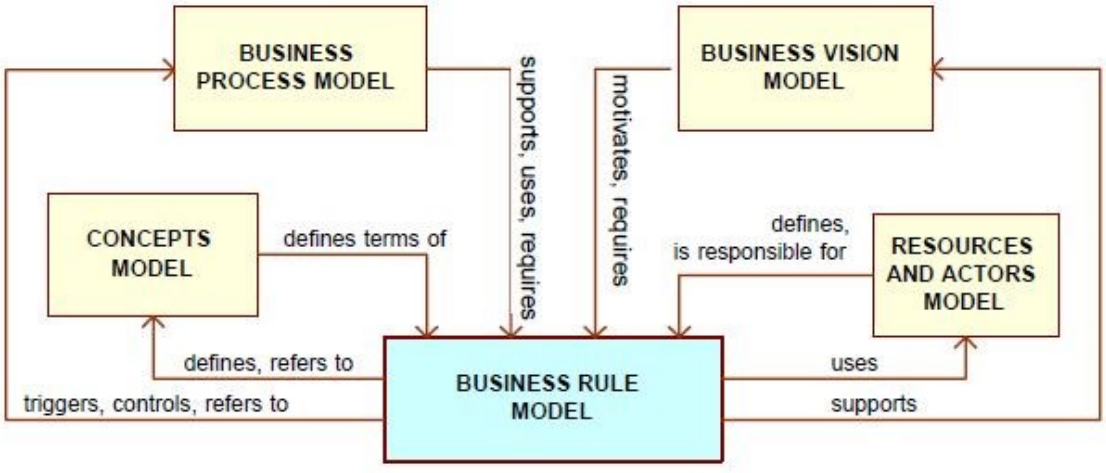

Figure 2.2. Bajec and Krisper's Enterprise Model (Bajec & Krisper, 2005, p.428)

Bajec and Krisper (2005) stated BR can serve many purposes and affect all parts of a business. This characteristic requires categorising BR according to their general capabilities. Many typologies for rule categorisation exist. These are mainly divided into what other type of enterprise model they are intended to reflect (Bajec & Krisper, 2005). Most of these categorisations are made in conjunction with business process modelling and what types of rules are included in a process on different levels (Zoet et al., 2011). These categorisations are of main interest for this research as decision modelling is partially a separation of concerns of decision and process logic into different models (Taylor & Purchase, 2016). These rule categorisations in relation to business processes might apply to decision modelling as well where a specific category of rules have greater implications for integration in decision models.

To further elaborate the relationship between rules and processes Kovacic (2004) presented three general categories of BR in relation to BP in a metamodel (Figure 2.3). In this model, Kovacic presents how these three broad categories relate to processes, data, activities, events, conditions, and actions. Kovacic claims rules contain constraints governing workflows of a business. Global rules govern the overall process and are not dependent on a single activity within the process. Rules related to a single activity within a process are activity rules which are similar to the definition of behavioural rules in SBVR and hence relevant for decision logic in decision modelling. Further, there are rules that constrain the process flow and structure, these are categorised as structural rules. For instance, a structural rule would define that you should do "Activity A" before "Activity B".

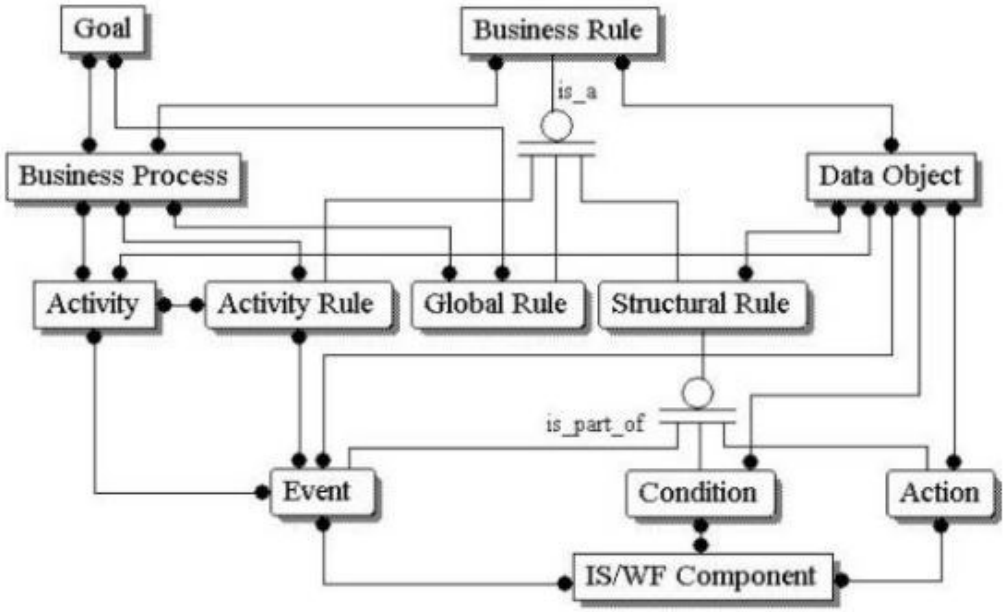

Figure 2.3. Kovacics business activity metamodel (Kovacic, 2004, p.166)

Other rule categorisations exist. Process specific typologies are presented by Indulska and Zur Muehlen (2010) and by Zoet et al. (2011). Indulska and Zur Muehlen use rule categories for a representational analysis of modelling languages for BR and BP using Bunge, Wand and Weber (BWW) ontology, a theory on representational capabilities of IS modelling standards introduced by Wand and Weber (1993). Indulska and Zur Muehlen (2010) discovered

significant overlap in modelling languages for BR and BP, meaning modelling techniques for both rules and processes had elements for representing the same ontological constructs in BWW ontology. Further, their findings indicated BP often require supplements from BR to reach a good level of representational capabilities. They argue for the need of integrating BR with modelling of BP in a clearer way and by overseeing the ontological capabilities of rule and process modelling languages which will aid in understanding how business processes and business rules should be aligned.

2.1.3 Process and Rule Integration.

Business decision modelling in DMN is a middle step between processes and rules. The possibilities of integrating business rules into in business processes might be applied to integration of business rules in decision modelling. Parallel modelling of processes and rules is important. The business rule contains knowledge of how an action is conducted and the business process contains the sequence of activities to reach the final result (Holmberg & Steen, 2011).

Integration of BR applied in process models clearly link the BR to the BP. Various types of process and rule integrations exist. The most straightforward way is to simply add a text annotation in the BP model stating the applicable BR (Zur Muehlen, Indulska & Kittel, 2008) exemplified in figure 2.4. This approach is found to be the most commonly used by practitioners requiring representation of business rules in process models. This can be accomplished by using the text annotation element in BPMN (Recker et al., 2011). However, the use of text annotation to integrate BR in BP models is argued to be problematic since it reduces the consistency and reusability of rules by not tracking the rule source (Zur Muehlen, Indulska & Kittel, 2008). Wang, Indulska, and Sadiq (2016) propose three general categories for BR integration into BP. Firstly, Annotation, which has been discussed previously. Secondly, encapsulation which aims to capture BR within a specific element of the BP modelling language used, for instance the business rule task in BPMN 2.0 (Object Management Group, 2011). The last category of BR integration presented by Wang, Indulska, and Sadiq (2016) is extension, where reference to an external rule model is provided. Figure 2.4. Presents these integration types in a business process diagram.

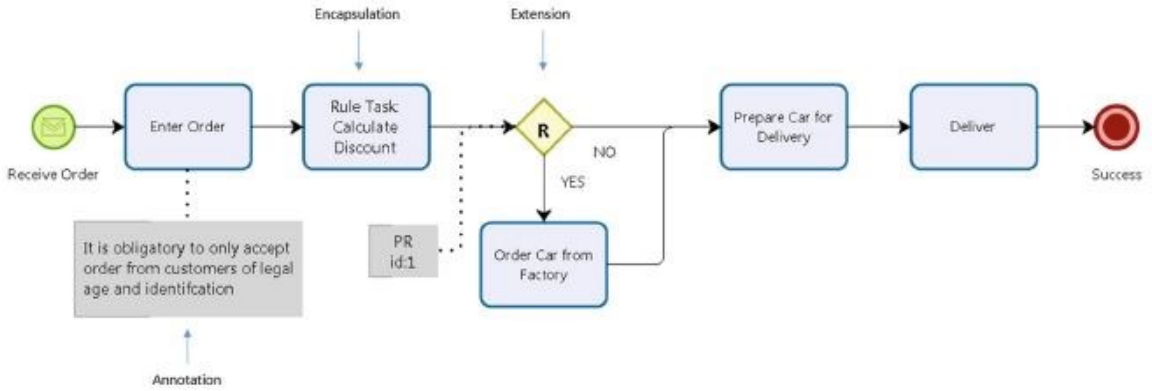

Figure 2.4. Rule integration in business process. Adopted from: Wang, Indulska & Sadiq, 2016

To understand why and when BR should be integrated in process models, Wang, Indulska and Sadiq (2016; 2017) introduced factors affecting whether BR should be integrated into BP. These factors explain in which situations integration of BR should be applied. Their findings indicate that agility, criticality, rate of change, and reusability were significant factors affecting BR integration into BP. Agility represents how rapidly a BR can adapt to changes in the business environment. The rate of change relates to agility, which in turn relates to how often the rule is required to change. Frequently updated rules requires careful monitoring.(Wang, Indulska & Sadiq, 2017). Criticality is how important the BR is to the business operations. Reusability refers to that some BR can be applied across multiple situations, not only reflecting one situation or context. These factors affected if the rule was preferred to be modelled independently of a process model or integrated in the process. Their findings indicated that rules requiring infrequent changes and not reusable across multiple scenarios should be integrated in process models.

2.2 Business Decisions

All businesses rely on decisions in their operations (Blenko, Mankins & Rogers, 2010). In the context of business decision management, decisions are divided into operational, tactical, and strategic levels. These are encompassed in business decision management. The Business Decision is defined by Taylor and Purchase (2016) as:

> *A determination that businesses make on a regular basis, a selection or calculation of an outcome that depends on a number of prevailing circumstances (inputs) and which, ultimately, has an observable impact on the behaviour of the organisation.* - (Taylor & Purchase, 2016, p.37)

Hence, a BD dictates what specific inputs are required to reach a specific output in a decision situation. Operational BD benefit through the approach since they present opportunities for decision automation (Taylor, 2013). The ability to quickly execute key decisions heavily affects the efficiency of a business (Blenko, Mankins & Rogers, 2010). Hence, decisions should be captured and managed effectively (Taylor, 2013). It is becoming increasingly apparent among practitioners that businesses should prioritise operational decisions. As the business environment today is moving at a fast pace, the underlying requirements of a decision can change rapidly (Taylor & Raden, 2007). It is hence important to establish proper capabilities for BD management. A key part in managing BD is to capture them with use of specific methodologies applying standards for decision modelling. The standard for decision modelling "The Decision Model" by von Halle and Goldberg (2009) was the first standard published for BD modelling. However, this standard is owned by Sapiens Inc. and was not widely adopted. The Decision Model influenced the recently introduced standard "Decision Model and Notation" from OMG. This standard provides capabilities of capturing and defining BD and the logic important for decision automation. DMN is currently the only open standard for decision modelling (Taylor & Purchase, 2016).

2.2.1 The Decision Model and Notation

DMN has three purposes: To define human decision making, model requirements for automated decision making, and implementing automated decision making (Object Management Group, 2016, p.18). The decision automation properties of DMN has been discussed in literature and the possibilities of using DMN as a tool for implementing decisions as a service (Hasic, De Smedt & Vanthienen, 2017). The research around this standard has mostly been in governmental organisations and regulatory compliance applications.

DMN consists of two parts, decision requirement diagrams (DRD) and decision logic (DL) (Object Management Group, 2016). Figure 2.5 presents the relationship between DMN's levels and the link to process models. Decision requirements diagrams clarify the relationship between decisions. The result of one decision can be required as input to another. Besides this, the decision requirement diagram specifiy the required inputs to the decision and the sources dictating allowed answers. The decision requirement diagram is a graphical notation easily comprehendible by business users. This graphical notation has four parts. The decision, business knowledge model, input data, and knowledge source. The element of a decision is the central part of a decision requirement diagram referring to all other elements as input required for that decision. The business knowledge model represents business knowledge required to make decisions. This element can represent business rules in DMN, or decision logic applied across multiple decisions. However, how the business knowledge model should be used seems to be a matter of taste, as stated in the standard document published by Object Management Group (2016). The secondary use of business knowledge models is representing repeatable decisions. The knowledge source is used to specify documents containing knowledge relevant for the decision. Input data is used to specify required data for a decision.

The second level of DMN is the decision logic level which defines the fundamental logic for a decision. The definition of how a specific output is reached based on several defined requirements constraining the business. This can be derived from business rules (Taylor & Purchase, 2016). Decision logic provides a detailed view on the representation of the business knowledge model. Decision logic is defined in boxed expressions, which in turn could be represented as either decision tables or FEEL (Friendly enough expression language) expressions. A decision table contain a large amount of business rules in a decision activity but not in a natural language pattern, instead they are represented as conditions in the rows of a table. FEEL is the expression language defined in the standard for formulation decision logic expressions in a user-friendly manner, close to that of natural language BR (Taylor & Purchase, 2016).

The complexity of DMN has been evaluated in academic research by Hasic, De Smedt, and Vanthienen (2017a). This evaluation is argued to be related to learnability and perceived usability of modelling standards. In comparison to other modelling methods, DMN was evaluated as being less complex as it has few relationships and property types (Hasic, De Smedt & Vanthienen, 2017b). A limitation to their research is the lack of empirical validation, as the user's perception of complexity and usefulness determines the viability of Hasic, De Smedt and Vanthienen's (2017a) results. The low complexity indicated by Hasic, De Smedt and Vanthienen supports the extraction of decision logic from process models as a separation of concerns, which in turn decreases the overall complexity of process models.

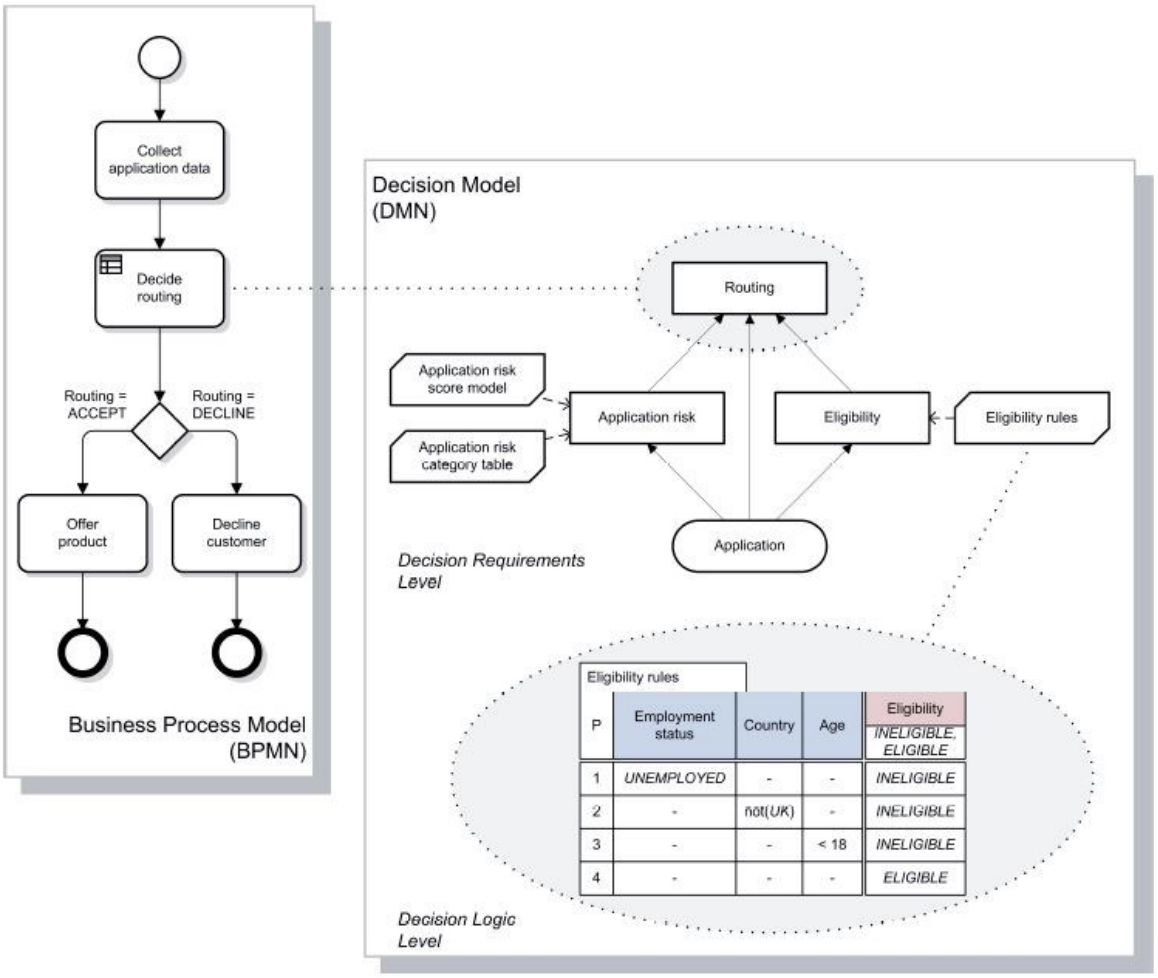

Figure 2.5. Decision model relationships. Adopted from Object Management Group, 2016, p.16

2.2.2 Business Decision Modelling in Context

Similar to how business rules are represented as relating to other models in Bajec and Krisper's (2005) enterprise model, business decisions interact with other types of models as well. Taylor and Purchase (2016) explain how DMN interact with other models in a business (Figure 2.6). In DMN, data inputs from business data models as UML are applied to be processed in automated decisions. Business motivation models provide the reasons for the decision being required and aligns the decision model with the business visions. This motivation is required for assessing if decisions are successful, by producing results achieving business goals (Taylor & Purchase, 2016). Organisational models define the decision owner. If the decision is not automated, this context is crucial for defining who will decide. Processes are responsible for defining the activity flow, and decisions in turn can aid processes through separating decision and process logic. The relationship between the process and the decision is where the research community has focused a lot of their efforts (Bazhenova, Zerbato & Weske, 2018; Biard et al., 2015; Janssens et al., 2016) .

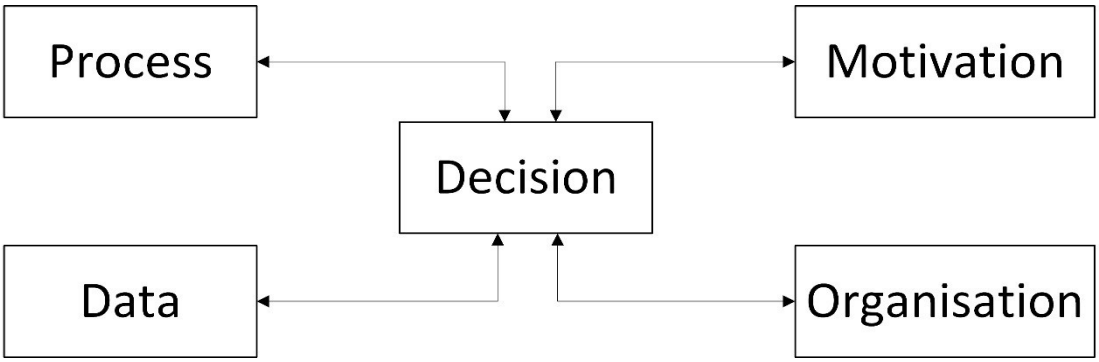

Figure 2.6. Decision model's connection to other models in business architecture. Adopted from Taylor & Purchase, 2016, p.92

In comparison with the enterprise model presented by Bajec and Krisper (2005), there are several similarities between their model and the relationships to other models in a business presented by Taylor and Purchase (2016). Comparing Taylor and Purchase to Bajec and Krisper, they see BR or BD having similar roles in a business. The resource and actors model in Bajec and Krisper's model represent who is responsible for defining and maintaining the BR. This relationship can be found again in how Taylor and Purchase define the interaction against the organisational model. These similarities also occur against the business vision model where both BR and BD are reliant on this model for their motivation and context. In relation to process models, the most significant difference exists between Bajec and Krisper and Taylor and Purchase. In relation to BP, the BR constrain or trigger the BP and the BP require business rules or refer to them. The BD is related to BP through the BP providing context to the BD and the BD extract the decision logic from the BP and trigger events within the process. The model presented by Taylor and Purchase defines data instead of business concepts model, but they serve the same function as providing terms used in BR or BD. In the case of BD, this could be a UML data model that provide the specific data points used in the underlying decision logic which is key for decision automation. This proves that the concepts of BD and BR both exist in the same place in the enterprise architecture. However, this does not mean they are interchangeable, instead BD are dependent on BR in decision logic (Taylor & Purchase, 2016). This could indicate they should coexist in an enterprise architecture. An adjustment is proposed in Figure 2.7 taking both Taylor and Purchase (2016) together with Bajec and Krisper (2005) into regard for an enterprise model including both BR and BD. Important to note in this model is that not all business rules are definitions for decision logic as there are rules not applicable in decision situations such as structural rules in SBVR as described by Object Management Group (2017).

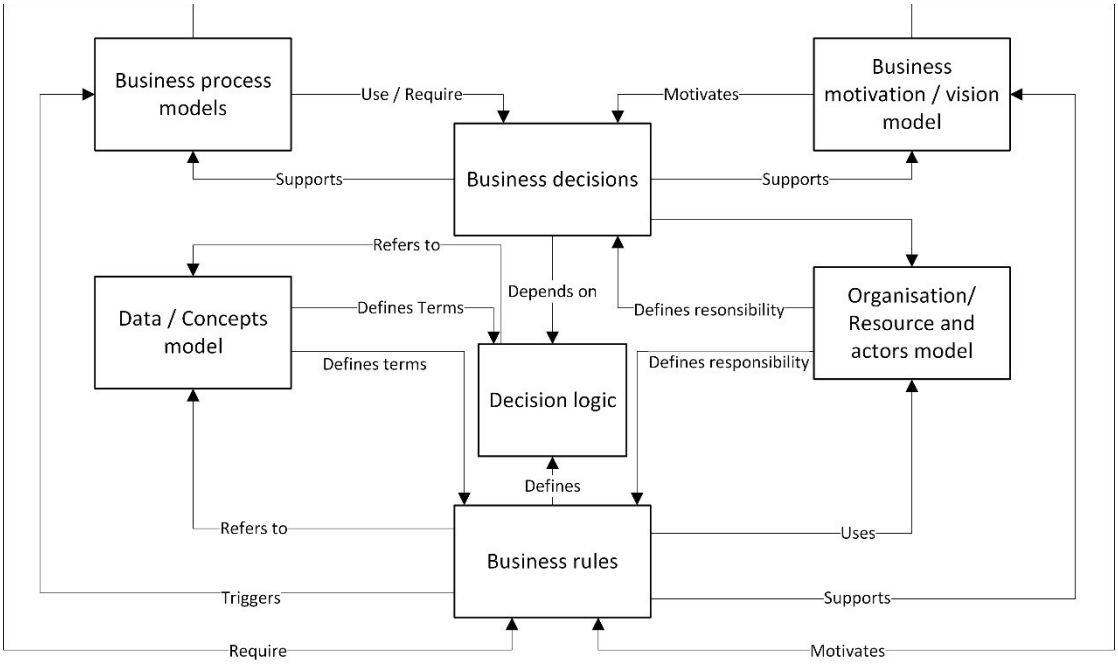

Figure 2.7. Enterprise model with BD and BR. Adopted from: Bajec & Krisper, 2005, p.428; Taylor & Purchase, 2016, p.92

2.2.3 Decision and Process Integration

Process and decision integration is almost seamless as decision modelling in DMN is intended to extend and extract decision logic from business processes modelled with Business Process Model and Notation 2.0 (BPMN 2.0)(Taylor & Purchase, 2016). Linehan and Sainte Marie (2011) indicated how this interaction would be characterized before DMN was published. They proposed the use of the business rules tasks for representing decisions in processes, which is how decision integration in processes is conducted currently(Taylor & Purchase, 2016).

In academic research, the integration between BD and BP has attracted attention with several studies mentioning this relationship as it supports the separation of process and decision logic (Bazhenova, Zerbato & Weske, 2018; Biard et al., 2015). Extraction of decision logic from processes is a topic well explored by researchers. However it is mentioned that no element exist in BPMN 2.0 for representing a decision apart from the business rules task (Janssens et al., 2016). This binds decisions to processes by reflecting the naming of the business rule task in the process model in the decision of the decision model. All processes do not contain decisions, and in turn, some decisions are not reliant on process flows. Integration is only relevant in processes applying decisions (Janssens et al., 2016). Hasic, De Smedt, and Vanthienen (2017b) presents principles for integrating process and decision models consistently. They highlight importance of aligning decision models and process models. The presented principles aid in consistently aligning models when separating decision and process logic. All but that which is relevant to the process flow should be hidden from the process model and vice versa in the decision model.

Further research in the locus of BP and BD has focused on decision mining from processes. Bazhenova & Weske (2016) propose how BD can be extracted from BP by mining decisions in processes. Most research focuses on how to integrate the standards BPMN 2.0 and DMN. However, other process modelling standards can be used in conjunction with decision modelling. Mertens, Gailly and Poels (2015) investigated DMN integration with the declarative process modelling language Declare-r. They argue that BPMN and DMN are already well aligned as concepts in BPMN supports decision logic. The declare-r language is in their view suitable for knowledge intensive processes and decision logic is more suited for these types of processes, hence the combination of declare-r and DMN is beneficial to use for these types of processes (Mertens, Gailly & Poels, 2015). The integration and relation with BPMN 2.0 is of more interest because of its wide adoption as a process modelling language (Recker et al., 2011) and is published by the same organisation as DMN.

Process and decision integration in the standard "The Decision Model" is discussed by Pitscke (2011). The Decision Model, much alike DMN serves the purpose of decreasing the complexity of process models through separating the reasoning behind a single decision outcome from the process. On the contrary to integration of BR in BP, modelling BD in a separate standard decreases BP model complexity. Meanwhile, integration of BR in BP tends to clutter process models. Hence the separation of BD from BP and integration of references to decision models is universally agreed to be beneficial to decrease process model complexity regardless of which standard is used for either decision or process modelling.

2.3 Business Rules and Business Decisions

As described in literature, BD heavily rely on BR for formulation of decision logic. It is important to align the two, hence you could either argue for merging or integrating of standards for BR and BD to clarify the connection between decisions and rules. Business rules and processes literature indicate integration is more beneficial than standard merging (Wang, Indulska & Sadiq, 2017).

2.3.1 Decision and Rule Integration

An integration and alignment of SBVR and DMN is proposed by Linehan and De Sainte Marie (2011). They propose that SBVR rules should be implemented as decision logic, which in turn can be executed in systems. The indication of this relationship has not been elaborated extensively in literature. The claim of decision logic being dependent on business rules for its formulation is supported by Taylor and Purchase (2016). However, Taylor and Purchase argue for decision management not revolving solely around BR. A decision requirement diagram can be constructed without any automatable decision in mind as a methodology for mapping strategic or tactical decisions.

In decision management, business rules have been identified as a key concept for regulatory compliance as traceability to the source of meaning is important. This is provided through linking business rules used in a specific decision clearly to the rule source (Smit, Zoet & Slot, 2016). When integrating rules and decisions it is important to have common definitions of the terms applied in the decision logic and business rules. For this purpose, a business glossary can be applied to reach consistency between BR and decision logic (Taylor & Purchase, 2016).

In DMN there is no formal element for referencing the business rules used. In the previously mentioned standard "The Decision model" by von Halle and Goldberg (2009) a formal element exist for rule integration. Each decision could reference one or several rule families where a reference to each BR applicable to the decision is defined. These are then defined in a grid matrix reminiscent of decision tables.

Taylor and Purchase (2016) discuss extensions for integrating business rules in DMN. These extensions were proposed by software vendors involved in the development of DMN. They propose a rule level annotation by documenting the intent of each row in a decision table with an annotation of the rule that is referenced in the row in question. On the decision requirement diagram(DRD) level, rules could be annotated as a message in the DRD, showing which rules the decision are dependent on. Further, Taylor and Purchase claim rule annotation is already possible in DMN as the knowledge source element could provide a reference to BR. Providing refence to the rules used in decisions like this presents possibilities for traceability of the formal reasoning behind the decision outcome, hence making the decision model more complete. The integration possibilities presented by Taylor and Purchase (2016) are reminiscent of those presented for BR and BP integration, mainly the rule annotation in BP models suggested by Zur Muehlen, Indulska, and Kittel (2008). Encapsulation as suggested by Wang, Indulska, And Sadiq (2016) can be supported in the knowledge source element of DMN.

2.3.2 Merging Standards for Decisions and Rules

Possible explanations for either integration or merging could be found in theories about ontologies. An ontology presents a description of the real world, as is the case with modelling standards, hence modelling standards can represent ontologies (Wand & Weber, 1993). Research has been conducted on ontologies and evaluation of modelling standards regarding their abilities to represent ontologies (Recker et al., 2011). A widely adopted ontology evaluation of IS development grammars is presented by Wand and Weber (1993). Their evaluation criteria are based on Mario Bunge's (1977) theory on ontology.

Wand and Weber's ontology evaluation consist of several criteria. Of most relevance to the research question of this thesis are the concepts of ontological complexity and completeness. Ontological completeness concern the ability of modelling standards to reflect all parts of reality. However, the more concepts involved in a modelling standard, the more ontologically complex it becomes (Wand & Weber, 1993). There are indications that ontological complexity in modelling standards affects the perceived usefulness of the standard for IS analysis and design (Recker et al., 2011). This could apply to rule and decision modelling as well. If the standards are merged, the merged standard would become more complex which affect its perceived usefulness.

Bunge, Wand and Weber ontology and use of ontologies in information systems development in general is not without critique. Wyssusek (2004) claims application of ontologies in information systems research overlooks current philosophical debates about ontologies. As the philosophical theories of Mario Bunge (1977) applied by Wand and Weber (1993) are no longer relevant in the philosophical or social sciences, Wyssusek argues the wide adoption of Bunge's theories limits how IS researchers view reality when adopted for evaluations.

Another concern in merging standards is the separation of concerns. SBVR is mainly described as a tool for knowledge management (Object Management Group, 2017) and DMN a tool for decision automation (Object Management Group, 2016). Merging the two would be undesirable from a separation of concerns point of view. Process and decision logic should be kept separate (Janssens et al., 2016), decisions and rules might be best served by being kept separate instead of merged in one standard.

The rule types introduced by Object Management Group (2017) or Kovacic (2004) might affect why rule and decision modelling are not merged, since some rule types are not well suited for decision situations (Taylor & Purchase, 2016). BR constraining process flow will seldom be involved in decision situations. The structural rules might not be able to be included in decisions since they define the overall relationships between concepts in the business. Behavioural rules defined in SBVR (Object Management Group, 2017) provide a better fit for decision integration as they define what should happen within activities. All business rules do not provide fit for integration with DMN. this could be a reason to not merge standards for BR and BD. An article by Kluza and Honkisz (2016) presents how SBVR, DMN and BPMN 2.0 can be used to represent the same things. This is an indication of the overlap between the standards.

2.4 Theoretical Summary

In summary, scarce literature exist on the topic of decision modelling and its interaction with business rules because decision modelling is a relatively new topic. However, the interaction between business processes and decisions or rules is well explored in research. This thesis includes previous research conducted about the interaction between process and decisions, and process with rules. Rules and processes are included because decision modelling has much potential to extract business rules from processes through a separation of decision logic and process logic. Table 2.1 presents the concepts identified in the literature review with a brief explanation and the literature related to each concept.

Table 2.1 Theoretical summary of literature review

Concept	Description	Described in
Separation of concerns	Concepts should be separated wherever possible and not be concerned with anything else than the input they require, not how that input is reached.	(Bazhenova, Zerbato & Weske, 2018; Biard et al., 2015; Janssens et al., 2016)
Enterprise model interaction	Business rules and business decision modelling have distinct interactions with other model types	(Bajec & Krisper, 2005; Taylor & Purchase, 2016)
Integration	Business rules can be integrated in process models depending on factors characterising the business rule to be integrated. As business decisions aim to extract decision logic from processes this logic contains business rules which can be integrated in the same way as rules in processes	(Taylor & Purchase, 2016; Wang, Indulska & Sadiq, 2016, 2017; Zur Muehlen, Indulska & Kittel, 2008)
Integration type	There are different ways of integrating business rules in process models. These are: Annotation, Encapsulation and extension.	(Wang, Indulska & Sadiq, 2016; Zur Muehlen, Indulska & Kittel, 2008)
Ontological complexity / completeness & perceived usefulness	The complexity of a modelling standard depends on how many constructs are included in it, which increases its completeness. Studies indicate that complexity is undesired as it affects the perceived usefulness of a standard.	(Recker et al., 2011; Wand & Weber, 1993; Wyssusek, 2004)
Rule Type	There are different types of business rules which have their own distinct interactions with processes and decisions. Some of these types will not interact with decision and hence not required to be integrated.	(Bajwa, Lee & Bordbar, 2011; Kovacic, 2004; Object Management Group, 2017; Wang, Indulska & Sadiq, 2016; Zoet et al., 2011)

3 Research Method

This chapter introduce the research process adopted throughout the collection and analysis of empirical data. Motivations for the applied method are provided along with a discussion regarding quality and ethical considerations affecting this thesis.

3.1 Literature Search

The literature in the literature review was identified through an extensive search for academic literature on the topics of business rules and business decisions. The literature was searched for on three search engines for academic literature. These were LUBSearch, Google scholar and the IS specific database AIS Basket of Eight. The keywords used for searches were "Business decisions", "Business rules", "DMN", "SBVR". Further sources were Business Rules Journal and Object Management Group's website. Business Rules Journal is a practitioner-oriented journal with articles discussing business rules applied in practice. Object Management Groups website was used to retrieve standard documents for SBVR and DMN.

3.2 Research Approach

To investigate the research question which is explanatory, a qualitative method with the aim of deduction was adopted for the data collection. In this case semi structured interviews were the basis for the research instrument. The goal of an deductive approach is to infer theory from the gathered data (Recker, 2013).As explanatory research focuses on explaining the interaction between concepts (Bhattacherjee, 2012) it is well suited for answering the research question. The interaction between business rules and business decisions and the explanation behind why these seemingly similar concepts are kept in separate standards was sought. For this, the reasoning behind the standards through the views of subject matter experts were required.

The research question required an interpretive research design in both data collection and analysis to enable deduction of theory. As the answers to the research question will be shaped by the previous experiences of the respondents and their social contexts (Bhattacherjee, 2012). Because an interpretive approach is adopted, generalisations in the sense of inferences from a sample to a population are not the desired outcome of this research and would be impossible with the form of data collected. Instead, this research focuses on generalising from empirical findings towards theory, in this case, the standards SBVR and DMN. This type of generalisation is discussed by Lee and Baskerville (2003) . Further, this distinction from positivistic research is discussed by Orlikowski and Baroudi (1991) as interpretive research aims to understand the deeper meaning behind phenomena.

Bhattacherjee (2012) discuss interpretive research approaches being more suited for theory building than theory testing. As the research question of this thesis is largely unexplored in previous literature, theory was attempted to be derived from the data collected. This supports the choice of semi structured interviews for collection of qualitative data. Furthermore, an interpretive research design can help identify hidden reasoning which is not possible through positivistic and quantitative research approaches (Bhattacherjee, 2012).

3.3 Interview Design

The interviews conducted were semi structured with few predefined questions and of an open nature allowing interview participants to interpret the question and provide answers that were not of a "yes/ no" nature (Bhattacherjee, 2012). This approach is to be expected in this thesis as it is exploratory. Using structured interviews instead of semi structured would defeat the purpose of identifying new concepts through interviews. Structured interviews typically do not allow for interview participants to elaborate on and interpret questions (Recker, 2013).

The questions in the interview guide (Appendix 1) were based on concepts identified in the literature review. As the reasoning behind the standards is sought and not practical examples, the questions were asked on a general level avoiding any inquiry to mention practical examples. The corresponding literature to each question and the factors behind the questions are presented in table 3.1. This style of interviewing fits with the exploratory nature of the research question. The exploratory interview aims to investigate and identify previously unexplored subjects, which is applied in a deductive approach to explore new theories (Recker, 2013). To give a common structure in the interviews conducted, an interview guide was designed with 17 questions in total, 5 of which were introductory and closing questions. As the interviews proceeded in rapid succession after one another, adjustments in the interview guide were not made, since the questions were sent to interview participants beforehand to give them the possibility to prepare well thought out answers and judge if they had the ability to answer the questions.

Allowing interview participants to review the questions beforehand allowed the partial addressing of the artificiality of the interview situation discussed by Myers and Newman (2007), as the interview participant is expected to create opinions under time pressure. The interview participants had the opportunity to review the questions beforehand, they knew what to expect and could prepare to discuss the subjects in the interview.

Table 3.1 Interview questions relation to concepts

Concept	Adopted from	Reflected in question
Separation of concerns	(Bazhenova, Zerbato & Weske, 2018; Biard et al., 2015; Janssens et al., 2016)	Question 5,6,7
Enterprise model interaction	(Bajec & Krisper, 2005; Taylor & Purchase, 2016)	Question 13, 12
Integration	(Taylor & Purchase, 2016; Wang, Indulska & Sadiq, 2016, 2017; Zur Muehlen, Indulska & Kittel, 2008)	Question 7,8,10
Integration type	(Wang, Indulska & Sadiq, 2016; Zur Muehlen, Indulska & Kittel, 2008)	Question 10
Ontological complexity / completeness & perceived usefulness	(Recker et al., 2011; Wand & Weber, 1993; Wyssusek, 2004)	Question 13
Rule Type	(Bajwa, Lee & Bordbar, 2011; Kovacic, 2004; Object Management Group, 2017; Wang, Indulska & Sadiq, 2016; Zoet et al., 2011)	Question 9

3.4 Interview Participant Selection

The selection of interview participants was based on the criteria of having deep knowledge of the standards DMN and SBVR. As the reasoning behind the standards is of interest they should preferably be involved in the work with standards in the Object Management Group. As experts are interviewed, their views on the subject is trustworthy. This means the study is not generalisable to a larger population (Bhattacherjee, 2012) but that is not the type of generalisation sought in this study.

Decision and rule standard experts were contacted through e-mail stating my research intensions. Of the ten initially contacted experts, 3 were willing to participate in interviews. As interview participants were located at a substantial geographical distance from me, the interviews were conducted through Skype, which is not preferable in a qualitative interview setting. There are several variations that are missed in comparison to face to face interaction (Schultze & Avital, 2011). As there were no interview participants in close geographical vicinity this is a limitation that is considered as negligible to the ability to answer the research question.

3.5 Transcription

The conducted interviews were transcribed to support the analysis of the collected results. Transcriptions offers an over-viewable approach to analysis (Recker, 2013), time spent on transcribing was deemed worth the investment in time to support the analysis. The transcriptions were done directly after the interviews and each question and answer were given an ascending numerical code to ease referencing the transcripts in the results.

3.6 Analysis

The analysis followed a qualitative approach, as it emphasises on word rather than numbers, and the difficulty of conducting this type of analysis compared to a quantitative analysis is higher (Bhattacherjee, 2012). The interviews conducted resulted in 25 pages of transcript text. This amount of text meant there was a need for reduction of the meaning contained within the text. This enables a condensed discussion and comparison of facts presented by the experts interviewed otherwise difficult to comprehend (Recker, 2013). As the data collected is of a qualitative nature, an interpretivist approach to the data analysis was required.

To reduce data, coding was adopted as an analysis method to separate the concepts; this coding is both based on the literature review concepts based on the research question Coding in this manner is a tried way of reducing data (Bhattacherjee, 2012). Although coding is mentioned as somewhat subjective since the researcher choses the central topics of interest (Walsham, 2006), it still provides the most apparent way of analysing exploratory research. The assigned codes are presented in table 3.2 and were identified in the literature review. The corresponding literature to each concept is found in Table 3.1

Table 3.2 Coding Scheme

Concept	Code
Separation of concerns	SOC
Rule Type	RT
Complexity / Completeness	C/C
Integration	I
Enterprise Model	EM
Decision definition	DD
Rule definition	RD

Considerations of which display format the data reduction should be embodied as resulted in the decision to present data separated by the concepts and facts identified in previous literature and in the interview transcripts. Each of the results from the interviews relating to the central concept are referenced in text with reference to the answer in the transcript according to the following code: I1T1 where I1 refer to interview 1 and T1 refer to the first answer of the interview participant. The T is replaced by other letters in the following interviews as that refer to the last name of the interview participant.

3.7 Quality

To assure quality in research, there are several aspects to address. In interpretive research, these quality measures are not as straightforward as in positivist research (Bhattacherjee, 2012). The dependability, credibility, conformability, and transferability of qualitative research requires considerations (Bhattacherjee, 2012). Statistical generalisability is difficult to assure in interpretive qualitative research, as the sample generally does not represent an entire population (Recker, 2013). Further differences in quality measures also exist when compared to quantitative methods, which rely heavily on statistical rigour to draw meaningful and valid conclusions. As the empirical data collection and selection of respondents were not based on numbers, these quality measures are not applicable in this thesis. Alternative measures of quality are discussed by Recker (2013). Instead of reliability, dependability was insured through giving clear reference from transcripts in the results chapter, as this aids in following the line of reasoning from the transcripts applied in the analysis.

3.7.1 Ethics

Ethics are important to consider in all research, as research should do no harm to the participants in the research or to communities at large (Recker, 2013).Therefore, the voluntariness of participation was emphasized to the participants to assure them not feeling forced to participate. The option to withdraw their participation without further consequence or correspondence was also given. If desired, the interview participants were given the option of being assured confidentiality. As anonymity cannot be assured in interview research (Bhattacherjee, 2012) confidentiality was the option offered to interview participants. Although given the option, all interview participants chose to have their identity disclosed in text.

3.8 Limitations

The limited time allotted for research resulted in no triangulation of sources. Triangulation of sources improve the credibility of research, which is important in interpretive research (Bhattacherjee, 2012) The interviews conducted are the only source of empirical data, which reduced the variety of the results. As only three interviews were conducted in total, this is a limitation to my results. This because of not being able to get access to more interview participants. Although, the interview participants are all very knowledgeable in decision modelling and have deep knowledge within the subject. Their answers can be deemed of good quality and trustworthy. Further, the interview participants were all oriented against working with DMN. Attempts to contact people involved in SBVR resulted in no responses. This is a limitation of my study since the views and reasoning behind the standards are biased against decision modelling through the views on rules, decisions and standards of the interview participants.

4 Results

In total, three interviews were conducted with professionals possessing deep knowledge of business rules and business decisions. While given the option of confidentiality, all interview participants chose to disclose their identity. The following section introduce the interview participants.

4.1 Interview Participants

James Taylor (Appendix 2: Interview 1 (I1)) is one of the originators behind the term "Business decision" and has written several books on the topic. "Real-World Decision Modelling with DMN" and "Smart Enough Systems" both address the concept of business decisions. He is the CEO of Decision Management Solutions working with decision management and decision modelling. Further, he is a member of DMN's committee and is one of the originators submitting the original request for proposal to OMG.

Jan Vanthienen (Appendix 3: Interview 2 (I2)) is a professor in information systems at KU Leuven university in Belgium. He has a long background in the business rules and business processes field. Decision tables has been in his focus for a long time. Vanthienen is a member of the DMN committee and one of three persons behind DMN's request for proposal.

Inge Lemmens (Appendix 4: Interview 3 (I3)) is the Chief Technology Officer of the consultancy firm PNA Group. PNA works with both DMN and SBVR in their methodology. They are an OMG member organisation and have voting right in both DMN and SBVR. While Lemmens is not directly involved in the standards, she follows them closely and shares the vote in the standards together with her colleagues and does a lot of the background analysis on PNA's behalf in the standards.

4.2 Definitions of Rules and Decisions

In their definitions of business decisions, Vanthienen, Taylor, and Lemmens shared similar views on the concept. They all considered a decision to be the output based on a number of input values (I1T5, I2V8, I3L10). However, Vanthienen specified it as an operational decision in the context of DMN (I2V8), and not as much about the tactical and strategical level. All interview participants mentioned that operational repeatable decision is the main intent in the definition of a business decision in the context of decision modelling in DMN.

In their definition of business rules several differences in meanings is identified between the interview participants. Taylor defined a business rule as:

It's what we should do in a particular circumstance. Given a certain set of facts, what alternative should we pick? So, it's one of the ways you can make a decision - (I1T8)

After this definition Taylor stated he consider business rules as a subset of the business decision. This is also related to the relationship seen between the concepts where the business rules are one of the ways in which you can reach a decision outcome (I1T10).

Contrasting Taylors definition of business rules, both Lemmens and Vanthienen considered the business rule as a larger concept then business decisions, stating that business decisions are a subset of business rules (I2V11, I3L13). In similarities between rules and decisions Lemmens considered rules and decisions as interchangeable meaning a rule can be expressed as a decision and a decision as a rule. It is all a matter of which surface language, or standard you choose for the representation (I3L15+16). In the similarities between the concepts Vanthienen considered the business decision to be a type of business rule; the decision rule which deals with reactions to inputs or results of inputs (I2V15).

4.3 Separation of Concerns and Complexity

When reasoning about why the standards are separate or why they should be merged, several variations between the participants were identified. While reasoning for the separation of DMN and SBVR, their distinct purposes were mentioned as a reason for not merging them. DMN deals with automation of decisions, while SBVR mainly attempts to overcome ambiguity in businesses by establishing common definitions. Taylor mentioned that decision modelling can also be used for manual decision making (I1T12). Taylor further mentioned problems which he sees with SBVR. In SBVR everything is seen as a business rule, for instance process flows, which is typically defined in process models. These rules are not useful artefacts for businesses (I1T13).

While discussing the emerging complexity from a combination of SBVR and DMN, the interview participants views differed. If the standards would be combined the following reasoning is given by Taylor who considered it would not become complex but contradictory and unfinishable:

The way SBVR talks about rules is antithetical, it's the opposite of DMN thinks about rules. It is not a resolvable situation there. There is no overlap between the way SBVR talks about rules and the way DMN talk about rules. They just don't touch anywhere. – (I1T15)

This view is critical against the traditional way of capturing business rules. Vanthienen explained the reasoning for separating rules and decisions as the following:

At some point in time we had to make a choice, do you wait for the automation of the general thing, or do you deal with the more limited one, and I think DMN has been there because SBVR is not an operational standard in the sense that you have tools to automate the business rules. – (I2V16)

Here, the main focus is on the automation properties of DMN as SBVR does not support executable specifications of business rules. It deals more with descriptions, hence not supporting the main focus of DMN. Separation is mentioned as favourable from the Object Management Group perspective to appeal to different audiences. From a consultant perspective of an organisation which works with a methodology involving both SBVR and DMN, the concepts of rules and decisions should not be kept in separate standards, as they both attempt to represent

the same things (I3L18). Merging does not really serve the purpose of automation in DMN and would lead to a more complex standard. However, Lemmens states that there is overlap between DMN and SBVR in contrast to the views of Taylor:

There is definitely overlap between them. Behind DMN you can express DMN in predictive logic. Many cases even propositional logic. If I can express something in logic I can take any surface language on top of that. SBVR could be one of them. - (I3L49)

The separation of concerns was not necessarily seen as affecting the separation of rules and decisions by Vanthienen, rather focus as decisions were easy to extract from business and rules seen as a complex and overarching area (I2V18). Taylor mentions the separation of concerns as the decisions should be treated as their own artefacts (I1T26). Vanthienen believes that a merged standard would become too complex and that decisions were extracted into its own standard as it could be easily done. This extraction supported an executable standard for decision automation. As SBVR deals with a larger area than DMN an executable standard for SBVR would add considerable complexity (I2V34). As SBVR deals with a larger area it is believed it will never be able to reach a point where it is executable (I3L50).

4.4 Rule Type

Rule types were not mentioned as affecting the choice to model rules and decisions in separate standards but were discussed in the context of decisions and rules. The business decision is considered a rule type by Vanthienen, the decision rule which determine a decision outcome (I2V14). There were also discrepancies of what is considered a business rule, depending if you look at it through a purely theoretical view or as a concept applicable in businesses (I3L43). The decision rule is the only rule relevant for integration in decision modelling. As Taylor does not work with business rules besides their direct implementation in decision logic, rule types were not relevant for the operations of Decision Management Solutions (I1T21). In Taylor's experience, rule types were not relevant as they only support a categorisation irrelevant for formulating what a decision outcome should be, and even problematic if not related to the decision model (I1T16).

However, Lemmens view on rule types differs from Taylor. According to Lemmens, there are several rule types relevant for a decision model because rules are required for defining data constraints or describing concepts used in the decision model. This level of detail difficult to attain purely in the decision logic of DMN (I3L31). For instance, cardinalities are required as compliments to decision models. Lemmens mentions that this could be represented in an entity relationship diagram or UML model, but those are insufficient tools for discussing with business (I3L38). Natural language rules are used as a communication method with business users as decision logic in DMN is not friendly enough for business.

4.5 Enterprise Model

While discussing the influence of other models applied in a business, concept and process models were found to have the most influence on business rules and decisions. Organisation models and motivational models play a secondary part on the operational level where the motivation is often clearly defined. Motivation models exist on the strategical level. The process and rule interaction and process and decision interaction were mentioned as key by all interview participants. These areas already have clear interactions supported by a separation of concerns.

Vanthienen indicated that these interactions affected why rules and decisions are modelled separately. Rules are not a model per se, rather a list, their interaction with other enterprise models becomes difficult (I2V27). The main concern with interaction between models in a business was mentioned to be the level of detail provided in models. On the conceptual level, the granularity should be low, hence no referencing between models should exist on this level, as its main purpose is to discuss with business. Vanthienen reasons on the difference between the operational and strategical levels as the following:

At the top strategy level, you are dealing with the business motivation, but once you are on the operational decisions, the business motivation is given. – (I2V31)

Lemmens' organisation only applies process, data, rule and decision models. Motivational models are unnecessary on the operational level where the main purpose of the interaction is reaching automatable decisions(I3L42). These interactions are dependent on the type of methodology used. There are differences between the models required depending on if a rule or decision-based approach is adopted (I3L45, I1T36).

4.6 Integration Possibilities

Whether natural language rules should be integrated is a question of methodology. Taylor sees no purpose in representing rules in this way in decision modelling but would like to see a way of verbalising rows in decision tables in a more business user friendly language than FEEL (I1T21). A possibility for clearer glossary integration which could be an SBVR glossary is seen to increase consistency with decision models(I1T14). It is argued that rules are already integrated in DMN, but not in a natural language specification. The required business rules are integrated in the decision logic (I2V22). Instead, the possibility for separation of concerns is emphasized:

In most cases business processes contain or try to show too many rules and too many decisions, there should be separation of concerns so that the process is simple and the decisions are separated, or the rules in a lot of cases are separated. – (I2V25)

Again, the level of granularity is mentioned, Vanthienen discuss the difficulty of deciding where to stop in extracting process and decision logic (I2V26). Integration is also seen as a long-term goal. DMN might be considered rather limited and progress against clearer rule integration (I2V35,36). On the contrary to Taylor's view on decision and rule integration, Lemmens' requires integration of business rules in decision models in the methodology used by her organisation. This methodology starts with facts types, which rules are then extracted

from. The last step is to apply these in decision situations. They use a natural language representation of rules to complement each row in decision tables. This is an integration of business rules in decision modelling as they use natural language rules for discussions with business (I3L26-29). Lemmens uses business rules for defining cardinalities and fact types which are important inputs in a decision model to make it executable. These rules support discussions with business where a UML diagram is too complex for business users to comprehend (I3L35).

4.7 Summary

In summary, the interview participants were critical towards merging standards for decisions and rules, depending on which perspective they addressed it from. From the perspective of a standards development organisation, a merge would be undesired as it would make the standards more complex and appealing to a smaller audience because of it.

Their definitions of rules and decisions were somewhat similar with disagreements regarding whether business decisions should be considered subsets of business rules. One interview participant disagreed with this stating that business rules are a subset of business decisions. They all agreed that business decisions should mostly deal with operational decisions that are repeatable.

Separation of concerns and complexity were both mentioned as reasons for keeping decisions and rules separate. DMN and SBVR have distinct purposes, mixing these would create an overly complex standard and make the standard less useable since it no longer appeals to one specific audience seeking one purpose.

Rule types were mostly seen as irrelevant, as the decision itself can be seen as a type of rule; the decision rule. Depending on which methodology is used, there could be further rules types of relevance to decision modelling such as data quality and constraint rules.

Interactions with other enterprise models such as data models and process models were mentioned by all interview participants. During these discussions the separation of concerns was mentioned again. Motivational models were not seen as important for neither decision modelling, nor rule modelling since DMN deals with the operational level where motivation is already well established without the need of models.

Possibilities for integration between rules and decisions were not seen as viable as integration does not support the separation of concerns. However, the interview participants would like to see a way of representing decision logic in a manner more reminiscent of natural language than is possible at the moment in DMN and thus integrating natural language rules but as a part of DMN. This to make it more understandable to business users. Glossaries were also seen as important and are possible to integrate from SBVR to DMN.

5 Discussion

Varied views on the involvement of rules in decision modelling emerged through the interviews. The variations of methodologies adopted by the interview participants organisations governed their views on how to apply rules and decisions. The purpose of the standards varies depending on the organisational level as it affects where rule integration in decision modelling is required. The relationship indicated by Linehan and De Sainte Marie (2011) is reflected in the interviews. Linehan and De Sainte Marie discussed the interaction between DMN and SBVR. However, SBVR rule specifications are not used by any of the interview participants in its pure form. They have their distinct methodologies for verbalising rules which are less complex than SBVR. The complexity of SBVR is one of its foremost drawbacks. SBVR attempts to capture everything as business rules, even though it might be captured someplace else in process or decision logic. The three main themes in the interviews are whether you should integrate or merge standards, the clear distinction between conceptual or executable specifications, and the interaction with other business models.

5.1 Integrate or Merge?

The interview participants were critical against the suggestion of merging SBVR and DMN. Merging the standards would create unnecessary complexity by mixing standards with distinct purposes. This would cause confusion rather than alignment. SBVR deals with larger area than DMN as the concept of business rules extends beyond decisions. DMN was created because decisions are easily extractable and automatable business concepts. Merging DMN with SBVR would not serve the purpose of decision automation. The complexity produced by a merge outweighs the benefits of completeness. This concern was discussed by Wand and Weber (1993). Compromises between ontological completeness and complexity were indicated. These indications were reflected in the findings by Recker (2011) where ontological deficiencies in modelling affects how users perceive the usefulness of standards, one of which is the balance between complexity and completeness. The findings from the interviews indicate that reduced complexity is desired over completeness in a standard. A standard with a clearly defined purpose is seen as more useable than one with ambiguities(Recker et al., 2011). DMNs main purpose is agreed on by all interview participants to be automation of decisions. Adding complex rule definitions would make the execution of DMN difficult, hence not desirable for DMN's main added value on the operational level. As SBVR allows for ambiguity it is seen as less useable. DMN has been assessed as a standard with low complexity (Hasic, De Smedt & Vanthienen, 2017b). Adding complex concepts would be counter-productive as it has been found to affect the learnability of standards (Hasic, De Smedt & Vanthienen, 2017b).

Integrating business rules in decision modelling is more beneficial than a merge according to the interview participants. Depending on which perspective they view it through. Merging would be beneficial from the perspective of PNA-Group's methodology. But it would be undesirable from the perspective of a standards organisation where keeping the standards separate accommodates different audiences. The scope of business rules is seen as a larger area than business decisions. Decisions are a subtype of business rules referred to as decision rules. An overlap between DMN and SBVR exists, as they are both surface languages that can be used to represent the same thing. Indulska and Zur Muehlen (2010) presented an overlap analysis of rule and process modelling languages and found significant overlap. DMN and SBVR are both surface languages that can be used to represent the same concepts, but one is

executable and the other not. This was indicated by Kluza and Honkisz (2016). They presented that the same thing can be represented in decision logic, SBVR rules or process flows in BPMN 2.0. This might be related to the overarching role business rules have, where a rule can be used to represent all constraints in a business. Process flows are discussed by Kovacic (2004) as global rules and therefore an artefact able to captured as business rules instead of containing them in processes. There is a disagreement among interview participants on whether to consider this as business rules or contained in process flows. It depends on whether business rules are considered from a purely theoretical standpoint, or as an artefact for discussions with business used to derive executable code. A process flow rule presented in a natural language format is not necessarily more business user friendly than presenting it in a process diagram. Most users would prefer to see it as a process diagram. When considering rules in DMN, natural language representations would aid business users understanding of decision tables by explaining decision tables to business users unfamiliar with the standard in a familiar language. This is reflected in the findings of Indulska and Zur Muehlen (2010), where BP are required to be complemented with BR to reach sufficient representational capabilities. Wei, Indulska and Sadiq (2017) discussed when business rules should be integrated in business processes and concluded business rules should only be integrated in processes when they were not critical for business operations and required infrequent changes as this would create two sources for business rules; the process model and the rule repository. This is reflected in the thoughts of the interview participants where either integration or merging is undesired. Rather, a replacement of current representations of rules in DMN with a more natural language specification is desired.

A separation of concerns should exist. The main purpose of decision modelling is to achieve execution of decisions (Taylor & Purchase, 2016). Rule models should be an overarching directory of constraints in a business (Morgan, 2002). As indicated in the purposes of the standards DMN is mainly for decision automation (Object Management Group, 2016). SBVR aims to create an unambiguous source for rules and concepts confined in a business (Object Management Group, 2017). To keep decision models simple, careful considerations should be made before integrating business rules in decision models further than representations provided through decision logic. According to Janssens et al. (2016) the separation of concerns is the main reason for separation of process and decision logic, where considerations of how the integration between decision and process models is required for consistent alignment. Using DMN would allow for separation of decision rules from a rule repository, containing decision rules in decision logic formulations instead. A natural language rule integration would only be required for presentation to business users of which rules are applied in decisions. Glossaries are an important part of DMN to prevent ambiguity (Taylor & Purchase, 2016). The glossary is discussed by Lemmens as facts types and Taylor mentions this as a glossary. This is a concept contained within SBVR that would be beneficial to integrate, or merge into DMN to prevent ambiguous formulations of decision logic.

5.2 Business Friendly or Friendly Enough for Execution?

Variations were detected regarding if rules should be integrated. This depends on if the purpose of decision modelling is discussions with business or the execution of automatable decisions. On the operational level, decisions models should be executable to have added value. However, on this level the defined logic is not business user friendly. Lemmens saw the need for natural language-based rules for discussions with business, verbalising rows in decision

tables in natural language. Taylor saw this as an opportunity for increased business friendliness and would like to see a clearer way of integrating natural language rules in DMN.

A difference exists in how rules are represented between executable decision logic and natural language representations. Integration of natural language business rules is irrelevant for execution, but useful for discussions with business as a communication method. This depends on the methodology applied or if the usage is for conceptual or executable models. The methodology of Lemmens organisation starts with rules and facts types which is used to derive decisions. This aids in lifting rules and assuring they are not kept in source code which has long been recognised as a common problem with business rules (Morgan, 2002).

The rule type has a crucial role in deciding which rules should be applied in decision modelling. Data quality rules are difficult to display to a business user as diagrammatic representations in UML. Natural language rules can be used to verify cardinalities for instance, as these are hard to represent in DMN. The rule type discussed by Vanthienen as the decision rule are the only rules required in DMN for decision logic. A natural language formulation of data quality rules is easier to comprehend than a UML diagram. This is in line with the Business rules manifesto, where it is stated that business rules should be a business concern and not a technical concern (Business Rules Group, 2003). This can explain the discrepancy between how rules are formulated in DMN which is still too technical for business users to formulate rules. DMN require technical formulation of rules for executable decisions. Creating a natural language formulation for rules in DMN would be difficult to achieve, as these rules relies heavily on the business context they are created for, and hence, operators might look different from case to case. A more business friendly formulation of rules in DMN is supported by the Decision Management Manifesto claiming decisions should be extracted and reviewed continuously by business (Taylor, 2013). This is one of the main problems between DMN and SBVR. DMN aims for execution, while SBVR aims for being understandable by business, creating a discrepancy that is hard to overcome while attempting to integrate or merge them. The natural language formulations are not a necessity for reaching automated decision making.

5.3 Enterprise Perspective

As indicated in literature, the interaction with other business models is similar between business rules and business decisions (Bajec & Krisper, 2005; Taylor & Purchase, 2016). The organisational level affects whether rules and decisions should be integrated in models. Bajec and Krisper (2005) defined the relationship between business rules and business vision/ motivational models as the business rule either hindering or supporting business goals. The motivational/ vision model only provide value on the strategic level as to motivate which rules and decisions are required. On the operational level the motivation is often clear. The motivation for actions is known on this level and you do not need vision/ motivational models to see why you need them. Two models mentioned as most important on the operational level were data/concepts models and process models, which interact with both rules and decision models. Interesting variations emerged in the relationship with data models, where business rules are important input to define data constraints. Business rules in a natural language format, as discussed in the previous section, acted as a tool for discussion with business. However, not all interview participants shared this view. Some saw them as unnecessary.

Decisions address a small part of the business; business rules are more overarching and can be used to capture all parts of a business in a way that business decisions cannot. If capturing all these rules are relevant for business value is another question, as according to one interview participant, this methodology of capturing all rules in a business is not relevant for reaching automatable decisions. As decisions are seen as what is valuable in a business (Blenko, Mankins & Rogers, 2010), capturing all business rules are not be relevant for achieving business value. Rules and decisions have distinct interactions with other enterprise models. As decisions deal with a limited artefact, their interactions cannot cover all of those which the rules have with models in an enterprise. The decision acts as a middle step between the processes and business rules.

6 Conclusion

The stated purpose of this thesis was to investigate the interaction between business rules and business decisions. SBVR and DMN were used as a basis for the empirical investigation. DMN includes concepts in its decision logic that can be interpreted as business rules. As decisions are what is seen as important in businesses by some, this led to the question if business rules specifications such as SBVR still have value as DMN is a middle step between the process and rules offering an intuitive way to categorise business rules for execution. The question this thesis set out to answer was hence:

Why are Business rules and business decisions kept in separate standards?

An easy answer to this question would be the purposes of the standards are not compatible. This would of course be an oversimplification of the relationship between rules and decisions. The standards are developed by an organisation aiming to appeal to a broad audience. Merging two distinct concerns would narrow the audience. DMN is meant for automation of decisions and SBVR is meant for capturing of business rules and a business vocabulary unambiguously in a way understandable by business. Treating these concepts in one standard would create complexity affecting how useable the standard is perceived to be. Looking past appealing to a broad audience, rules and decisions have different interactions with enterprise models. Merging would create ambiguous interactions. Although, the concepts of SBVR vocabularies and natural language rule specifications are possible to transfer to DMN for increased business friendliness.

However, business rules are already kept in DMN to some extent in its current specification. The business rules relevant for DMN are the decision rules and data quality rules. Decision rules are already included in DMN as decision logic and are represented as behavioural rules in SBVR. Data quality rules are required as an extension to DMN where a data model would be used, as a data model is not business user friendly. DMN only deals with decisions as a separation of concerns from processes. Including concepts from SVBR such as the vocabulary would be useful for DMN. But capturing rules other than decisioning rules and data quality is not relevant for DMN when applied for decision automation. SBVR is applied in businesses with requirements to capture other things than decisions as rules. SBVR can be used to describe everything in a business as business rules and hence deals with a much larger area than DMN. SBVR still has a place in the enterprise architecture as to achieve unambiguous communication, but not for execution of decisions where DMN has stepped in as the mediator between processes and rules with a separation of concerns between process and decision logic.

DMN is gaining increasing recognition. This thesis elaborated its interaction with business rules which varies depending on the organisational level on which it is applied, and the methodology adopted. Further research should focus on investigating methodologies for decision-based approaches including different amounts of rule specifications to investigate which differences exist between the two. This could help define which most efficient in building automatable systems which is the main added value of adopting decision modelling.

Appendix 1: Interview Guide

Interviewee: Time started:

Interviewer: Time ended:

Emphasize that participation is voluntary, you are free to withdraw your participation at any point, the finalised interview transcript will be sent to you for crosschecking and any interpretation made from your answers will be crosschecked if you desire. Would you like to be anonymized from published text?

Interviewee background

Q1: Can you tell me about your background in decision modelling and / or rule modelling?

Q2: How familiar are you with the standards SBVR and DMN?

Q3: Were you involved in the development of either SBVR or DMN?

Q1: How would you define a business decision?

Q2: How would you define a business rule?

Q3: What similarities are there between the two concepts – how do you see that they are related?

Q4: According to you, should they be kept in separate standards?

Q5: What is the main purpose of DMN, how is it applied in the real world? Example, beneficial to use for decision automation

Q6: What is the main purpose of SBVR, how is it applied?

Q7: If you had to choose between merging SBVR and DMN into one standard or having clear references providing easy integration between the standards. What would you choose and why?

Q8: How can business rule be represented in decision modelling?

Q9: Are some rules more suited towards decisions than other, does a rule type exist that cannot be applied in a decision situation? (Can you give an example of a rule that would not be well suited for a business decision**)**

Q10: Three general categories for integrating models with each other exists: Annotation, Encapsulation, and Extension. Which of these categories for integration would be most suited for integrating a business rule with the following characteristics into a decision model?

- A business rule that is required to be changed frequently.
- A business rule that is required to be changed rapidly.
- A business rule that is applied across multiple situations.
- A business rule that is of key importance to business operations.

Q11: Business rules and business decision models interact with other business models. For instance, business process models. Do these interactions affect why they are modelled in separate standards?

Q12: In your view, could standards for rules and decisions be merged to create a more complete standard, or would this lead to a standard too complex for being perceived as useful?

Closing questions

Is there anything you would like to add that I have not asked for?

Do you see any other key persons that would be beneficial to interview for this thesis?

Thank you for your participation, interview transcripts will be sent to you as soon as they have been finalized.

Appendix 2: Interview 1

Interviewee: James Taylor (**T**)

Time started: 2018-04-25-18:26 (GMT +02:00)

Interviewer: Oskar Hall (**O**)

Time ended: 19:14 (GMT +02:00)

O1: Then I would like to ask if you would like to be anonymous in this interview?

T1: No, happy to be me

O2: I thought we could start off with a bit about your background in business decisions and business rules?

T2: Sure, I'm the originator of the phrase decision management. I came up with it at Fico back in 2002. I've been doing decision management ever since, I am one the original submitters of the decision model and notation standard and continue to be an active member of the committee, decision management solutions I am an OMG member and participated in the DMN standard from the first RFP (request for proposal). I was an active member when I was at fair Isaac of the production rule presentation and I wasn't involved in SVBR, I am familiar with it and certainly stood by and observed it as it was being developed.

We do decision modelling in every project, as a company we probably model around 3000 decisions around the world right now, we have a dozen active decision modelling projects.

O3: So, then I would assume that you are very familiar with both the standards

T3: Much more so with DMN, as I'm on the revision taskforce, I spend hours every week looking at DMN. SBVR, Less so, more of an observer of the standard and as a non-user of it, by choice.

O4: Is there any special reason why you choose not to use it, like in collaboration DMN?

T4: Because it contradicts DMN, the rules presentation in SBVR are utterly unhelpful for anyone who is trying to do automation of business rules using a business rules management system and that's our primary focus.

O5: Interesting, I think we will get into that later more questions as well, then let's proceed with more specific questions. How would you define a business decision?

(DD)T5: I use the definition we use in DMN, we define a business decision as, it is always a bit tricky with decisions. If you are defining the decision approach or the instance of a decision. We generally talk about, a business decision is how you take inputs, a set of information and make a choice of what you are going to do, select between available actions, decide an output essentially. They may be calculations, selections, classifications, but they have a focus on deciding what to do. So, they either are an action picking actions, or contribute to how you pick an action. It's about, most of the decisions we care about are decisions you make more than once. But there is both an approach, essentially, how does one take this set of inputs and

turn it into output. Then, within a transaction environment you make that decision for a whole bunch of transactions and track those, so those are decision outcomes if you like.

O6: You define it as kind of a decision that can be operationalised and automated, so its not about the strategic level?

(DD)T6: I do not have to be automated but generally, for our use of it, we focus on the ones that are repeatable. We do a lot of work with decisions that are not automated in the sense that they are still made by a person. But generally, we don't. It is entirely possible with the approaches we use for a single decision that would be made just once but we don't test against that sort of scenario. We're not trying to do the "Should we do business in Belgium?" type of decisions. That you take once.

O7: It's more about the operational and tactical levels?

T7: Yes, but we generally don't test it against the strategic level. We've had some clients to say it works for those kinds of decisions but frankly, we are generally interested in situations where there is both the decision-making approach and a series of applications of the decision-making approach that results in decision outcomes.

O8: That is kind of the view that I have of it as well, that it is very useful for decision automation. Going on then to a business rule, how would you define a business rule?

(RD)T8: I define a business rule the way a business management system would define a business rule, that is a set of, I have a definition I use in one of my books that I can't remember for the life of me, but it's what we should do in a particular circumstance. Given a certain set of facts, what alternative should we pick? So, it's one of the ways you can make a decision.

O9: So you see it as a subset of what is used in a decision?

T9: Absolutely, and this is why I don't use SBVR. Business rules is not a useful business artefact, decisions are.

O10: yes, do you see that there are any similarities between the two concepts, are they related in some way?

(RD)T10: Yes, when you think about it an action or rules, not a constraint, a rule that says: "if this and this and this, then do this". What does a decision do? Given this set if inputs, how are we going to pick an output? A rule is one of the ways you pick from, given the set of inputs we said we had for the decision, this particular combination of values results in us picking this output. It's a clear way to articulate on of the paths of a decision. So for me, that's it you know, it's a useful construct in that sense because you know, that's what a rule is. Whether you call that decision logic or business rule I don't really mind , but it is a single statement of intent, the mechanics of making a decision.

O11: You see it as they are related, business rules can be the decision logic used by a decision?

(RD)T11: Yes exactly, for instance, if you overdecompose a decision model and keep decomposing a decision model too far, the decisions at the bottom all have the same data inputs and knowledge sources because they are all an individual rule really, I have seen decision models

I have done myself, where you just keep breaking it down several times until you realise that the bottom nodes of your decision model all have the exact same inputs and outputs, they all use the same knowledge source, because they are not really decision, that are distinct from each other, they are just getting to a point where each decision is a single rule, which is just overdecomposition. All of these things use the same source, really they are just ways of making a decision.

O12: I think we have touched upon this a bit already, but the main purpose of DMN, what would you describe it as?

(SOC)T12: The main purpose of DMN is to give you a way to accurately represent decision making that captures what you need to know about a decision without imposing unnecessary operation constraints on it. For instance, sequence: when you make a decision in real life you almost always have to follow a sequence. But generally, the sequence it not material to the decision making. If I have to check various things for the eligibility of a customer, in reality I probably check them one at a time, but it doesn't matter in which order I check them. So a decision models need to know all those things without telling me that I have to do A before B, or that I really need to do A before B.

Notice that I didn't say for rules or for automation. That is one of the key thing about decision modelling, is that you can use exactly the same notation for decisions that are completely manual and decisions that are going to be informed in machine learning and analytics using constraint-based optimisation or using business rules. In fact, we done decision models that had decisions in them that were represented by all these things. So that's one of the strengths of decision modelling. It does not require the decision model to executable, it does not require the model to be defined using business rules, and it is just a way of expressing decision making.

O13: Okay, going on then to the more rule specific questions, if you to the contrary to DMN then, if could describe the main purpose of SBVR, how could it be applied and used?

(SOC)T13: Depends on how rude you want me to be, the problem with SBVR is that is has two very different pieces, the vocabulary definition piece and its got business rules. The problem with the business rules piece is that the business rule definition in it is in my mind, it thinks everything is a business rule, that everything is a constraint, meaning that you have business rules in it that in a real business could be represented as process steps, "you must always do X before you do Y" - that's a process sequence, you build that in a process model, it has rules that constrain data, but you would build that in a data model and it has rules that constrain decision making which you build in a decision model, the problem with SBVR is that the rules piece sees everything as constraints and defines thing that are wildly different from each other that should be represented in different models, an it assumes that each individual rule is an artefact of note where our experience is that each individual rule is not a useful artefact. The vocabulary piece on the other hand is a much more interesting attempt to have a restricted vocabulary. I can't say I've used the vocabulary bit of SBVR, in part that is because it is all wrapped up in the rules piece, which is the other part of the standard. Many of us feel that if we could split it into two different pieces, the vocabulary piece would get a lot more use than the rules piece.

O14: I think that the vocabulary could e used a glossary in some sense in DMN?

(I)T14: Yes exactly, we do not have a glossary in DMN, one of the reasons being, if we would have a glossary in DMN it would probably have to be SBVR, and if we used the glossary bit of SBVR, we would have to explain why we weren't using the rules piece. We couldn't square that circle because the way SBVR talk about rules is not combinable with decision logic. It is true that we have client who have used the vocabulary piece of SBVR as their way of defining the information model they want to run their DMN models against.

O15: So in essence, if you would try to combine the two, you would think it would become a too complex standard if you incorporated both DMN and SBVR in one standard?

(C/C)T15: I don't think it would necessarily be complicated, but it would be unfinishable and greatly contradictory as the way SBVR talks about rules is antithetical, it's the opposite of DMN thinks about rules. It is not a resolvable situation there. There is no overlap between the way SBVR talks about rules and the way DMN talk about rules. They just don't touch anywhere. The vocabulary on the other hand. As a use of a glossary definition that you could reference in a decision model, I certainly think you could do that. We've had that conversation with a couple of folks who like SBVR, "Why don't you use SBVR in DMN for the glossary?" well because it's hard to separate from the rest of SBVR. I could certainly imagine writing something that says: take the glossary definition piece of SBVR and use it as a glossary piece for DMN that could certainly be useful instead of saying the allowed answers for a decision are a text string you could point them to a glossary entry that says "this decision is how we come up with this output" this thing and this thing is a glossary entry. All of these things pick between these three states, and these three states are a glossary item. And most best practices in my book that I wrote with Jan Purchase say that. We just don't say how you do that, but the glossary bit of SBVR would be fine.

O16: So you would say that SBVR is like the process flow rules and those types of things, and data constraint rules are not really relevant in DMN, but are there any kind of rule which you could formulate in SBVR that would be useable in a decision modelling sense?

(RT, SOC)T16: I mean, I don't I wouldn't say that we don't have folks who have built a decision model having identified a set of rules for a decision sometimes use the kind of verbalisation that is supported in SBVR to sort of describe the rules they wrote, as a way to represent them somehow. They do not just use a decision table where you could verbalise the rules. But it is a way to make sure that people understand what the rule says. The problem is a design problem, our observation is that everyone who tries to do this discovers one of two things: first of all they categorise all these rules, but when they come to build a decision model they find that: A, it wasn't useful to have this big bucket of rules, and B, it wasn't really helpful to know what kind of rule it was, it doesn't help them build a decision model. Second it actively gets in their way, we had a potential client a while ago that tried to build rules in SBVR for DMN, and one of the rules they had in SBVR was "Customers have to be at least 13 years of age", classic SBVR like rule, well defined in SBVR. The problem with this is that this rule then shows up in multiple decisions. Because of the way they built the decision model and the problem with that is that it fails the basic test of decision modelling, where one decision change should result in one rule change and now we have the rule defined in many different places. If you were doing DMN, you would instead say: "at some point I have to decide who is a valid customer". There might be several criteria in there to choose who is a valid customer or not and might need to know what country you are trying to do business in, where these criteria might differ, but I would have a decision that said: "is this person a valid customer or not?" and all the rules who would determine if that customer was valid or not would

be encapsulated in that decision. As far as every other decision in that decision model is concerned, it does not care why you are a valid customer, it just cares that you are one. The problem with doing SBVR first is that you end with the same rules in multiple decisions, and that is a bad practice. Our experience is no, there has been no value and no circumstances in which we would do the rule modelling piece of SBVR before we build a decision model. In fact you can tell that in the name of our methodology as it is "decisions first approach". We have a very clear point of view on this. We did some work in Lund who had wrote in their review, the different way of classifying business rules and when they were done, they found that it wasn't helpful to know what kind of rule it was. It didn't help them build the decision model. That's our observation too. A big bucket of rules does not help you build a decision model. But a decision model helps you capture rules.

O17: So you are all for the decisions first approach, I have some experience on that myself in a course we did on decision modelling where we started of with BPMN models first, but I became kind of difficult when you tried to implement it later with the decisions.

T17(C/C): The thing about a decision is that they are a thing, they are not part of a process or a rule, they are a real thing. And thinking about them first is one of the great thing about DMN it says "Decisions are a thing". What's interesting is when you look a the difference between a set of rules and the decisions that represents it, we had a vendor recently who added decision modelling capabilities to their rule engine and used the same demo they had always used and one the experiences hay had with one of their sales engineers is when he saw the difference between the DMN model and the demo he had been using for years literally said: "Oooh, that's what it does" because he got so used to looking at he rules on the micro level. He didn't really have a feel for what the overall thing did. But as soon as he saw the decision model equivalent, it was clear what it did.

O18: It is a more easily understandable standard then looking at loads of rules.

T18: Yes, we are pretty all in on this respect, we've jumped over that side.

O19: Do you see any case where you could apply business rules and try to represent them in decision models in some kind of way?

(I)T19: If would drill into books about rule modelling, SBVR or Rulespeak or any of these things. You would find very specific thing in there, as avoiding use of "I" and "We", being specific about that you understand the context of a subset which the rule applies to are equally true for decision making. When we are building decision models, we will do some of the very same things. If a decision is being made about a transaction but it is only a decision that can be said about a subset of those transactions make sure that is clear in the question. Be specific about what you are trying to do right. Many of the best practices that you use for describing rules applies to how you describe decisions as well. Within those decisions we capture the rules and again, maybe the same best practices apply. If it is a enumeration makes sure it says it's an enumeration. If you've got the same enumeration in multiple places make sure you define it once so you have a common glossary. Make sure the terminology you are using in the decision logic is consistent so that people don't get confused to as what it means. So a lot of these micro level best practices are true no matter how you are representing decision logic. The problem is that there are no circumstances in which we would go out and attempt to document a set of rules first. Now, we have one project where their documentation was so bad that they felt they could not even rely on it. So were going to go through and do an exercise

trying to clean up their documentation before they built the decision model. They asked us about using SBVR as a form of representation of that and we felt like that was overkill, but it would certainly be useful to try and think about the documentation by keeping the rules in the back of your mind as you were cleaning up the documentation, trying to be clear on what the documentation is trying to get you to do. So in those circumstances you might use it, but again, I would be reluctant. My sense is that it creates a sense that rules are independent artefacts that float out there and apply themselves to a business, and our experience is that the only time rules get applied is in a decision.

O20: So you wouldn't keep them in a separate model anywhere and then represent them in for instance decision logic. You would just do the decision logic and not the rules?

(I)T20: Correct, but we would externalise the glossary, we would say in this decision table I've got this four requirements that feeds my decision table. Two of them are pieces of information defined using this glossary item and two of them comes from these subdecisions and they are defined using these glossary items and this this decision is producing this glossary item so that I have consistent terminology between them, that's a really useful artefact when you are writing rules. But I would not keep the rules separate under any circumstances, that is asking to get yourself in trouble.

O21: Okay I guess then that these questions are a bit difficult to answer, since they are a bit rule specific

(RT)T21: yes I mean the rule type question, we are focused on using rules to describe what we are going to do. Now , if you wanted to have a textual representation of the constraints that needed to be represented in a database or if you wanted to have a textual representation of something that would help constrain how somebody drew a process model, sure you might have tools for that, but it is not what we do, what we do which is getting people to apply business rules management systems and analytics on decisions the make more than once and our experience is that there is no value to have a separate set of rule artefact that are not closely related to the decision model integrated in the decision model to be problematic.

O22: but in these business rules management systems, do you use business rules in there where decision logic is implemented as FEEL expressions or is it the specific rule language that is defined in that business rules management system?

(RT)T22: we do a bit of both, so we have certainly done projects where we have used tooling that lets us write the decision logic in FEEL, but we also done projects and more project to be honest where we build a decision model but then when we write the logic for a particular decision in the model we put that into a business rules management system where we will have a decision model and a decision in there that will validate or disclaim all the fields that it needs but it implemented in ODM or Redhat where the rules are defined that tells us how we in fact make that decision. One of the attractions of doing that is that it lets you have a certain technical stuff in the business rules management system that isn't in the decision model then trying to have to get all of the technical details into the decision model. The problem with executable models is they tend to get overloaded with more technical details like "how do I do iterations" and making it quite complicated, so we often find that we would rather keep the decision model cleaner and not show that level of detail in the decision model and throw the function in the rule engine. But that is a methodology choice on our part.

O23: So you use the decision model for more like conceptual modelling?

(RT)T23: Yes its like conceptual database modelling, the entity model is not representative of a database design, you might have a many to many link in an entity model as a table in the database design, but it may not be necessary to show that to anybody who doesn't know database design. Its more useful for most people to see that "customers are linked to a location"

O24: it's kind of there to give you the big picture

T24: But that's our methodology choice. There are some projects where people are specifying the logic in FEEL. FEEL is not a perfect language, particularly when it comes to set handling and iterations, but it's getting there. For us one of the key value proposition of a decision is to dramatically decrease the complexity of the kind of rules that you write, there are never any OR's in rules in DMN, you always keep thing as separate rules, the rules tend to be much simpler since there is no repeating groups since you've normalised the data, and normalised the structure of the decision making. Most of the decision tables and logic that we produce for decisions is extraordinarily straightforward. But that helps a lot.

O25: If we go more into how a decision model on a conceptual level and how it interacts with other models in a business, like process models for instance or motivation models?

(EM)T25: For us the best practice is automation, the best practice for decision automation is to deploy a stateless side effect free decision service. And the thing is, if you have a stateless side effect free decision service, no one else really should care how it does that. That's kind of the point, that's part of the service oriented mindset, so how a process and decision model interacts ought to be extraordinarily defined and very simple. I've got a decision for this task in this process where I have to make a decision. I don't care how you make that decision, only care that if I give you this data and you give me back an answer, that's defined by a decision service. You do not want someone in the process world to care what all the subdecisions are all about or looks like. One of the big debates we have is whether BPMN, DMN, CMM should be one big uberstandard and our experience is that there is no value proposition for it. They should have an arm's length relationship with each other by definitions as a best practice

O26: So it is a matter of separation of concerns?

(SOC, EM)T26: Exactly, Decisions are not processes or cases, they are their own artefact. Me, I like the fact that they are separated as useful artefacts. Do you need to know which processes you are in and what impact the decision has on it? Yes that is useful to know but, the mechanics of how a decision is made are not relevant to the mechanics of the process and vice versa, the decision does not care how hard it was for you to assemble the data you needed to call the decision service, it just wants to know what the data is. That is the separation of concerns. Now, CMM and Archimate and some of the services and motivational types of things, you do want to know some of that, what your challenges is that you want to know what a good and a bad decision looks like. So you have to have some kind of understanding of how your decision impacts your key performance indicators and metrics and you also care how it fits organisationally, one of the key problems with decision making is that decision making changes a lot, so it's really important to not get fixated on the first version that you're thinking about, instead the tenth version, 100th version, 200th version. To do that you have to understand who cares about which piece of information in the decision making so that we can have a conversation about, who's objectives are being met when we are making the decision

in this way and does it contradict anyone else's objectives. There's value to understanding how the decision-making impacts and is impacted by your motivations and your organisational structure. I'm still not sure we have gotten the linkage right on that level we are still working through that, but its clear from projects that decision outcomes, how you make a decision for a particular claim or policy, and the structure of the decision model, but I know essentially not just what the answer was for this claim, but also the subdecisions for this claim, then I could map that to my claims metric to my claims outcomes metrics, I could get some really interesting analysis, but I think there is still work to do there.

O27: Okay, so there are interactions with all of those kinds of models, to keep track of why and who should do it.

(EM)T27: Right, its about management mostly, you want know those thing because you want to know who is allowed to changes this, and who do I have to tell if I change this subsubsubsubdecision, do I know what part of the organisations behaviour will now change even though the decision definition has not changed, obviously if I change who is an eligible customer that any decision that is dependent on that decision is changed by invocation. How do I figure out who I have to tell this kind of stuff. There's a lot of value in being structural and it's about management. It's not really about execution or about decision design.

O28: Okay, then we are reaching the end almost

T28: well I have a very definitive point of view so it's easy to argue for your points then.

O29: But if we move on to the last question about the complexity of involving the concepts of rules and decisions in one standard

T29(C/C): Well I think DMN, and this is usually where I differ from everyone else is that I think DMN already does include definitions of rules. Because DMN describes how you define the rules for a decision, I think that DMN is a standard that already includes definitions of how you do rules. So think I needs some more robust panhandling, at the moment since we make you iterate over collections when we ought to say: any of the things in this collection could do this, or do pattern matching against sets, the way rule engines do, for instance when looking at TDM (The decision model) its logic structures has some more robust set handling than FEEL does, and we recognise that that's an issue, so I recognise that for writing the rules DMN could be improved by being more declarative. But I feel that DMN already does describe rules, if I build a decision table for a decision I am defining the rules, I am defining the rules as rows. So DMN does include rules, it replaces the production rule representation standard and builds repeatable decision making structures including all the rules definitions that you need you don't need the rule definition piece of SBVR. Now, what I like to see glossaries in DMN?, yes I would, I think we ought to have a better more robust definition of a glossary and I'd like to se the language of rules made a little bit more semantically rich and I feel like FEEL (no pun intended) is a little bit too focused on being executable as a language and not on representing rules to a non-technical user, but I think that is solvable because most of the time you use a decision table.

O30: So you would go more against a natural language specification?

(I)T30: I think so yes I would like to be able to write the rules like here's how you verbalize a row in a decision table. And you could more or less do that now, but there is a few symbols

and pieces in there that's a little bit focused on being executable while not necessarily being easy to describe to someone. But I think we are in fact describing decisions and rules in DMN and I think that is appropriate to introduce the vocabulary in DMN and other representations of decision logic such as decision tress or rule graphs. I think we would repay some long term investment in making easier to write rules where a tabular format is not the right approach in something that is a little bit less programmatic and programmer oriented. But I would always do those things in the context of a decision, for me the standards are trying to describe the rules as an independent artefact are unhelpful.

I think DMN for instance makes a huge mistake in my mind because it tries to make business strategy into rules and would be much better off if you link business strategy to decisions. The definition of how I decide who is customer clearly is impacted by my strategy. Trying to articulate that as a rule feels a little tough.

O31: So you can not do it all in DMN?

T31: I would always begin with the decision model so what I would care about is how robust of a definition I can put into a decision model. Right now the two problems are that the only semantically rich and easily understandable representation of the logic is the decision table even if it is a very good representation, secondly the vocabulary / glossary is not managed well. I would like to see these things improved but I'm interested in our richness in ability to describe rules inside DMN, because I think that´s where you should describe rules.

O32: But then in some sense it is a more rule oriented approach you are trying to incorporate in a better way in DMN?

(I)T32: Right, exactly, the people on the committee for DMN, without a doubt, all of us build a lot of rules-based systems. We have all worked with rules a long time and we've all worked for different vendors, and many of them have used rules a lot we used rules terminologies a lot and we know what helps us build rules-based systems, and we came up with DMN. It's not an accident that we did this. The only other thing I have to say is that what I think serves key characteristics when you look at DMN is that you tend to focus on automated decision making and executable decision making because FEEL is so luminous. But I would say that we regularly build models where significant chunks of the model are not automated they are still made by people and it is still useful to describe the structure of decision making, many of the decisions, even in an automated model could be represented by algorithms, optimisation engines or other representations which are not rules. One of the strengths of DMN is that it focuses on what is the decision you are trying to make? Not what rules you want.

I will give a short example, we did one for a famous medical clinic where we built a decision model for picking heart surgery approached for surgery patients. One of the decision included were "Does this patient look like it will survive surgery?".

O33: That's a hard one to automate

T33: Yes, hard one to automate, but it doesn't matter, it sits there in the model. There are certain decisions that depend on the other, other that don't and it's not an override, because there are circumstances in which the surgeon think that the patient will not survive, they will still operate, because they know you are going to die if they don't. But there are other circumstances under which you will probably not die, then that decision becomes trivial, and then

that decision becomes trivial. In a decision model this is trivially easy to show. Just because it's a hard one to automate does not mean it's not a decision. "Is the ship seaworthy?" was another one – well someone has to go take a look at the ship.

O34: I guess there is a number of criteria which makes it hard to model such a decision

T34: Yes, but you could certainly model that decision as if you can use a particular ship for a particular shipment, which is otherwise very automatable. Ships are certified for certain amounts of weight and located at the right place and cost a certain amount of money. You can divide this up in a decision model deciding if the ship is seaworthy, but someone has to physically walk around the ship and inspect it. That's one of the things about decision modelling – It really works, even for thing that really aren't needing rules.

Alright I would very much like to see the final result of this paper.

O35: Do you have anything you would like to add to this that I have not asked for?

T35: The only thing is that one of the thing we found with decision modelling that makes it so good is how fast it is. How much more quickly we get to the right answer. How much engagement we get from the business in doing that, which I think comes out of two things. First of all it's very business user centric, we don't ask what your rules are, instead we say how do you decide what you are going to do with a claim? Which is something they do everyday so they are very willing and able to describe it. We did a big loaner resignation for big bank in North America and at the end of three days of workshops we had a decision model with a 103 or 104 decisions to it. When we finished in doing the analysis of all the logic and all the supporting rules we had maybe 110 decisions. So the structure of the model was basically correct from the beginning. We see that over, and over again, we can very quickly break the barrier to the problem and finding the structure of the problem which we can then fill in the details. That makes it easier to be iterative, it makes it faster. It's much easier to say that you are going to focus on a certain decision, who knows about that decision, what documents do we need to look at? Instead of these massive exercises that requires months and months of document analysis which you go into when you put rules first. That speed and that business engagement is real critical issue for us and why we think when we talk to other people who were on the DMN committee building DMN tooling, what they see to is that customers who adopt it think about decisions and decision models get to answers much more quickly. It's just a tremendously different experience relative to the traditional experience of rules.

O36: Its more efficient approach then

T36: Yes, imagine you were trying to build a database by listing all the fields in the database. That does not have a structure. You could do it and you would get a lot of details but it would be a big retrofitting exercise figuring out which one goes with which one. It would takes up months of time and so, using an entity model dramatically speeds up the process and our experience is that decision modelling has the exact same impact on understanding logic. That why we do decision first. It's not just a question of standards, the notations matter and the standards matter but the methodology that is supported by the standards, because the OMG does not deal with methodology, so the other question would be to ask if there is a material difference between the kinds of methodologies that are supported by the standards. The thing about DMN is that it supports a very agile and very iterative approach and that its very business user engaging, so it supports the kind of mixed teams scrum style get everybody in a

room and figure it out kinds of workstyles in a way which SBVR does not, SBVR lends itself to more waterfall oriented document focused mindset and I think that is not part of the standard I would think it is worth asking if there is a difference between the kinds of methodologies that use standard X vs. Standard Y.

O37: Okay, many thanks for your interview participation!

Appendix 3: Interview 2

Interviewee: Jan Vanthienen (**V**) **Time started**: 2018-04-26-19:06 (GMT +02:00)

Interviewer: Oskar Hall (**O**) **Time ended:** 19:31 (GMT +02:00)

O1: I thought that we could start off with your background in decision and rules modelling if you could tell me a bit about that?

V1: First, tell me again what is the subject of you masters thesis?

O2: Of course, the thesis is trying to answer the question of why business rules and business decisions are modelled in separate standards, because as the area looks now there are two things, either you do business rules or you do business decisions, so it's kind of like how you do both of them together is what I'm trying to investigate and the reasoning behind the standards.

V2: Are you also involved in business processes, with the context of business processes or without it?

O3: I'm trying to have it without the context of business processes just the connection between business rules and business decisions. But business processes are a part of it as well of course since there is an ecosystem with all kinds of models you have in a business.

V3: My background, I'm a professor in information systems, I have been dealing with decision tables for a long time and also business rules. It's only when the new DMN standard came out that I found myself more into decision modelling.

O4: Were you somehow involved with the conceptualisation of DMN?

V4: Yes, I was in the committee but also one RFP (request for proposal) parties. So, a standard normally starts because someone asks for a proposal. I was one of the three people who submitted the RFP, the request for the standard.

O5: Okay, so you were one of the people behind the concept from the beginning?

V5: Yes

O6: Are you familiar with the standard SBVR as well?

V6: Yes, I know when it came into existence also. It's a little older, and it's a bigger standard in the sense as it deals with more items than DMN. The business rules area is a larger are than the decision modelling in area I would say.

O7: Okay, were you involved in that standard in any way?

V7: No not really, I was aware that it was going on and I heard some new and some things, but I was not personally involved in SBVR no.

O8: That was kind of the background questions, so we can proceed over to the more specific questions towards business rules and business decisions, so the first question is how you would define a business decision.

(DD)V8: That's a difficult question, because in the standard there was a lot of discussion. I think we put a definition in the standard like "a decision is the act of obtaining an output based on some input values" or something like that, but it is hard to define a business decision. Anyway, we only deal in the standard with operational business decisions not a very strategic decisions or tactical decisions, but the operational decisions, the day to day decisions.

O9: You don't see that you can use the standard for tactical decisions or something like that?

V9: Not really, you could use it as some documentation, but the purpose of the standard is finally to automate operational decisions, and you don't automate a tactical decision.

O10: But you can use it to visualise those kinds of decisions?

V10: You could use it to visualise, yes that is true.

O11: Moving on then to the definition of a business rule, what is your definition of a business rule?

(RD)V11: Also there, you should go to the business rules manifesto to define what a business rule is, I would say a business rule is much more general then a decision, It is very often a constraint, or a decision rule, There are many types of business rules as you will know. And very often business rules are constraints which is not so much what we envision when we talk about business decisions.

O12: So, do you see like, process constraints as a business rule according to you, or is that something which is contained within the process logic, like you go from one step to the next. Do you see that as a rule that is contained within a process?

V12: Yes, it's some kind of rule, in a declarative process modelling world, but I would not call it a business rule, because the business rules area deliberately did not deal with processes.

O13: Okay, so in the concepts of business decisions and business rules, do you any similarities between the two concepts and would you see that they are related?

V13: Business rules and business decisions?

O14: Yes

(DD, RD)V14: Yes, a business rule is a much more general concept and the business decision is only one specific kind of rule. I often call it, a decision rule. Which states that given some inputs, there is some output to be obtained. So it's a very specific kind of rule, only dealing with reactions to inputs or results of inputs. While a business rule in general is much more general, it can be a constraint, not dealing with a decision, so the DMN standard is basically dealing with a much smaller area than the business rules area, it's a subset of all these business rules.

O15: Could you give an example of a rule that is contained within a decision, what would that be, and what would be a more general rule that is not applicable in a decision situation?

(DD)V15: A typical decision rule would be that, you have some discount rules depending on some attributes of the customer, you will give a discount of so many percent if the customer places a large order or small order and orders for certain products, so there are a number of variations in customer attributes and this leads to different discounts. That would typically be decision rules. A business rule on the other hand is much more general, for instance a let me see… "you should review your record every five years", or you should never do this, it's more a constraint type of thing.

O16: Okay, according to you should those two concepts in separate standards as they are now, you do not have business rules in a sense beyond like decisions rules in DMN and SBVR does not really touch these?

(SOC)V16: That is a good question, the purpose DMN is to automate these operational decisions. And this is possible because the area is rather limited, it only deals with decisions and operational things. And business rules area is much larger, so at some point in time we had to make a choice, do you wait for the automation of the general thing, or do you deal with the more limited one, and I think DMN has been there because SBVR is not an operational standard in the sense that you have tools to automate the business rules. It's more a descriptive thing. It's a good standard but it can hardly be used to automate things on a day to day basis.

O17: So you would say that it's because that DMN is more on the operational level and SBVR deals more with the overall business?

(SOC)V17: Yes, there is a need for all these small business decisions or large business decisions, a subset of business rules, there is a need for automation, certainly in the context of processes, where a process has all these gateways and you have to decide "what do I do"? "What do I give as discount", what is a customer, what is a good customer, do I give a loan yes or no. These are operational decisions which fits well with business processes so there was or is a urgent need for automation of these things. That is the reason why they are separate, is this a good idea, yes or no to keep them separate. There is some relation but probably the area of one is a little smaller and the other area is much larger.

O18: So do you see it as a separation of concerns perhaps between business rules and business decision, and the decision logic, that they are separate concepts that should not be mixed?

(SOC)V18: Yes, I think it is more a matter of focus than really separation of concerns probably. It is easy to take out the decision things and decision rules from the general business rules thing, because the business rules thing is much more complex.

O19: So then if you would have to choose between merging them and integrating them in some way that you reference the business rules in SBVR that are decision rules in some way in DMN, is that something that you would like to see?

V19: it would be possible to say that DMN things are one kind of specific business rule described as something in SBVR but it doesn't help the automation of operational decisions I think. Because then we would have to wait for a complete operational status of SBVR and

that's a big issue. So I think there is no need to merge the two. They go together, in fact, DMN refers to SBVR for definition of the entities and the concepts they refer to the concepts actually.

O20: Okay, I did not know that. In what way does they already relate, or refer to eachother?

V20: well DMN does not have a specific glossary. If you use a concept in DMN it's not well defined how to define this concept and then you can refer to any kind of glossary or definition of concepts, for instance, SBVR.

O21: So you see it as an SBVR glossary or vocabulary part can be used in DMN

V21: Yes, the vocabulary part could be used in DMN.

O22: So, business rules, how do you see them being represented in decision modelling, if they even should be?

(I)V22: Depends on the definition of the kind of business rule being used, the specific kind of business rules that deal with decisions, the decision rules, are part of DMN and the other business rules, more the constraint type of thin, the general descriptions and glossaries are not a part of DMN and do not have to be because it's a different area. DMN is really very specific about only these decisioning things.

O23: So it's the ones that are applied in the decision logic?

V23: Yes

O24: Okay I think we have answered the next question then as well, so let's go on to the next one

V24: There are indeed lots of rules that can not be applied or do not have a purpose in decision situations.

O25: So, but if you would integrate these two models there are some different ways in which you could integrate rules in, I took this from the process world, like how you integrate business rules in processes, so there is like annotation which means you write out the entire rule in the model as a textbox relating to the specific decision or task. Then encapsulation it's kind of like contain the rule within a model element which you can then extend to see that rule. And then there is extension and provide a reference to an external rule model so, would see that any of these categories could be applied to any of these categories of business rules or the characteristics of a business rule listed?

(RT, I)V25: Yea, not to familiar with the difference between annotation, encapsulation and extension. That's one observation, but the integration of business rules and business processes, or business decisions and business processes is a very large research area. So its hard to put it in a few words. In most cases business processes contain, or try to show too many rules and too many decisions, there should be separation of concerns so that the process is simple and the decisions are separated, or the rules in a lot of cases are separated. There is no miracle solution probably but what we see in research is that there is a lot of room for much more separation of process and decisions, because most processes contain too many decisions in all the gateways and these are actually decisioning things.

O26: It's kind of extracting the decision logic from the process logic right?

(SOC)V26: Yes, yes, and it's very hard to determine how far do you go? Because even in some cases the process is nothing else than a decision and then it becomes of course a little bit more difficult to tell what is a process and what is a decision. What if you have the process of making a decision? Then becomes difficult to separate.

O27: Then it becomes hard to tell what to separate. But If we move on then to like the interaction with other business models, you know motivational models, organisational models, data models. Like business rules and business decision models they both exist in a ecosystem with these other models, they depend on input from each other to coexist. So do you see that theses interactions affect why they are modelled separately?

(EM)V27: Yes, certainly, with process and decision models. That interaction is more or less becoming clear now, then between process models and rules, requires a little bit more research but there are a number of interactions. But it is much harder to say what do you put in which model. Because a business rules model is not so much a model, it's a set of rules, a list of rules but the modelling part is bit more difficult then.

O28: I guess there isn't a graphical model in sense since it more as, as you say a list

V29: Yes, true, true

O30: But do you, are you familiar with other standards, like ArchiMate, motivational standards?

V30: Like BMM, business motivation model?

O31: yes exactly

(EM)V31: Which is a bit more higher level, for instance business decisions or business rules rely on the business motivation, as why do you take a decision, so there could be an interaction but it is a different levels at the top strategy level you are dealing with the business motivation, but once you are on the operational decisions, the business motivation is given.

O32: There is a relationship between them, like they are motivated by BMM?

(EM)V32: Yes, there has even been talk in the DMN committee when we were dealing with the standard that we should adapt to the business motivation model since the word decision is not in the business motivation model, but it could be since there are strategic decisions. Motivations, tasks so that could also be decisions

O33: So there is talk about trying to integrate them more clearly with reference to each other?

V33: Yes absolutely

O34: Interesting, so moving on then to the last question, it's been very quick, you have given very good answers, very concrete and clear. So if you could merge these, if you merged them would you say it would become a more complete standard or do you think these would lead to an overly complex standard?

(C/C)V34: I think it would be overly complex yes, the reason why decisions were standardised is that it was easy take out that part and build some kind of decision standard which could work for operational decisions, while SBVR or rule standards deal with a very large area. So, its much more difficult to build a nice standard there and automate the standard and have modelling tools for the standard. It is much more complex. Putting them back together again would not help the day to day operations.

O35: It would be too complex I guess, if you have all of these rules sets, it would be a very big thing right?

V35: It could be nice if you could integrate them, but I think it's a more long term goal, not immediately.

O36: How do you see that progressing over the years? How do you think that they can become more integrated?

(I)V36: Who knows? Maybe after some time we will realise that DMN and the decisions modelling is rather limited and we have to start adding some more business rule things in that area and maybe that lead to some more integration. But there are no really specific plans at the moment I think.

O37: Okay, then I just have a few closing questions as well if you think that there is anything that I haven't asked for that you would like to add?

(C/C)V37: Well every standard has its own area and purpose, the purpose of DMN is to first model then automate decision making. It really has to be an executable standard, that has always been one of the big purposes. If you model something in DMN, you should be able to execute it. It's not just a visual standard. The same happened to BPMN over a number of generations. First it was some kind of visual thing and then it went to being executable. And maybe in the future this will happen to SBVR, but not at this moment yet. It is a standard, but it is not an executable standard yet.

O38: Okay, then we are all done, I would like to thank you for taking the time for this interview. And I wish you a good evening.

V38: Yes, thanks and good evening to you.

Appendix 4: Interview 3

Interviewee: Inge Lemmens (**L**)

Time started: 2018-04-27-09:16 (GMT +02:00)

Interviewer: Oskar Hall (**O**)

Time ended: 10:10 (GMT +02:00)

O1: To start of could you tell me a bit about your background in decision and rule modelling?

L1: I graduated in 1996 which was about 22 years ago, and my masters thesis was about decision modelling. What I did was these methodologies called KISS methods, within the KISA methods it was about modelling the object in the rule world and the relationship between the objects in real world and my masters thesis was about creating decision modelling in that methodology. If you have your object and your relationships with your object, can you then do something with that information to create your decision model? So that's how my background.

O2: Okay, what kind of standard did you use for decision modelling then?

L2: Back then there were no standards. I was familiar with a book in dutch it called, in my times when artificial intelligence was thinking about decision support systems as they are now the ones from IBM, I'm very bad at names so I'm sorry for that. These decision reasoning tools you have now like rule engines. When I was graduating in artificial intelligence you had what they called expert systems who had a backwards and forwards chaining technology in it and there was no real underlying standard for it. So we all knew about decision tables, because that is something everybody know in some sense or some ways. During my studies, as I said I studied artificial intelligence, we studied the decision support system as they were called back then, rule based expert systems and always trying to find a way to express the rules in an more logical manner, hence decision tables. But then decision tables were not standardised, that's why DMN was formed.

O3: So you are familiar with the standards DMN and SBVR?

L3: Yes, I am quite familiar with both of them since our company has been involved in the development of both of them.

O4: Were you somehow involved in the development of these standards?

L4: Yes in the background, I have my colleagues. I do the analysis for the standards and the feedback on certain issues and we have votes in both standards as well. So I share our vote and share with them the data and information. I do this together with one of my colleagues.

O5: So you are quite familiar with them both I guess?

L5: Yes I am quite familiar with them both, but I don't know in the latest version of standard but in the earlier version of the standard there was an annex in SVBR on CogNIAM and ORM

from Terry Halpin and though I have worked closely with Terry Halpin as well and also on that standard we have our own meaning on that standard and how it evolves.

O6: In SBVR?

L6: Yes, and DMN I follow closely, I follow the issues closely, but again share a voting on them because that's how we always.

* Internet cuts off, about 2 minutes interruption

O7: Where were we? We were talking about SBVR?

L7: yes, we were saying how we were involved in the standards and I said that we are involved in the standards, not very actively, we follow it closely and we have voting rights in both standards. And we sometimes reject or comment on issues in the standards

O8: Okay I guess we can progress to the more specific questions then. If we start of with the first one, if you would define a business decision, how would you define it?

(DD)L8: That's a good question, have you looked at our website I'm am assuming, I don't know if you have seen that there is a whitepaper on how we look against rules and how we consider different types of rules.

O9: I haven't seen that actually

L9: Okay, I will send you the paper

O10: That would be very appreciated thank you

(DD)L10: So, we have a bit of a different view. For us a decision is a decision being the act of a result, for us the decision is the act and the business decision is the act for which the result has an impact on how business is being executed. That's how we define it, let me check if I'm correct... Yes

O11: Okay, could you give me an example of a business decision?

(DD)L11: Typically, the acceptance of a customer for a specific product. So, if you work for a bank, or in this case an insurance company to check on conditions that the customer has to meet in order for the insurance company to accept him as a customer.

O12: Moving on then to the definition of a business rule, what is your definition?

(RD)L12: That's a difficult one, because for us a business decision is a subset of a business rule and the business rule is any rule that has an influence on the behaviour of the organisation. Either by limiting it or by deriving it.

O13: So you see it as the business decision is subordinate to the business rule?

(DD, RD)L13: A business decision is a subtype of a business rule yes

O14: So you have a more general view of the business rule, that it can apply to every part of the business?

(DD, RD)L14: Yes it can, that's why I will send you the white paper where we define for instance how data quality rules which are often not decision rules are for us also important rules that influence the behaviour of the business and thus are business rules. In the paper we have really defined it and show how we look at it.

O15: So do you see that there are any similarities between the concepts and how are they related? I guess we have talked a bit about it as the decision being a subset.

(DD, RD)L15: Yes, the decision is a subset and if you look at it in the SBVR standard, a lot of the rules the you express or that you can express in SBVR have their, although a different from of representation, can also be represented in DMN. I think that every rule in DMN can be expressed in SBVR.

O16: Yes, but there is a difference in how you do it? like in the actual language they look different?

(C/C, I)L16: Yes, but the logic behind is stays the same. But the surface language you use is different in DMN and SBVR. That's if you look in a DMN decision table it is expressed purely in logic and that logic can be verbalised in any manner you would like. So, for me DMN is a logical way of representing it and it is an easy way because it is more business tailored, but you can put any surface language on top of it.

O17: So you see it as DMN being more focused on being executable than SBVR for instance?

(SOC)L17: Yes, as SBVR has no real language behind it. It's an intention, it's not so much the language behind it that constitutes the standard. DMN is typically describing the notation on how to develop and interpret your decision models and decisions. The latter one is also more executable because SBVR gives you more freedom.

O18: Do you see that they should be kept in two different standards, like the concepts of business decisions and business rules?

(SOC, C/C)L18: from a standardisation position, from an OMG position, yes because they are targeting different audiences, from consultant view from our organisation and from my own perspective no, because its two of the same thing, with SBVR being how do I say this correctly, SBVR being in quality less than DMN is.

O19: Can you elaborate on that?

(SOC, C/C)L19: yes, SBVR is for me a, DMN has a quite fine logic behind it. It has a strict modelling notation. SBVR is more allowing the ambiguity of language, natural language has an ambiguity. SBVR does not help you disambiguate, help you to determine if you use your language correctly and that that you interpret the language correctly as written in SBVR. I have had many discussions on that one, but for me SBVR is not tight enough, it is still giving me room for interpretation. If you say a person has a name, then I miss rules. Person has a name is a fact, they call it a noun concept I believe even, or verb concept, a verb phrase. For me there is no rule in it, but they imply a certain rule in it that makes SBVR less accepted an less useable than DMN is where we have very clear that one row and one column gives you a very clear outcome.

O20: There is still room for interpretation of concepts in SBVR?

(C/C)L20: Yes, very much so and it does not work well. There are interesting implementations of the concepts in SBVR, not SBVR itself. The concept of RuleSpeak, in Dutch it is called RegelSpraak is being developed at a tax office, a governmental tax office in the Netherlands. They try to insure that you have one interpretation of the words that are being used so they limit even how you can use your natural language expressions as allowed in SBVR, in that sense, it works to a certain degree.

O21: That's the glossary part, or vocabulary part of the standard?

(I, C/C)L21: Yes, but you also have the vocabulary part of the standard and you also have the rule standards of how you are allowed to express a rule, and expressing the rule is a very difficult thing if you use natural language. DMN gives you means to insure correctness and validate correctness but SBVR does not give you that. That is my problem with it. You can test a decision table, I can not test an expression in SBVR.

O22: That's true, but that is not really the purpose of the standard I guess?

(SOC)L22: Well, the purpose of the standard I still to insure that everyone understands what you are talking about and then you have to go to the concrete fact and you have to be able to test it. Because only by testing it and by making it concrete, you are assured that they are exactly expressing the same thing. So, the questions remain, what is the standards main purpose, taking into account how it involved capturing a common glossary and a common vocabulary then, it should stop evolving the way it is evolving now.

O23: Do you see it going in the wrong direction at the moment?

L23: I must say I've stopped following it totally in the latest discussions but what I see is we talk about time dimensions and how we are going to express certain not so logical things, then for me yes, it's going in a bit of a different direction. Without keeping in mind what it is intended for

O24: It's more of a computer independent standard in that sense, it doesn't really specify how you should run things

(C/C)L24: It does not, it is still for example if you look at the standard itself, it does not tell you, a common thing is " a person must have a name" well the musts does not tell whether each person shall exactly one name, at least one name. It is still not thorough enough in order for someone to develop and implement it to insure that it is a requirement, which is expressed in that sentence in being correctly interpreted.

O25: In decision modelling, we have been into it bit but how do you see that you apply business rules there? You have the FEEL expressions and Decision Tables right?

(C/C)L25: We use decision tables mostly because the FEEL expressions although it is called friendly enough it is not really friendly enough for business. And you question was again, how do we use it?

O26: How do you represent business rules in decision modelling?

L26: We have two surface languages that we use in DMN, the decision tables themselves and the decision requirements graph and that is the most common way to do it, because that is

something you can discuss with business and you can test against. The other one is that we verbalise them.

O27: how do you verbalise them?

L27: that's using our own rule language, because if I look at a decision table, one column or one row, then I can say the consequence is a certain value, it is given a certain value by all of the following condition rules. Then you can completely specify it formally in the conditions.

O28: So you have something more of a natural language?

L28: Representation on the surface yes, we use both

O29: So you have your own way doing natural language rules that you feed into DMN?

L29: We develop it using DMN and then the standards, we verbalise it order to asses and communicate with all stakeholders

O30: Interesting, because that is something my previous interviewees has been missing I bit from decision tables. They don't see a way to verbalise each row that they are in in a natural language sense that is not as programmer oriented.

L30: I don't know the background of the one you have interviewed before, but I have a background in facts based modelling where I used the object rule oriented methods, they have a strong history in verbalising rules because facts based modelling starts with natural language propositions then verbalising them using logic and then verbalise them again to natural language. It is part of my PHD thesis even that's why we might a bit ahead of other in this regard.

O31: Do you see that there are some rules that are more situated towards decisions than others? That applicable in a decision situation and that there are some that are not?

(RT)L31: Yes, more about as we said decisions are for us a subset of business rules, so I can easily express in a decision table the outcome of a set of variables that's we do in order for a value of a variable to influence your behaviour. But if look for example at rules that are like the start date of an event should always be before the end date of the event I don't see a way to express that in DMN. The problem with DMN in that sense is you create your decision table without taking into account any of the other business rules. But I can guarantee you that you will run into issues. A very easy example of something here in the Netherlands is if you go to the tax authorities you have a decision tree, which is also a representation of a decision table, and you have to go to the left branch if your salary is more than a specific amount and to the right if it is less than a specific amount. But it does not specify what salary means, is it for instance the sum of all my incomes from different organisations or not?

So, it does not take into account the fact that you have multiple cardinalities, so you can never decide on that one or if you for example have to compare your income and you don't know if you should take the highest or the lowest, or the average or the sum of them. That is typically issues if you do not have this in your business rules, your other rules, you have data quality rules in place, your data interpreting rules in place you can create a coherent decision table.

O32: Is that something you could see like a glossary being used for, to create a common definition?

(I)L32: The glossary is purely for a common definition, but I can still define my salary as being the income from a work which I'm being paid for by my employer. But it does not tell me if I have one salary, or one or three salaries. It does not tell me something about the cardinalates of the relationships. A person has an income, and my income is the sum of my salaries. So that's where we need more things.

O33: Is that were data quality rules and those types of things apply?

(C/C)L33: Yes, and you see quite often this going wrong in decision tables because people once you start testing them and you start validating with the business it's hard for them to tell "what am I to think here?" If you take medical protocols which is another example where decision tables are being used very often and have added value, definitely added value. You see there by testing them that in many cases they are averaging things because you have multiplicity. But if do more of this up front you're comparing apples with bees.

O34: I see, I see, but is there any scenario where you would integrate a natural language specification rule in to a decision model, for instance annotate it in a text box or anything like that. Do you do that?

L34: All the time

O35: So how do you do the integration of rules into a decision model? Like referencing them between like different models

(I)L35: That's a bit of the how work, our methodology that we use start always from the facts type perspective. So, you have the concrete facts like "Inge lives in Belguim" that's a concrete fact and you can generalise it to the facts types that a person lives in a country and country of residence preferably to make it more accurate. Then you can say that each person lives in exactly one country of residence or has exactly one country of residence. What you are doing by adding the keywords "each and exactly one" you know the cardinality of that relationship. And you have your facts types and you have variables that you can use in your decision modelling. So, you know that each person has exactly one age, you can derive the age using the FEEL expressions from the current date and the birthdate of a person. You know each person has exactly one birthdate and we can use that fact that derived fact again in your decision table. So, for us, I can not build a decision table if I do not have my fact types, and do I not have my business rules or facts types which are my cardinality constraints to know whether I can apply or use that variable in my decision table. So for us its one whole, I can not make a decision table without taking into account the fact types and if I need to define a conditional constraint as we call it to define a condition we always use DMN.

O36: You start from the bottom up to say, you begin with the facts and the rules and then you build decisions from that?

L36: Yes, that is always the way we do it, we always start with the concrete facts and generalise the facts types and validate the fact types and create a decision on top of it.

O37: And then you have clear reference from the decision to these fact types?

(I)L37: Yes, in that way I always have a more complete model and know I have not invented something new. Of course, with each concept that you use in facts types you have definition stating what it is exactly for. But that is why we use DMN as a way to express it but it is an intrinsic part of our method to do it this way.

O38: I see, if we go more about the whole organisational perspective, there are many types of models like motivational model, like process models, data models. Both decisions and rules live in an interaction with these models. Do you see this as affecting why they are modelled in separate standards?

(EM)L38: To be honest if I am looking now at, based on your question. Data modelling, I do not know many standards besides UML class diagrams, and I can say to be honest, they are crappy for discussing with business. I don't use a UML diagram to discuss with business because it does not tell them much.

O39: But do you use a concepts model in some way that describes what in a UML model, like a person has all of these attributes?

(EM)L39: That's why we have facts-based modelling and behind it is that "a person has a name", "a person has an address"," a first name", "lives on an address", "an address consists of street number", "house number and house number addition" etc. That's how we validate. But there is no standard for that.

O40: It's kind of like in a sense that takes the place of what would be the UML model in this interaction?

(EM, C/C) L:40 Yes, but with a UML model you have already specified the values. For instance, you have the problem with the person lives at an address. In the UML model that address would consist of a street, house number, etc. and same for the relational model. How are we going to model the address? Do we model it as a separate class or do we consider to be attributes in the person class? You can not answer that until you know the cardinalities so have to the next steps to insure you know exactly whether it is one address or more than one address and in the case of more than one address is it two times the same type of address or is two different roles that the address plays. There are so many ways you can model in UML and in the relational diagrams. That's a totally different question. What we do is we have our facts types and the facts types is what you would call concepts models, concepts and relating concepts. We have that one. So that as a fact type model.

I have lost your question exactly. We have that one, that is what we use to build our rules upon. So, once you have your concepts model and facts types, which are the relationships between concepts? We build our rules on top of that one. We state if I have a relationship and I have a concept what are the rules that apply to concepts, so for example a new rule telling me that birthdays or, a birthdate would be a bad decision. An age where you should be between 0 and 100 for example. We do not allow people who are older than 100 to drive for example so it tells me something about, or if the colour range of hair colours should be blond, brown, black or undefined. That would be on top of concepts or you have rules on top of the relationship itself, or the business rules on top of the relationship telling me what age I will be before an end date, this kind of things. First, you have your concept model and your rules model, and then you have also process models.

In the process model, once I have my concepts model and my rule model I can partly derive the allowed sequence of steps I can do. And then the other part of it that are certain actions that I have to do are derivations. What we call derivation rules, or what we call rules tasks in the BPMN standard. Those rules tasks are exactly the execution of the derivation of such a DMN decision table or S-FEEL expression. For us you cannot do one without the other.

O41: They are all very dependent on each other, the process rule, and decision?

(EM)L41: Yes, process, rule, decision, data model. The data model and these are the three ones that constitute your organisation. If you describe them in combination with each other and if you create your model in combination with each other you can see exactly where you have flaws.

O42: You can see all of the activities in the business in a very clear way I guess?

(EM)L42: Yes, and you can see exactly if you have all the facts to make a decision or all the facts to run my processes and if you have all the data that are in my processes and you have are keeping data that I do not use in any of my processes, why do I have this data? So, it helps you really to sharpen and question the use of your data, and the use of your processes and the way you conduct your business.

O43: Do you consider, let's say "You have to do activity X before you do activity Y" a business rule or process flow? Do you consider that that should be modelled separately as a business rule, or that it is contained within the process? And hence not needed to be modelled as a rule?

(RD, RT, C/C)L43: That is a good question, from my PHD perspective, I would you would just consider it to be a rule, because a process is nothing but a set of rules. From a perspective of talking with modelling and modelling with business, no you do not express that as rule. Because, in essence, a sequence can be expressed a pre- condition / post condition. Pre- condition to do an action etc... So you can build it up, but if I try to explain that to my customer they call me a bit crazy, they say that they exactly which actions they do and also the order of the things that we do so it's easier, a picture says more and a diagram says more than a 100 words. That is typically the case of process modelling.

O44: So you express it in the process model for the business user, but you still consider it a business rule, but it is not shown to the "regular" person?

L44: Yes

O45: How about motivational standards and such, do you work with business motivation models?

(EM)L45: No, we've never seen the reasonable need for doing that. The standards we use for our typical practices is BPMN, DMN, SBVR. We use cogNIAM methods to ensure that we have the correct representation and if you model that as a correct model some cases I transform it automatically to UML or ERD's. But, business motivation model, yea, I also have problem with value chain model and motivation models as most of the time, my businesses know exactly why we are doing this so there is no need to motivate it again.

O46: You don't need to keep track of it in a model, but in the organisational model do you define decision ownership and such? Who is responsible for each decision?

(EM, SOC)L46: That is part of the governance process, you have the governance process. Actually, if you look at decision modelling perspective you have the governance process that tells me who are my data owners. So for each concept you have you have data owner in your organisation. Data owner is responsible for the quality of that data belonging to that concept. So, if that concept is the outcome of a decision rule then the owner of that concept is also accountable and responsible for the decision on top of that concept. We totally integrate with the data governance process.

O47: I see, so you keep that in process models as well?

L47: Yes, governance process can be done in a process model as well.

O48: Then we are reaching the end of this interview, I have one more question. It's about the complexity of the standards if you merge the two if it would become a more complex standard for users to perceive it as being useful for the representations that they need? Or do you see it as not being a problem?

L48: Say again if combining them would increase complexity?

O49: Yes

(C/C) L49: To be honest, I have no business rules that understand SBVR in the standard itself. I have some people who can read the DMN standard and understand a bit of DMN because they have a bit of background in decision modelling. I was just reading an E-mail from the SBVR revision task force list, that someone was questioning the overlap of SBVR and DMN and there was this very bold answer stating that there is no overlap between them.

I totally disagree with this one, there is definitely overlap between them. Behind DMN you can express DMN in predictive logic. Many cases even propositional logic. If I can express something in logic I can take any surface language on top of that. SBVR could be one of them.

O50: So they can both be used to express the same thing?

(C/C) L50: Yes, it says here for example, the specification is interpretable as SBVR says, they claim, and I have my doubts about it, but the specification in SBVR is interpretable in predictable logic with a small extension using model operators. So, if that's the case, DMN is expressible in predictive logic, why would there not be an overlap? They see it as mutually reinforcing and complementary, but not in any meaningful way competitive or overlapping. I disagree with this one, would you merge them? No. The reason why not is that I would think DMN would get much more influenced by the computational world where you do decision modelling, not only decision modelling, but also decision execution, execution logic. SBVR will never be able to reach that point where it is executable. I think these are two different motivations behinds standards. That is why you should not merge them. I would not merge them

O51: Then I think I covered all my points, is there anything you would like to add that I have not asked for?

L51: No think we have covered most of the thing, but I will send you that e-mail where it is said that the resolution, where you can find people that are SBVR oriented.

L52: There are not that many that truly use SBVR.

O52: That is the impression I have gotten as-well, there are less people that are "Religious" in following SBVR then there are to DMN

(SOC)L53: That has to do with the fact that DMN is formal and more generated against executable logic and program code, where DMN is very well suited. SBVR is more oriented against the communication perspective with business and hence not executable because they have missed some steps in their formalisation, so that's why I think SBVR is not successful, because the surface language you use is truly dependent on the organisation itself. It depends on how you model the concept that you use, the terms that you use, that's so organisation specific and SBVR gives you so much freedom in that there is no added value in doing it, at least that's being perceived. If you want to find people who do something similar to SBVR, you have to look in the facts-based community.

References

Bajec, M. & Krisper, M. (2005). A Methodology and Tool Support for Managing Business Rules in Organisations, *Information Systems*, vol. 30, no. 6, pp.423–443.

Bajwa, I. S., Lee, M. G. & Bordbar, B. (2011). SBVR Business Rules Generation from Natural Language Specification, *Association for the Advancement of Artificial Intelligence*, p.7.

Bazhenova, E. & Weske, M. (2016). Deriving Decision Models from Process Models by Enhanced Decision Mining, in *Business Process Management Workshops*, Vol. 256, [e-book] Cham: Springer International Publishing, pp.444–457, Available Online: http://link.springer.com/10.1007/978-3-319-42887-1_36 [Accessed 17 April 2018].

Bazhenova, E., Zerbato, F. & Weske, M. (2018). Data-Centric Extraction of DMN Decision Models from BPMN Process Models, in *Business Process Management Workshops*, Vol. 308, [e-book] Cham: Springer International Publishing, pp.542–555, Available Online: http://link.springer.com/10.1007/978-3-319-74030-0_43 [Accessed 2 February 2018].

Bhattacherjee, A. (2012). Social Science Research: Principles, Methods, and Practices, 2nd edn, [e-book] University of South Florida, Available Online: https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=79 [Accessed 22 January 2018].

Biard, T., Le Mauff, A., Bigand, M. & Bourey, J.-P. (2015). Separation of Decision Modeling from Business Process Modeling Using New "Decision Model and Notation" (DMN) for Automating Operational Decision-Making, in *16th Working Conference on Virtual Enterprises (PROVE)*, Vol. AICT-463, Albi, France, October 2015, Albi, France: Springer, pp.489–496, Available Online: https://hal.archives-ouvertes.fr/hal-01224703 [Accessed 1 February 2018].

Blenko, M. W., Mankins, M. C. & Rogers, P. (2010). The Decision-Driven Organization, *Harvard Business Review*, vol. 88, no. 6, pp.54–62.

BUNGE, M. (1977). Treatise on Basic Philosophy: Ontology I: The Furniture of the World, Springer Science & Business Media.

Business Rules Group. (2003). Business Rules Manifesto

Chapin, D. (2017). SBVR: Ten Years and Still Ahead of Its Time!, *Business Rules Journal*, [e-journal] vol. 18, no. 12, Available Online: http://www.brcommunity.com/articles.php?id=b933 [Accessed 8 March 2018].

Cheng, R., Sadiq, S. & Indulska, M. (2011). Framework for Business Process and Rule Integration: A Case of BPMN and SBVR, in *International Conference on Business Information Systems*, 2011, Springer, pp.13–24.

Halle, B. von & Goldberg, L. (2009). The Decision Model: A Business Logic Framework Linking Business and Technology, CRC Press.

Hasic, F., De Smedt, J. & Vanthienen, J. (2017a). An Illustration of Five Principles for Integrated Process and Decision Modelling (5PDM).

Hasic, F., De Smedt, J. & Vanthienen, J. (2017). A Service-Oriented Architecture Design of Decision-Aware Information Systems: Decision as a Service, in *On the Move to Meaningful Internet Systems. OTM 2017 Conferences*, Vol. 10573, [e-book] Cham: Springer International Publishing, pp.353–361, Available Online: http://link.springer.com/10.1007/978-3-319-69462-7_23 [Accessed 13 February 2018].

Hasic, F., De Smedt, J. & Vanthienen, J. (2017b). Towards Assessing the Theoretical Complexity of the Decision Model and Notation (Dmn), *Enterprise, Business-Process and Information Systems Modeling. Springer International Publishing*.

Holmberg, N. & Steen, O. (2011). Business Process and Business Rules Modelling In Concert for E-Service Design Business Alignment, Vol. 1, International Conference on Cloud Computing and Services Science, Netherlands, 2011, Netherlands.

Janssens, L., Bazhenova, E., De Smedt, J., Vanthienen, J. & Denecker, M. (2016). Consistent Integration of Decision (DMN) and Process (BPMN) Models, in *Proceedings of the CAiSE'16 Forum, at the 28th International Conference on Advanced Information Systems Engineering (CAiSE 2016)*, 2016, CEUR-WS. org, pp.121–128.

Kluza, K. & Honkisz, K. (2016). From SBVR to BPMN and DMN Models. Proposal of Translation from Rules to Process and Decision Models, in *Artificial Intelligence and Soft Computing*, Vol. 9693, [e-book] Cham: Springer International Publishing, pp.453–462, Available Online: http://link.springer.com/10.1007/978-3-319-39384-1_39 [Accessed 7 March 2018].

Kovacic, A. (2004). Business Renovation: Business Rules (Still) the Missing Link, *Business Process Management Journal*, vol. 10, no. 2, pp.158–170.

Lee, A. S. & Baskerville, R. L. (2003). Generalizing Generalizability in Information Systems Research, *Information Systems Research*, vol. 14, no. 3, pp.221–243.

Linehan, M. & de Sainte Marie, C. (2011). The Relationship of Decision Model and Notation (DMN) to SBVR and BPMN Standards, *Business Rules Journal*, [e-journal] vol. 12, no. 6, Available Online: http://www.brcommunity.com/articles.php?id=b597 [Accessed 7 March 2018].

Mertens, S., Gailly, F. & Poels, G. (2015). Enhancing Declarative Process Models with DMN Decision Logic, in *Enterprise, Business-Process and Information Systems Modeling*, Vol. 214, [e-book] Cham: Springer International Publishing, pp.151–165, Available Online: http://link.springer.com/10.1007/978-3-319-19237-6_10 [Accessed 17 April 2018].

Morgan, T. (2002). Business Rules and Information Systems: Aligning IT with Business Goals, Addison-Wesley Professional.

Myers, M. D. & Newman, M. (2007). The Qualitative Interview in IS Research: Examining the Craft, *Information and Organization*, vol. 17, no. 1, pp.2–26.

Object Management Group. (2011). Business Process Model and Notation (BPMN), Version 2.0.

Object Management Group. (2016). Decision Model and Notation V.1.1, Available Online: http://www.omg.org/spec/DMN/1.1 [Accessed 22 November 2017].

Object Management Group. (2017). Semantics of Business Vocabulary and Business Rules, Available Online: http://www.omg.org/spec/SBVR/1.4/PDF [Accessed 26 March 2018].

Orlikowski, W. J. & Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions, *Information systems research*, vol. 2, no. 1, pp.1–28.

Pitschke, J. (2011). Integrating Business Process Models and Business Logic: BPMN and The Decision Model, in *Business Process Model and Notation*, Vol. 95, [e-book] Berlin, Heidelberg: Springer Berlin Heidelberg, pp.148–153, Available Online: http://link.springer.com/10.1007/978-3-642-25160-3_14 [Accessed 21 April 2018].

Recker, J. (2013). Scientific Research in Information Systems, [e-book] Berlin, Heidelberg: Springer Berlin Heidelberg, Available Online: http://link.springer.com/10.1007/978-3-642-30048-6 [Accessed 22 January 2018].

Recker, Rosemann, Green & Indulska. (2011). Do Ontological Deficiencies in Modeling Grammars Matter?, *MIS Quarterly*, vol. 35, no. 1, p.57.

Ross, R. (2017). The New Knowledge Paradigm: Challenges for Operational Excellence, *Business Rules Journal*, [e-journal] vol. 18, no. 5, Available Online: http://www.brcommunity.com/articles.php?id=b904 [Accessed 28 March 2018].

Schultze, U. & Avital, M. (2011). Designing Interviews to Generate Rich Data for Information Systems Research, *Information and Organization*, vol. 21, no. 1, pp.1–16.

Selic, B. (2003). The Pragmatics of Model-Driven Development, *IEEE Software*, vol. 20, no. 5, pp.19–25.

Smit, K., Zoet, M. & Slot, R. (2016). Compliance Principles for Decision Management Solutions at the Dutch Government.

Taylor, J. (2013). The Decision Management Manifesto, *Decision Management Solutions*.

Taylor, J. & Purchase, J. (2016). Real-World Decision Modelling with DMN: Effective Communication of Decision-Making, 1st edn, Tampa, Florida, Usa: Meghan-Kiffer Press.

Taylor, J. & Raden, N. (2007). Smart Enough Systems: How to Deliver Competitive Advantage by Automating Hidden Decisions, Pearson Education.

Walsham, G. (2006). Doing Interpretive Research, *European Journal of Information Systems*, vol. 15, no. 3, pp.320–330.

Wand, Y. & Weber, R. (1993). On the Ontological Expressiveness of Information Systems Analysis and Design Grammars, *Information Systems Journal*, vol. 3, no. 4, pp.217–237.

Wang, W., Indulska, M. & Sadiq, S. (2014). Factors Affecting Business Process and Business Rule Integration, 2014, ACIS.

Wang, W., Indulska, M. & Sadiq, S. (2016). To Integrate or Not to Integrate - The Business Rules Question, in *28th International Conference, CAiSE 2016*, Advanced Information Systems Engineering, Ljubjana, Slovenia, 2016, Ljubjana, Slovenia: Springer International Publishing, pp.51–66.

Wang, W., Indulska, M. & Sadiq, S. (2017). Guidelines for Business Rule Modeling Decisions, *Journal of Computer Information Systems*, pp.1–11.

Wyssusek, B. (2004). Ontology and Ontologies in Information Systems Analysis and Design: A Critique, in *Proceedings of the Tenth Americas Conference on Information Systems*, Americas Conference on Information Systems, New York, 2004, New York, pp.4303–4208.

Zoet, M., Versendaal, J., Ravesteyn, P. & Welke, R. J. (2011). Alignment of Business Process Management and Business Rules., in *ECIS*, 2011, p.34.

zur Muehlen, M. & Indulska, M. (2010). Modeling Languages for Business Processes and Business Rules: A Representational Analysis, *Information Systems*, vol. 35, no. 4, pp.379–390.

Zur Muehlen, M., Indulska, M. & Kittel, K. (2008). Towards Integrated Modeling of Business Processes and Business Rules, *ACIS 2008 Proceedings*, p.108.