Identifying Challenges in Business Rules Management Implementations Regarding the Governance Capability at Governmental Institutions

Koen Smit
HU University of Applied Sciences Utrecht
koen.smit@hu.nl

Martijn Zoet
Zuyd University of Applied Sciences
martijn.zoet@zuyd.nl

Abstract

As the number of BRMS-implementations increases, more and more organizations search for guidance to design such solutions. Given these premises, more implementation challenges experienced from practice become evident. In this study, we identify the main challenges regarding the governance capability as part of BRM, in the Dutch governmental context. To be able to do so, we utilized a four-round focus group and a three-round Delphi study set-up to collect our data. The analysis resulted in eight implementation challenges experienced by the participants. The presented results provide a grounded basis from which empirical and practical research on best practices can be further explored.

1. Introduction

As an increasing number of Business Rules Management (BRM) solutions are being designed and implemented, organizations are searching for best practices, lessons learned, methods and other types of handles to guide the design and implementation of these solutions [1], [2]. In this study, the concept of design represents the creation and planning of a solution, while the concept of implementation represents the technical integration and organizational embedding [3]. A BRM solution enables organizations to, in a systematic and controlled manner, elicitate, design, specify, verify, validate, deploy, execute, govern and evaluate business decisions and underlying business logic to create added value, see Figure 1 [4]–[6]. Each of the earlier mentioned nine capabilities mentioned need to be deployed, implemented and governed carefully. How a capability is realized by an organization depends on the situation in that specific organization, i.e. what technology or tooling is available, the maturity of the available technology, the available knowledge, and the available resources.

A business decision can be defined as: "*A conclusion that a business arrives at through business logic and which the business is interested in managing*" [7]. Furthermore, business logic can be defined as "*a collection of business rules, business decision tables, or executable analytic models to make individual business decisions*" [8].

An important aspect of BRM is the governance of business decisions and business logic, which is essential for the continuity of the added value originally created by the implementation of the business decisions and business logic.

In the current body of knowledge, a broad selection of literature on implementation challenges and critical success factors in the context of Enterprise Resource Planning implementations, for example, [9], [10], Business Process Management implementations, for example, [11], [12] and Supply Chain Management implementations, for example, [13], [14] is available.

In contrast to the available body of knowledge on implementation challenges regarding domains such as ERP, BPM, and SCM, little to no work on challenges in BRM implementations that are experienced in practice is available. This is caused by several reasons; 1) studies often provide the beginnings of a business rules research program, but often do not focus on the specific challenges and the larger context that business logic plays in organizations [15], 2) the body of knowledge regarding the BRM domain does not show a well-balanced mix of research, predominantly focusing on the technological aspects, while the non-technological aspects are rarely taken into account [4], [5]. Additionally, 3) in 2005, Arnott and Pervan [18] concluded, after studying more than one thousand papers, that the field lost its connection with industry some time ago and research output with practical relevance is scarce. This particular literature review has been revisited by the same authors, strengthening their conclusions from 2005 as follows: a transition is happening to a more practical-oriented approach; yet, still, a strong connection between theory and practice is lacking [19]. This was also one of the conclusions in the work of [1]. Therefore, we conclude that there is a need for BRM research from a broader perspective,

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taking into account the implementation and application of BRM capabilities in practice.

Organizations in which more and more BRM implementations are executed are governmental institutions. Government institutions deliver public administration (e-)services, which are specified in laws and regulations. Based on the laws and regulations, the business processes, procedures, decisions (that are executed) and the data (that is registered to deliver a particular service) are restricted. As laws and regulations change in an increasing pace, for example, due to societal developments, public administration (e-)services also need to change. A solution to guide the design and implementation of public administration (e-)services is BRM. The key building blocks of BRM are business rules, which are translated from laws and regulations into computer-executable business rules and serve as building blocks for legal digital products and/or services.

This paper is part of a large research project in which all nine capabilities of five Dutch government institutions were evaluated. In previous studies, the implementation challenges regarding the elicitation, design specification verification, validation, and monitoring capabilities were identified [20], [21]. A full elaboration of all BRM capabilities can be found in [21]. In this paper, we investigate and elaborate upon the governance capability and aim to identify the major challenges experienced in practice regarding the implementation of this capability. To be able to do so, we intend to answer the following research question: "*Which implementation challenges do governmental institutions encounter while implementing the governance capability of business rules management?*"

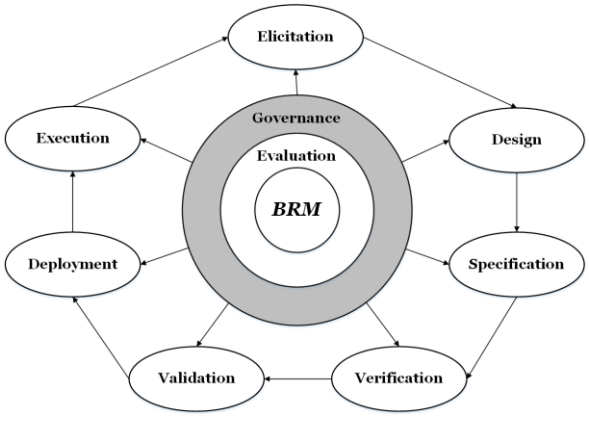

Figure 1. BRM capabilities overview

The remainder of this paper is structured as follows: First, we present an overview of the governance problem space. This is followed by the research method used to identify the current governance-related BRM implementation challenges at Dutch governmental institutions. Next, the collection and analysis of our research data is described. Subsequently, our results are presented that provide an overview of the implementation challenges regarding the governance of business decisions and business logic. Finally, we present our conclusions and discuss the utilized research methods and results of our study, followed by possible directions for future research.

2. Background and Related Work

Governance in terms of BRM can be defined as the capability of the registration of meta-data with regards to version management, validity management, traceability management and the relationships between these sub-capabilities [1]. The previously mentioned activities concern the entire lifecycle and thereby the implementation-independent and implementation-dependent artefacts that are realized or are required for the elicitation, design, specification, verification, validation, deployment, execution, and evaluation capabilities. The governance capability comprises three separate sub-capabilities: 1) Traceability Management, 2) Validity Management, and 3) Version Management.

In specific industries, the level of maturity with regards to traceability management is mature, i.e. healthcare, food processing and systems and software development (requirements) [22]. The goal of traceability management with regards to BRM is to make the relationships between specific versions of a specific set of artifacts visible, in two dimensions. The first dimension comprises vertical and horizontal relations. Horizontal relations refer to traceability relations that associate elements of the same type of artifact (i.e. relationships between facts) while vertical relations refer to associations from an artifact towards different types of artifacts (i.e. a relationship between a decision and its underlying business rule) [23]. The second dimension comprises pre and post-traceability, which is also referred to as forward and backward traceability [24]. Pre-traceability refers to the relations between business decisions/business logic and the sources that have given rise to these specifications, i.e. the stakeholders that have expressed the views and needs which are reflected in them while post-traceability refers to the relations between business decisions/business logic and artifacts that are created in subsequent stages of the software development life cycle. The second goal of traceability management is to form a basis for impact assessments when existing business decisions or business logic need to be modified [25]. Impact assessments are important as it allows organizations to provide feedback on the expected effect of a modification. Furthermore, impact

assessment allows for the creation of a justified planning of resources to process the modifications. For example, in most countries, executive governmental branches execute the laws and regulations that are imposed by legislative governmental branches. When laws and regulations change, the executive governmental branches are expected to deliver insights beforehand on what the impact of the changed laws and regulations are with regards to executability, budgeting and whether the intended effect can be realized. This is usually referred to as the pilot phase. The current body of knowledge with regards to traceability of business decisions and business logic contains some solutions to realize traceability, these are; European Law Identifier (ELI), European Case Law Identifier (ECLI), and Juriconnect [26]. However, these standards are defined for a specific context (for example, ECLI, which only traces case law) or with regards to a relationship between two specific artefacts.

Version Management aims to record changes in artifacts and to track and assign versions of the aforementioned changes in artifacts. To the knowledge of the authors, no standard that is specifically tailored to be utilized for business decisions and business logic exists. To our experience, organizations utilize generic methods, standards and processes developed for software engineering in general. Examples of such methods would be checking-out and checking-in artefacts via 1) Design on a trunk, fault recovery on a branch, 2) Design on a branch, fault recovery on a trunk, and 3) Design and fault recovery on a branch, deployment on a trunk [27]. Applying such methods, organizations often use applications, for example, Git [24].

The purpose of validity management is to provide a specific version of a specific set of artifacts at any given moment in time [28]. By realizing validity management, it is possible to see, at any moment in time, which instance is valid. This partly overlaps with the goal of validity management. Similar to version management, no standard that is specifically tailored to be utilized for business decisions and business logic exists, to the knowledge of the authors. However, to the experience of the authors, organizations utilize validity management best practices borrowed from the data-management domain. For example, IBM, Microsoft, and Oracle utilize validity management of database entries, by using two possible methods: 1) temporal data management or 2) bi-temporal data management [29]. Temporal data management in relation to BRM focuses on the use of two-time dimensions represented by either system or transaction start and end-timestamps. The combination of both enables organizations to determine when an artefact is introduced in the system and when it is changed. Temporal data management can also utilize a different set of time stamps; validity start and validity end-timestamps. The combination of both enable organizations to determine the exact period an artefact, i.e. a specific version of a business decision or ruleset, is valid. Additionally, there is bi-temporal data management which utilizes both the previously described system and validity timestamps in order to time travel. Time travel with artefacts is possible due to the fact that the combination of both the system and validity time stamps allow querying for historical, current and future implementation of artefacts [29].

The aforementioned sub-capabilities can be implemented in different domains, and thus must be managed accordingly. Also, multiple domains require multiple transformations as they are all part of the development process of business decisions and business logic. In literature, three domains are recognized, which influence the implementation of governance: 1) the source domain, 2) the implementation-independent domain, and 3) the implementation-dependent domain [25]. The first domain comprises any source, for example, laws, regulations, EU agreements, policies, policies, internal documentation, guidance documents, Parliament documents, official disclosures, implementation instructions, and expert hearings that must be taken into account when designing the value proposition (i.e. service or product). The second domain comprises artifacts that are established without incorporating language or properties that are affiliated to the use of specific technology (i.e. from specific vendors) and are processed in an implementation-independent language [1]. An implementation-independent language is defined as: "*a language that complies with a certain level of naturalness but has a delimited predefined expressiveness and is not tailored to be applicable to a specific automated information system*" [30]. The third domain comprises implementation-dependent artefacts which are based on their implementation-independent counterparts created or modified in the previously elaborated domain and are implemented in an implementation-dependent language. An implementation-dependent language is defined as: "*a language that complies with a specific software formalism has a delimited predefined expressiveness and is tailored to be interpreted by a particular information system*" [30]. An example of an implementation-dependent artefact would be the use of knowledge models specifically created and used in the application BeInformed.

3. Research Method Justification

The goal of this study is to identify challenges that are experienced in the implementation of the governance capability. The maturity of the BRM research field, with regard to non-technological research, is nascent [1], [15], [16]. An appropriate focus of research in nascent research fields is on identifying new constructs and establishing relationships between identified constructs (e.g. [31]). Therefore, through grounded theory based data collection and analysis, in our research, we search for implementation challenges with regards to the governance capability.

For research methods related to exploring a broad range of possible solutions to a complex issue -and combine them into one view when a lack of empirical evidence exists- group based research techniques are adequate [32]–[34]. Examples of group based techniques are focus groups, Delphi studies, brainstorming and the nominal group technique. The main characteristic that differentiates these types of group-based research techniques from each other is the use of face-to-face versus non-face-to-face approaches. Both approaches have advantages and disadvantages; for example, in face-to-face meetings, provision of immediate feedback is possible. However, face-to-face meetings have restrictions regarding the number of participants and the possible existence of group or peer pressure. To eliminate the disadvantages, we combined the face-to-face and non-face-to-face technique by means of applying the following two group based research techniques: the focus group and Delphi study. To further structure our results, we selected the information systems framework originally proposed by Weber [35] and extended by Strong and Volkoff [36]. The framework is divided into four sections: 1) deep structure, 2) organizational structure 3) physical structure and, 4) surface structure. Deep structure elements are subjects that describe real-world systems, their properties, states and transformations[35]. Organizational structures are the roles, control and organizational culture represented within organizations or within solutions [36]. Physical structure elements describe the physical technology and software in which the deep structure is embedded [35]. Lastly, surface structure elements describe the elements that are available in the information system to allow users to interact with the information system [36].

4. Data Collection and Analysis

The data for this study is collected over a period of three months, between April 2015 and June 2015, through a three-round focus group and a three-round Delphi study, see Figure 2. Additionally, we conducted another round of data collection and validation in January 2017 to ensure the validity of our identified challenges.

This approach is applied to the implementation challenges with regards to the governance capability. Between each individual round of focus group and Delphi study, the researchers consolidated the results. Both methods of data collection and analysis are further discussed in the remainder of this section.

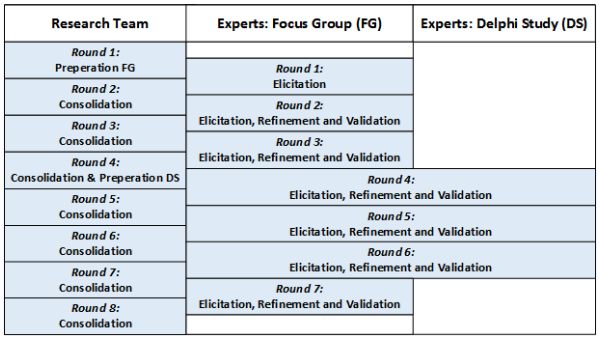

Figure 2. Data collection process design

4.1. Focus Groups

Before a focus group is conducted, a number of topics need to be addressed: 1) the goal of the focus group, 2) the selection of participants, 3) the number of participants, 4) the selection of the facilitator, 5) the information recording facilities and 6) the protocol of the focus group [37]. For us, the goal of the focus group meetings was to identify implementation challenges of the governance capability as part of BRM. The selection of participants should be based on the group of individuals, organizations, information technology, or community that best represents the phenomenon studied [38]. In this study, organizations and individuals that deal with business decisions and business logic represent the phenomenon studied; examples are financial and governmental institutions. Therefore, multiple Dutch governmental institutions were invited to provide input for this research. The organizations that agreed to cooperate with the focus group meetings were the: 1) Dutch Tax and Customs Administration, 2) Dutch Immigration and Naturalization Service, 3) Dutch Employee Insurance Agency, 4) Dutch Education Executive Agency, Ministry of Education, Culture and Science, and 5) Dutch Social Security Office. Based on the written description of the goal and consultation with employees of each governmental institution, participants were selected to take part in the four focus group rounds. In total, 21 participants took part in the

focus groups. The following roles were included in the focus groups: One software engineer, three BRM project managers, one enterprise architect, eight business rule analysts, one IT-architect, five business rule architects, one business consultant, and one tax advisor. Each of the participants had at least five years of experience with BRM solutions. Delbecq and van de Ven [32] and Glaser [39] state that the facilitator should be an expert on the topic and familiar with group meeting processes. The selected facilitator has a Ph.D. in BRM, has conducted eight years of research on the topic, and has facilitated many (similar) focus group meetings before. Besides the facilitator, five additional researchers were present during the focus group meetings. One researcher participated as 'back-up' facilitator, who monitored whether each participant provided equal input, and if necessary, involved specific participants by asking for more in-depth elaboration on the subject. The remaining four researchers acted as a minute's secretary taking field notes. They did not intervene with the process. All focus groups except the last were video and audio recorded. The duration of the first focus group session was 191 minutes, the second 168 minutes, the third 157 minutes, and the fourth 120 minutes. Furthermore, each focus group meeting followed the same protocol, each starting with an introduction and explanation of the purpose and procedures of the meeting, after which ideas were generated, shared, discussed and refined by the participants.

Prior to the first round, participants were informed about the purpose of the focus group meeting and were invited to submit their secondary data regarding known challenges with regards to the implementation of the governance capability. When participants had submitted their secondary data, they had the opportunity to elaborate upon their documented challenges during the first focus group meeting. Furthermore, during this meeting, challenges that were not present in secondary data were presented and discussed upon. For each challenge addressed, the name, description, origin (regarding which institutions experienced the same or similar challenges), and classification were discussed and noted. After the first focus group, the researchers analyzed and consolidated the results.

The results of the analysis and consolidation were sent to the participants of the focus group two weeks in advance for the second focus group meeting. During these two weeks, the participants assessed the consolidated results in relationship to three questions: 1) "Are all challenges described correctly?", 2) "Do we need to address additional challenges?", and 3) "How do the challenges affect the design and implementation of the BRM capability?" This process of conducting focus group meetings, consolidation by the researchers and assessment by the participants of the focus group was repeated two more times (round 2 and round 3). After the third focus group meeting (round 3), saturation within the group occurred, leading to a consolidated overview of challenges regarding the governance capability as part of BRM.

Data analysis was conducted in three cycles of coding, following Strauss and Corbin's process of 1) open coding, 2) axial coding, and 3) selective coding [38]. After each focus group round, open coding was conducted, involving the analysis of significant participant quotes by the individual researchers. In this process, the researchers tried to identify what Boyatzis [40] refers to as 'codable observations'. Here, the researchers coded the data by identifying sentences where challenges were discussed. The participants named and listed challenges that occurred. For example, one of the codable observations was as follows: "*Version management is complex to implement at our organization. This is due to the fact that all involved departments either adhere to different version management schemes or do not apply version management at all.*"

The open coding was followed by axial coding during the analysis and consolidation phase between the focus group rounds to see what challenges can be identified and how the participants supported their challenges. The researchers employed the Toulmin's [41] framework, which consists of three elements, claim-ground-warrant, to code the challenges addressed in the focus group rounds. For example, the following claim-ground-warrant relationship was coded: Claim - "The collaboration between the designing and implementation teams within the organisations is low"; Ground - "*We –the business logic design team- do not have the authority to change certain processes to ensure the design and implementation teams work the same way and with the same methods. They have different agenda's and different preferences with regards to governance methods.*", Warrant - "Authority, - the reliability and validity originated from a presumed expert source".

Lastly, selective coding was applied to categorize the identified challenges that were the output of the axial coding process. The coding family 'Unit' [39] was adhered to during the selective coding rounds to categorize the identified challenges. This process required inductive as well as deductive reasoning. The inductive reasoning was applied to reason from concrete factors to general situational factors. For example, multiple participants reported to use different (software) systems to govern their business decisions and business logic, for example, MS Word, MS Excel, and on paper. In this case, all different statements were

coded to the maturity of tooling to support the governance capability. Deductive reasoning has been applied to reason from general situational factors to specific cases. For example, one participant stated that MS word was applied to manage versions of business rules. When elaborating on this topic more in-depth, the specialized BRM tooling they own does not support version management at all, so they identified MS word to be the best workaround. Therefore the challenge was assigned to the maturity of the available tooling to support the governance of business decisions and business logic.

4.2. Delphi study

Before a Delphi study is conducted, also a number of topics need to be addressed: 1) the goal of the Delphi study, 2) the selection of participants, 3) the number of participants, and 4) the protocol of the Delphi study [33]. The goal of the Delphi study was twofold. The first goal was to validate and refine the challenges identified in the focus group meetings, while the second goal was to identify additional challenges. Based on the written description of the goal and consultation of employees of each organization, participants were selected to take part in the Delphi study. In total, 45 participants were involved. 24, next to the 21 experts that participated in the focus group meetings, were involved in the Delphi Studies. The reason for involving the 21 experts from the focus groups was to decrease the likelihood of peer-pressure amongst group members, which could have been the case during the focus group meetings. This is achieved by exploiting the advantage of a Delphi Study which is characterized by a non-face-to-face approach. The non-face-to-face approach was achieved by the use of online questionnaires that the participants had to return via mail. The additional 24 participants involved in the Delphi Study had the following positions: one project manager, three enterprise architects, five business rules analysts, six policy advisors, one IT-architect, two business rules architects, one business consultant, one functional designer, one legal advisor, one legislative author, one knowledge management expert, and one operational auditor. Each of the 24 additional participants had at least two years of experience with BRM. Each round (4, 5, and 6) of the Delphi Study followed the same protocol, whereby each participant was asked to assess the identified challenges in relation to three questions: 1) “Are all challenges described correctly?”, 2) “Do we need to address additional challenges?“, and 3) “How do the challenges affect the design and implementation of a BRM solution? Regarding the analysis of the collected data as a result of the Delphi study rounds, the same method of analysis as elaborated in the focus groups section was adhered to.

5. Results

In this section, a summary of the governance-related challenges derived from our data collection and analysis are presented and structured. The order of the challenges presented does not reflect their relative importance. Note that, as our aim is to solely identify challenges with regards to the governance capability, we did not explore solutions which address the identified challenges. All challenges derived were based on the majority of agreement of the participants.

The challenges have been further structured along the dimensions of the ontological foundations of the information systems framework [35] & [36], see also the research method justification section.

Governance Maturity Implementation Challenges

Challenge 1) Governance process maturity: The overall maturity of governance is low. This is grounded by the fact that the participants do not or barely utilize processes and educated specialists to ensure governance of their business decisions and business logic. The processes for governance are often not formally defined and most of the mechanisms to ensure legitimacy and transparency of the executed business decisions are grounded by manual labor of experts studded across multiple silos in the participating organizations. The number one concern is the legitimacy of the outcome of the business decisions executed. One of the participants stated: “*as we started to utilize some samples with regards to the validity of the different versions of business rule sets that were used we found out that 30% of the business rule sets that were executed were from a version that were not allowed to be executed due to changes in law.*” This could lead to situations where citizens or organizations could complain or appeal more, which results in additional resources that need to be reserved to handle such influxes due to improper governance. On the other hand, organizations and citizens could positively benefit from errors in the execution due to older versions of business rule sets such as illustrated in the previous quote. However, such errors could result in loss of tax money. For example, one of the participants stated the following: “*The worst case scenario is that our mistakes will make the headlines of the national newspapers. When this happens, politics will start to get involved, and we will be investigated and monitored closely.*”

Challenge 2) Maturity of tooling supporting governance: The current level of maturity of available commercial tooling with regards to governance is low. This is grounded by the fact that the participants experience that vendors only focus on the implementation of business decisions and business logic, but lack to invest in the development of functionality to properly support the governance capability. For example, with regards to version management, the participants currently have to manually add version metadata to their artefacts as the tooling they utilize do not support the automatic generation of versioning-related metadata. Another example was given with regards to the need for applying version management to decision tables, which is simply not possible in their current tooling, while the participants believe this should be possible and do not require a lot of resources to realize by the tool vendors. One of the participants stated: "*It surprises us that a specialized tool like RuleXpress does not support such functionality by default.*", another participant added: "*To my knowledge, all the tools available focus on executing the decisions and logic, while the functionalities with regards to governance are simply omitted. Tools are very immature when talking about governance.*"

Additionally, the participants addressed that they experience the tool vendors to ignore improvements with regards to governance, as the tool vendors develop their own methods and standards for their clients to adjust to, while the participated organizations expect the opposite. Therefore, based on this, we can also identify a possible gap between the expectations of both clients and tool vendors. An example of this is the need for validity management, where the validity start/end date and system registration date needs to be registered. This was not possible in the system that two of the participated organizations utilize, and the tool vendor admitted that they would not include functionality to support the registration of such data. Therefore, one participating organization built a tool to support validity management themselves that automatically checks the validity of different versions of business rule sets. One of the participants stated: "*We sometimes feel not taken seriously by tool vendors, with regards to our demands.*"

On the other hand, the participated organizations utilize tooling which is not intended to support adequate governance, while some of the tooling in their portfolio does support some basic functionality for governance. Three out of five participated organizations manage their business rules in MS Word and MS Excel, while they own licenses for specialized tooling such as RuleXpress, Bizzdesign-TDM, FICO Blaze Advisor, Drools, and Oracle Policy Automation. One of the participants stated: "*Working with tools like MS Word as a repository for our business rules greatly reduces the effectiveness and efficiency of version management.*"

Organizational Layer Implementation Challenges

Challenge 3) Feedback loop: Additionally, in relation to the first challenge, the current maturity level influences the feedback loop with regards to the effectiveness and efficiency towards legislative bodies. This is grounded by the fact that the participants find it hard to make a business case for improving governance. As also stated in challenge 6 and 7, the responsibilities of stakeholders related to the governance processes are vague or not defined at all and the stakeholders themselves are spread over multiple silos in the organization. Therefore, it is difficult to provide insights into how much time and effort it costs to perform the manual labor by those stakeholders. One of the participants stated: "*We do not and cannot measure how much resources we currently spend on realizing manual traceability, version management and validity management because we do almost everything manually. When researching how much time it costs to answer a, for example, traceability-related question, they don't know as they do not measure it. Additionally, they don't want to get bothered with such questions.*"

Challenge 4) Governance standards: The amount of knowledge with regards to standards for governance is low. This is grounded by the fact that all organisations claim that there are no standards with regards to validity management, versioning management and traceability management. However, in current practice, standards with regards to these three governance capabilities are available and widely applied, such as GS1, Juriconnect and ECLI (traceability management) [22], temporality versus non-temporality (validity management) [29] and development on branches and stem in different compositions (version management) [27]. For example, one of the participated organizations is now able to trace three out of eleven implementation-dependent artefacts that they adhere to, to their source(s). The other four organizations admitted that they are not even able to trace their implementation-dependent artefacts to their sources adequately. Therefore, this challenge is more related to a knowledge problem, where the organizations are not adequately aware of the existing standards to support all three capabilities. Moreover, the participants addressed that knowledge to implement the standards known to them is absent. This knowledge is needed due to the fact that standards for traceability, version,

and validity management often need to be adopted and adapted from other, neighboring fields, i.e. process management and data management.

Challenge 5) Partial governance: Not all abstraction levels/artefacts are covered by current governance practices. This is grounded by the fact that multiple stakeholders addressed that they find it very helpful to be able to trace to, assign validity data to, and manage the versions of fact types in the fact abstraction level. One of the participants stated: "*We all know why this is important, as, currently, everyone is adding fact types to be used by different artefacts. Currently, no governance meta-data is captured when adding a fact type, so it is hard to find, for example, a definition of a fact type in a given period of time.*"

Challenge 6) Data quality: The quality of data needed for adequate governance is overlooked. This is grounded by the fact that all participants admit that the quality of the data needed for traceability, version and validity management must have a certain quality by being complete, available and consistent. For example, traceability metadata must be complete in order to follow the trace successfully when required. However, the organizations see less in investing into enforcing or governing the quality of the data as it requires more resources, so the participants stated. Furthermore, the benefits of the investment are not always directly relevant or visible for all stakeholders. This is caused by the fluctuations in demand for transparency of decision making, i.e. when an appeal is made against a decision regarding tax returns. When this happens, the organization that made the decision must be able to prove that the decision is based on valid sources and that their business logic can be traced to these sources. For example, one of the participants stated: "*It depends on how much trouble our organization is in when we are unable to prove our decisions outcome with the help of governance. It is hard to measure the benefits of quality data, as we do not even measure the current effort we invest into solving appeals by manually tracing back decision making. Therefore, it is hard to express benefits of capturing and enforcing data for governance*"

Challenge 7) Governance responsibilities: The responsibilities of the different roles with regards to governance are not adequately defined. This is grounded by the fact that the participants are unable to point out who is responsible for the repository where the business logic and their versions is managed. For example, one of the organizations has appointed information management the ownership of the business logic repository, while they have no experience with managing business logic. In the cases of the other participated organizations, it is vague who is responsible or isn't defined at all. Therefore, when problems need to be addressed or improvements are identified, it costs a significant amount of effort to find or appoint responsible roles or individuals.

Furthermore, because of the separation of design by business rule architects and analysists and implementation by IT specialists, collaboration with regards to responsibilities is more difficult according to the participants. With regards to the implementation of improvements in governance, the design teams deliver several proposals to persuade IT specialists into implementing the identified improvements, i.e. capturing governance data so that designed implementation-dependent artefacts can be traced to their implementation-independent artefacts. One of the participants stated: "*We currently can only employ a facilitating attitude towards IT specialists as we have no authority to force them to capture data according to a specific format to improve governance.*" Another participant added: "*For example, people that build our web sites for the e-services just do their thing and do not care about our preferences to improve traceability management.*"

Challenge 8) Design and implementation teams: The collaboration between the designing and implementation teams within the organisations is low. This is grounded by the fact that the design team delivers the business decisions and business logic for implementation, after which they lost all track of the status of the actual implementation. The participants addressed that this is a serious gap between both teams and does decrease effective and efficient collaboration, as the organisations are organized in silos. One of the participants stated: "*It is important for the design team to know in what phase the implementation of the business decisions and business logic is located. In certain phases, when we identify a small error, processing a quick fix is still possible. But because we simply have no insights into statuses after handing it over to the implementation team, we find it difficult collaborate."*

6. Discussion and Conclusion

In this paper, we aimed to find an answer to the following research question: "*Which implementation challenges do governmental institutions encounter while implementing the governance capability of business rules management?*" To answer this question, three focus groups sessions and three Delphi study rounds were conducted in a study that, to the knowledge of the authors, has not been conducted

before in this research domain (concerning governmental and non-governmental context). By including 45 subject-matter experts in total over both qualitative data collection techniques, we managed to identify eight implementation challenges with regards to the governance capability as part of BRM projects at Dutch governmental institutions. The eight implementation challenges identified should be taken into account when designing a BRM solution. From a theoretical perspective, our results are mapped on the information systems framework of Weber [35] and Strong and Volkoff [36]. The gained insights provide knowledge to better understand the implementation challenges in the context of the information systems framework with regards to BRM. Furthermore, it will enable further exploration and identification of problem classes. From a practical perspective, our study's results provide insights into what governance-related challenges are experienced in the Dutch governmental context. Organizations of any type, even non-governmental organizations, should take into account the common pitfalls to ensure future projects avoid the need to deal with such implementation challenges. Additionally, BRM solutions-software vendors and customers themselves should learn from the insights presented and start developing best practices, concepts, and methods as this could guide them in avoiding these pitfalls in future projects. Lastly, the now explicit challenges could trigger vendors and client organizations to enter the discussion and formulate future collaboration to tackle these challenges.

Our study and its results have several limitations. Considering our sampling and sample size, the current sample is solely drawn from governmental institutions in the Netherlands. We argue that governmental institutions are representative for organizations that implement BRM solutions, for example in other industries. However, it is important that future research focuses on further generalization towards non-governmental organizations, i.e. other industries like healthcare and financial services, due to the fact that our results are limited to Dutch governmental institutions. This same argument also holds as a basis for future research into implementation challenges experienced in other countries. Such research could identify differences in the implementation challenges experienced due to a different cultural composition, especially with regards to the organizational layer related challenges. With regards to the sample size, while we believe that 45 subject-matter experts is a sufficient sample to conduct explorative research on the current implementation challenges in the Dutch governmental context, future research should also focus on including more participants, preferably in conjunction with the aforementioned future research directions. Taking into account the identified challenges presented in section five, we see an overrepresentation of implementation challenges in the organizational layer compared to the other layers. This is in line with the literature [6], [15], [18], [19], since most research has a focus on the technical and theoretical perspective while lacking management-related solutions in the context of BRM. Therefore, future research should aim to investigate whether this was related to our data collection and analysis. We believe that the use of the BRM capabilities defined in earlier research and the framework by Wand and Weber is appropriate to structure our findings to identify and cluster challenges. However, this results in the fact that our findings are also limited to this particular viewpoint, which should be taken into account in future research as well.

Lastly, the focus of this study was on identifying new constructs and establishing relationships, provided the current maturity of the BRM research field. While we believe that the research approach selected for this research type and study is appropriate, research focusing on further generalization as identified previously in this section should apply other research methods, such as quantitative research methods. Quantitative research methods allow for the incorporation of larger sample sizes to further validate our findings. Yet, provided the nascent nature of BRM research, this might be more appropriate in the years to come.

7. References

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