A Tool for Analyzing Business Rules Management Solution Implementations

Sam Leewis
Digital Smart Services
HU University of Applied Sciences Utrecht
Utrecht, The Netherlands
sam.leewis@hu.nl

Koen Smit
Digital Smart Services
HU University of Applied Sciences Utrecht
Utrecht, The Netherlands
koen.smit@hu.nl

Martijn Zoet
Optimizing Knowledge-Intensive Business Processes
Zuyd University of Applied Sciences
Sittard, The Netherlands
martijn.zoet@zuyd.nl

***Abstract*— Evaluating an (implemented) Business Rules Management Solution (BRMS) is not a frequently conducted process within organizations. A tool is needed, which supports this process and supports future BRMS implementations. A literature study is conducted on the relevant building blocks of a BRMS. The results are validated through qualitative expert interviews. This resulted in the BRMS analysis tool that can be utilized to structure the analysis for one or multiple BRMS implementations. Next, the BRMS analysis tool is applied at 13 organizations that implemented a BRMS. The BRMS analysis tool provides the BRMS implementation stakeholders with a tool that structures, in a systematic and controlled way, that is capable to analyze a BRMS implementation for one or multiple organizations. This research contributes to structured and managed information which is important for better business and IT alignment. Furthermore, structured and managed information contributes towards the easier creation of a business case.**

Keywords-Business Rules Management; Business Rules Management Solution; Implementation; Analysis tool

I. INTRODUCTION

The increasing number of business rules, the pace at which the business rules change, the different types of business rules, the necessity to execute business rules consistently and being transparent towards external stakeholders produce many challenges for organizations [1][2]. A business rule is defined as ''*a statement that defines or constrains some aspect of the business. It is intended to assert business structure or to control or influence the behavior of the business.*'' [3]. A systematic and controlled approach is required to get a grip on these business rules, which is known as Business Rules Management (BRM) [4]–[6]. BRM is defined as "*a systematic, and controlled approach to get a grip on business decisions and business logic to support the Elicitation, Design, Specification, Verification, Validation, Deployment, Execution, Governance, and Monitoring of both business decisions and business logic."*[7]. The solution supporting implementing this method in a practical context is known as a Business Rules Management Solution (BRMS). A BRMS is a configuration of capabilities which supports the Elicitation, Design, Specification, Verification, Validation, Deployment, Execution, Monitoring, and Governance of business rules. Both the BRM System and BRMS support Business Rules Management as a method. A distinction is needed between a BRM System and a BRMS. A BRM System is ''*a set of software components for the Elicitation, Design, Specification, Verification, Validation, Deployment, Execution, Monitoring, and Governance of business rules*''[5]. The BRMS contains the BRM System as a whole together with the utilization of the capabilities (e.g., the processes, data models).

BRMS research is part of the IS research field. In the IS field it is not a habit to publish work on questionnaires or surveys, contrary to the alpha sciences where this is usually the case [8]–[10]. Publishing created and validated questionnaires shows a level of transparency and can thereby be utilized by other researchers for future research. Furthermore, the field of BRM lacks research focused on the organizational implementation of a BRMS and is more focused on the technical aspects of a BRMS implementation [1][11]. This research contributes to the knowledge on the organizational implementation of a BRMS by providing a tool that creates the possibility to structure, in a systematic and controlled way, the analysis of a BRMS implementation. The existing research focused on BRM maturity models is relatable towards BRMS implementations [11]–[13]. Therefore, it is not possible to structure data focused on analyzing a BRMS implementation. To utilize such data, it needs to be structured into information [14]. The BRMS analysis tool provides that structure. A BRMS implementation is more than only data and information; knowledge is an important element as well. Davenport and Prusak [15] state that: ''*Knowledge can and should be evaluated by the decisions or actions to which it leads*''. This research provides organizations with a tool that structures the data collection process on how to have the most optimal configuration of a BRMS for an organization with different specifications. The business rules and the Business Rules Management definition define ''structure'' as an important element when dealing with data and information, which is also supported by Davenport and Prusak's work on data and information [14]. The BRMS analysis tool provides

 ISBN: 978-1-61208-620-0

''*structure*'' in a ''*systematic*'' and ''*controlled*'' way when analyzing a BRMS implementation for one or multiple organizations.

Furthermore, the BRMS analysis tool provides organizations with the option to get to know more about the current or completed BRMS implementation, which can lead to the improvement of the current or possible future implementations.

Multiple problems exist in the BRM research field: 1) no structure in the data collection process on how to have the most optimal configuration of a BRM Solution for an organization given their characteristics, 2) no possibility exists to get to know more about the current or completed BRMS implementation, and 3) no tool exists which supports the gathering of cases used in situational artefact construction in the BRM field. The situational artifact construction technique requires an input of different situations for the creation of a situational artifact [16].

The remainder of the paper is structured as follows: First, the research methods that were utilized to create the BRMS analysis tool are discussed. Second, this is followed by the construction of the BRMS analysis tool, which was the result of a literature study. Subsequently, the BRMS analysis tool is validated through expert interviews and by utilizing the BRMS analysis tool on 13 organizations, distributed over the Dutch public and Dutch financial sector. Lastly, the conclusions are provided that can be drawn from the results, together with a critical view towards the used research methods and the results of this study followed by possible future research directions.

II. RESEARCH METHOD

In this research, structured interviews are utilized to gather BRMS implementation cases, focused on the specific configuration of the BRMS elements (the *what?*) and specific problems that the implementation of BRMS should solve (the *why?*). The BRMS analysis tool is constructed with the use a literature review, containing relevant building blocks of a BRMS and its implementation (building blocks are elements of which a BRMS consists of). The questionnaire is validated through expert interviews with experts from the BRM community. The experts are chosen on their experience and knowledge in the field of BRM and BRMS. The experts consisted of a professor lecturing and performing research in the field of BRM and BRMS (expert 1), a lecturer and PhD with practical and research experience in the field of BRM and BRMS (expert 2), and a master-student with 3 years of practical and research experience on BRMS capabilities (expert 3). All the interviews were conducted in a controlled environment and each interview had a length of around 90 minutes.

III. THE BRMS ANALYSIS TOOL CONSTRUCTION

The BRMS analysis tool [17] consists of the building blocks of a BRMS containing questions related to that specific building block. The following subsections contain literature supporting the construction BRMS building blocks. The upcoming subsections are referring to questions in the BRMS analysis tool by ''Q#''.

A. Organizational characteristics

The organization information section retrieves specific organizational characteristics and are identified as situational factors. These questions are focused on retrieving the sector, the number of employees, and the scope of the BRMS implementation of the organization. Q2 retrieves the number of employees of the organization at which the implementation is conducted. These number of employees could influence different implementation setups. Example: Organization A with <50 employees possibly needs a different setup of BRMS capabilities than Organization B with >5000 employees. The employee numbers are adopted from previous questionnaires conducted in comparable studies in other research fields [6][16]. Q3 intends to retrieve the organizational scope at which the BRMS implementation is conducted. Three main organizations scopes can be identified, which are: Application focused, Line of Business focused and Organization-wide. This is supported by the work of Nelson et al. [11], which showed the scoping from narrow (single application focused) and expanded to Line of Business focused and eventually to Organization-wide. This question intends to retrieve data about what the scope was of the BRMS implementation conducted by the organization.

B. Characterization of Business Rules Management

The characterization of BRM section (Q4) defines how and why organizations are using BRM and a BRMS. In other words, the benefits or advantages of a BRMS [1]–[3], [18], [19]. Similar questionnaires in other research fields also propose a characterization section and therefore, for this tool, this is also adopted [6][16].

C. Business Rules Management Solution Building Blocks

This section will contain the building blocks of a BRMS. Each building block correlates with one of the nine BRM capabilities, which are addressed in detail in the work of Smit and Zoet [5], and Zoet and Versendaal [6]. Each building block has a specific set of questions which are unique to each building block and thereby creating possible different BRMS configurations.

Elicitation

The elicitation capability determines the knowledge, which realizes the value proposition of the business rules. This knowledge needs to be captured from various sources including, but not limited to, laws and regulations. The second goal of the elicitation capability is to conduct an impact analysis. This is only performed when a business rule architecture is already in place [5], [20].

Q6 extracts what sources are used for the elicitation capability at a specific organization. For example, Subject-Experts (people), existing organization regulations and guidelines (documents), existing database data, or a

combination of the previously mentioned examples. Besides extracting what sources are used during elicitation retrieving if these sources are actually stored for possible future use is covered in Q7.

Q7 is focused on retrieving if this capability is actually used as it was intended to be used. The possibility exists that only data is extracted and nothing is done with the sources that are used for extracting data. Extra effort is needed when new business rules should be created because of the change in laws or regulations. The stored sources can be used for the type of analysis retrieved in Q8.

Q8 measures which type of analysis (source analysis and scenario analysis) is applied in the elicitation capability. Source analysis compares sources (e.g., parliament documents versus organization regulations) with each other, determines where the source is from and whether the source is reliable or not [20]. Scenario analysis is the development and comparison of possible business scenarios [20], [21]. A combination of both source and scenario analysis is also a possibility, also known as a hybrid.

Originally, impact analysis should be performed in the design capability. Nonetheless, the BRM experts state that, in practice, this is also performed in the elicitation capability (Q9). Impact analysis is conducted when there already is a business rule architecture in place [5], [20].

Design

The output of the design capability is the business rule architecture and contains a combination of context designs and derivation structures [5], [20].

Q10 is focused on retrieving if the 5 V's (value, velocity, volume, variety, and veracity) are taken into account when implementing the design capability. The Big Data five V's [22] are adopted and altered to the field of BRM. The BRM 5 V's depict the value, velocity, volume, variety, and veracity of a decision. Besides these five dimensions concerning decisions, good decision-making also depends on the assignment of specific and clear roles.

Rogers and Blenko [23] created the RAPID model to clarify the decision-making process (Q11). RAPID stands for Recommend, Agree, Perform, Input and Decide. Recommend, people carrying this role are responsible for gathering input, and proving the correct data to ensure a sensible decision in a correct and timely order. Agree, people in this role have the responsibility to state if the recommendation is good or not, respond with yes or no or, in other words, the so-called right to veto the recommendation. Perform, someone or multiple people have the responsibility of executing the decision, once the decision is made. Input, the role of input is consulted on the decision. Decision, the person in the deciding role is the formal decision maker.

Same as in the elicitation capability, Q12 is focused on retrieving if an impact analysis is conducted when there already is a business rule architecture in place. The impact analysis provides the organization with an overview of which artifacts within a business rules architecture are hit when a change or the addition of a new artifact occurs.

Specification

The specification capability specifies the content of each separate context design. [5], [20]. Specifying business rules in models is based on the idea that humans should not use a programming language to write code, but instead, should create models from which code is generated [24]. In this case (Q13), the business rules (and the underlying elements of the business rule) are specified with the use of models. An example of such a modeling language is the Decision Model and Notation (DMN) [25]. Specifying business rules in text is based on the premise that business rules are specified with the use of different types of languages. Any form of language ranges from programming code to natural language. In this case, the business rules are specified in any form of text. Examples of this are the Dutch language and Semantics of Business Vocabulary and Business Rules (SVBR) [26]. The language retrieved in Q13 is implemented in the rule engine. Q14 is focused on retrieving if the language used in the specification capability is implemented in the rules engine without any influence of a person, thereby ensuring that the language used in the capability only has one meaning. Therefore, being unambiguous.

Verification

The verification capability checks for semantic and syntax errors in the created business rule architecture [5], [27].

Semantic and syntax errors need to be detected to prevent future problems in the business rule architecture. This is supported by the IT Controls Automation Strategy of Tarantino [28] which shows in what degree the control system is automated. The IT Controls Automation Strategy is adopted by Smit, Zoet, and Versendaal [27] for the BRM field and therefore used in Q15 and measures the degree of automation of the verification capability. The matrix consists of four archetypes 1) manual - detection, 2) automatic - detection, 3) manual - prevention, and 4) automatic - prevention of verification errors in business decisions and business logic. Manual - detection is the element where employees manually check for possible errors and report back to the author of the business logic if any errors were found. Automatic - detection is the element that is defined as a system that checks the business logic after its creation and reports back in the form of a list of identified errors. Manual - prevention is the element that employees are always authoring business logic together with the author and manually intervene when an error is made, enforcing the business logic author to correct the error. Automatic - prevention is the element which is applied by the system, suggesting or enforcing certain behavior regarding the authoring of business logic to prevent errors.

 ISBN: 978-1-61208-620-0

Validation

The validation capability checks the value proposition for possible errors in its intended behavior [5], [27].

Q16 is focused on retrieving what type of validation (peer review, scenario validation, and source validation) is used in a certain BRMS configuration. Peer review is the validation of work by colleagues of similar expertise and competence to the authors of the work. In the case of peer review, a colleague (peer) checks if the artifacts are similar to its sources. When errors are identified that artifact is rejected and the capability cycle (elicitation, design, specification, and verification) starts from the beginning [27], the sequence depends on the identified error. Scenario validation is a validation method that uses hypothetical stories to support the tester through a test system or complex system. In the case of a BRMS, scenario validation makes use of all possible business scenarios. Source validation validates with the use of actual sources (laws and regulations) [27]. The types of validation are controlling on a specific set of quality attributes, different in each BRMS implementation, which are retrieved in Q17.

Q17 is focused on retrieving whether the validation capability controls with the following quality attributes in mind [29]: traceability, completeness, accuracy, and usability. Traceability is the ability to provide an audit trail of access to the business rule and of any changes made to the business rule. Traceability provides organizations with the ability to verify history, location, or the application of a business rule by means of documented identification. Completeness indicates which data (element) need to be registered regarding the objects within the process. Accuracy indicates the degree to which the stored data reflects the reality concerning an object, thereby describing the closeness of a measurement to the true value. Usability indicates the ease of use and learnability of the business rule. These four quality attributes are selected because of the relevance in the BRM field [19].

Deployment

The deployment capability transforms implementation-independent business rules to implementation-dependent executable business rules. The stakeholders of this capability can be both human and a system [1]. During that data collection phase no specific questions where identified for the deployment capability.

Execution

The execution capability processes and executes the Implementation-dependent rules that were transformed in the deployment capability. The realization of the added value is conducted by executing the business rules by (a combination of) information system or human actors [1].

Q18 is focused on retrieving if the principle of gaming is taken into consideration. Gaming gives the user of the system the possibility to generate any desired result by trial and error [30]. For example, a user working with a BRMS in the governmental sector needs a custom solution for a citizen, in this case, the result is more important than the way it is executed. Therefore, the user is ''gaming the system'' to generate the desired result. Gaming also has a negative side because the possibility exists that the user of the system is doing this for all the wrong reasons. Besides the possibility of ''gaming the system'' the execution capability can be configured to store input data, output data, and executed rules.

Q19 retrieves what specific data is stored during the execution. Stored data can be categorized in input data, output data, and executed rules. Input data is the data that is required to execute the business rules. Output data is the stored data and the outcome of the executed business rules.

Monitoring

The monitoring capability monitors the execution of the value proposition and the full range of activities part of the BRM capabilities that realize the value proposition [1].

Q20 is focused on retrieving what is being evaluated in the monitoring capability. The BRM Key Performance Indicators are adopted from the work of Smit and Zoet [5] to measure what is being evaluated in the monitoring capability. The unit of measurement used in the question is the frequency of the evaluation of the KPI's. For example, evaluation of the KPI's could be applied on a daily, monthly or yearly basis or a combination of such frequencies. The possibility exists that there are differences in the frequency of evaluation between sectors. The existing set of KPI's is limited because of the small sample size and the industry where it was focused on (public). The authors of the earlier mentioned work state that the government institutions are representative towards organizations implementing BRMS [5].

Governance

The governance capability contains three sub-capabilities: version management, validity management, and traceability management [3], [5].

Q23 is focused on retrieving which sub-capabilities (version management, validity management, and traceability management) of the governance capability are implemented during the BRMS implementation. The purpose of the version management capability is capturing and keeping track of elements which are created or modified in the other eight capabilities. The purpose of validity management is to create the possibility to provide a specific version of a value proposition at any given moment of time. The purpose of the traceability capability is to ensure the possibility to trace created elements to their corresponding laws and regulations. Furthermore, the traceability capability creates a foundation for impact analysis when, for example, new laws are needed to be processed into value propositions. Alternatively, a combination of the options mentioned above.

 ISBN: 978-1-61208-620-0

D. Leader of the capability

The business rules task/service model from [11] identifies three areas within a firm relevant when dealing with the responsibility of working with a BRMS: IT, Business and a Central IT/Business group. Q24 focusses on retrieving which area has the responsibility of a specific capability. The model provides high-level services, and functions focused on a BRMS as a whole. Focusing more on the capabilities of a BRMS, different responsibilities of capabilities connect with different areas. Often the technical-oriented capabilities of a BRMS are more IT related and management-oriented capabilities are more related to the Business.

E. Autonomy

Coming into the era of computer automatization, the possibilities are growing where computers take over some tasks or whole processes from humans [31]. The same is possible with some of the capabilities of a BRMS. Therefore, the question is asked what the level of autonomy of the machine within the confines of the implemented capability runs. Measuring the degree of autonomy can be performed with ten degrees of autonomy [31]. Q25 is focused on retrieving on what degree of autonomy the machine within the confines of the capability runs. The degree of autonomy ranges from level 1, the computer does not help, and humans must do everything, to level 10, the computer takes a decision independently without any intervention from humans.

IV. BRMS ANALYSIS TOOL VALIDATION

Validation is required to ensure the correctness of the created BRMS analysis tool. A selection is made from experts from the BRM community. The group of experts existed of a professor conducting research focused on utilizing BRM, a Ph.D. student conducting research in the BRM domain, and a master student with research and practical experience in the BRM domain. The interviews were focused on the completeness and the relatability to practice of the concepts, themes, and questions. All the elements of the questionnaire were discussed and validated on completeness and relatability in practice. The experts gave examples of what should be included in a questionnaire on implementing BRMSs. This resulted in comparable structure and content as compared to the BRMS analysis tool created out of literature. Elements adopted from comparable questionnaires which handle the same problem in a different research field were not mentioned during the expert interview. Nonetheless, these elements were still included in the BRMS analysis tool for the sole reason that previous work, conducted in this field, has proven useful [16], [32].

To further validate the BRMS analysis tool, a pilot test is conducted where the BRMS analysis tool is implemented at 13 organizations. This BRMS analysis tool aims at experts with experience in implementing BRMS. The groups consist of members distributed over a wide range organizations, mostly from the public and finance sector. An interview approach is used for the implementation of the BRMS analysis tool [33]. The data is gathered from different organizations distributed over the financial (n=6) and public sector (n=7). Employee ranges included 251 – 500 (n=2), 501 – 1000 (n=2), 2001 – 5000 (n=6), and >5000 (n=3). The implementation focus added an additional characterization of the BRMS implementation cases. The implementation focusses are divided into Application focus (n=3), Line of business-focused (n=4), and Organization-wide (n=6).

V. DISCUSSION AND CONCLUSIONS

The goal of this research is to create a tool that structures, in a systematic and controlled way, the data collection process on how to have the most optimal configuration of a BRMS for an organization with different specifications. Furthermore, the BRMS analysis tool provides organizations with the option to get to know more about the current or completed BRMS implementation. This can lead to the improvement of the current or possible future implementations. The BRMS analysis tool included important BRMS building blocks gathered from literature and expert opinion. The BRMS analysis tool is validated through expert interviews and implemented using a sample of 13 organizations distributed over the Dutch public and financial sector.

From a research point of view, this study provides a fundament for situational artifact construction in the BRM field and related fields. Gathering different implementations to eventually create a situational artifact is deemed as an important phase in situational artifact construction [16]. Furthermore, this study brings the building blocks of a BRMS implementation together in a BRMS analysis tool. From a practical perspective, this study provides organizations with a tool that structures, in a systematic and controlled way, the data collection process on different BRMS configurations an organization with different specifications.

Several limitations may affect the results of this study. The first limitation is the sample of the validation of the BRMS analysis tool. This sample is limited to three experts and to state with confidence that the elements included in the BRMS analysis tool are the only needed elements in such a technique, more experts need to be included for the validation of the BRMS analysis tool. The second limitation is that of the implementation of the BRMS analysis tool. The implementation is limited to only 13 organizations distributed over the public and financial sector. We believe that the public and financial organizations are representable towards other organizations, although additional organizations from other industries are recommended to increase the representability of the sample. Furthermore, the addition of new possible technologies could affect the completeness of the BRMS analysis tool, and continuous research is needed on the validity and relevance of the elements of the BRMS analysis tool.

REFERENCES

[1] J. Boyer and H. Mili, *Agile business rule*

 ISBN: 978-1-61208-620-0

development. Berlin, Heidelberg: Springer, 2011.

[2] I. Graham, *Business rules management and service oriented architecture a pattern language*, 1st ed. Hoboken, NJ: John Wiley & Sons, 2007.

[3] T. Morgan, *Business Rules and Information Systems : Aligning IT with Business Goals*. Boston, MA: Addison-Wesley, 2002.

[4] M. W. Blenko, M. C. Mankins, and P. Rogers, "The Decision-Driven Organization," *Harv. Bus. Rev.*, no. june, p. 10, 2010.

[5] K. Smit and M. Zoet, "Management control system for business rules management," *Int. J. Adv. Syst. Meas.*, vol. 9, no. 3, pp. 210–219, 2016.

[6] M. Zoet and J. Versendaal, "Business Rules Management Solutions Problem Space: Situational Factors," in *Pacific Asia Conference on Information Systems 2013 (PACIS)*, 2013, p. 247.

[7] K. Smit, M. Zoet, and M. Berkhout, "Functional Requirements for Business Rules Management Systems," *Twenty-third Am. Conf. Inf. Syst.*, pp. 1–10, 2017.

[8] P. J. Cooper, M. J. Taylor, Z. Cooper, and C. G. Fairburn, "The Development and Validation of the Body Shape Questionnaire The Development and Validation of the Body Shape Questionnaire," *Int. J. Eat. Disord.*, vol. 6, no. 4, pp. 485–494, 1987.

[9] L. R. Derogatis, K. Rickels, and a F. Rock, "The SCL-90 and the MMPI: a step in the validation of a new self-report scale.," *Br. J. Psychiatry*, vol. 128, pp. 280–289, 1976.

[10] T. J. Meyer, M. L. Miller, R. L. Metzger, and T. D. Borkovec, "Development and validation of the penn state worry questionnaire," *Behav. Res. Ther.*, vol. 28, no. 6, pp. 487–495, 1990.

[11] M. L. Nelson, J. Peterson, R. L. Rariden, and R. Sen, "Transitioning to a business rule management service model: Case studies from the property and casualty insurance industry," *Inf. Manag.*, vol. 47, no. 1, pp. 30–41, 2010.

[12] B. Von Halle and L. Goldberg, *The Business Rule Revolution*. Silicon Valley: Happy About, 2006.

[13] B. Von Halle and L. Goldberg, *The Decision Model: A business logic framework linking business and technology*. New York, NY: Taylor and Francis Group, LLC, 2009.

[14] T. Davenport and L. Prusak, *Working Knowledge*, 2nd ed. Brighton, MA: Harvard Business Review Press, 2000.

[15] T. Davenport and L. Prusak, "Working Knowledge How Organization Manage What They Know," *Harvard Bus. Sch. Press*, no. January 1998, p. 15, 1998.

[16] R. Winter, "Problem analysis for situational artefact construction in information systems," in *Emerging themes in information systems and organization studies*, Berlin: Springer, 2011, pp. 97–113.

[17] S. Leewis, K. Smit, M. Zoet, and M. Berkhout, "BRMS analysis tool," 2017. [Online]. Available: https://goo.gl/f9ems3.

[18] B. Von Halle, *Business Rules Applied — Business Better Systems Using the Business Rules Approach*. New York, NY: John Wiley & Sons, 2002.

[19] M. Zoet, *Methods and Concepts for Business Rules Management*. Utrecht: Hogeschool Utrecht, 2014.

[20] K. Smit, M. Zoet, and J. Versendaal, "Identifying Challenges In BRM Implementations Regarding The Elicitation, Design And Specification Capabilities At Governmental Institutions," in *Twenty-Fifth European Conference on Information Systems (ECIS)*, 2017, p. 14.

[21] D. A. Aaker, *Strategic market management*. Hoboken, NJ: John Wiley & Sons, 2008.

[22] A. McAfee and E. Brynjolfsson, "Big Data. The management revolution," *Harvard Buiness Rev.*, vol. 90, no. 10, pp. 61–68, 2012.

[23] P. Rogers and M. Blenko, "Who Has the D?," *Harv. Bus. Rev.*, vol. 84, no. 1, pp. 52–61, 2006.

[24] L. Bass, P. Clements, and R. Kazman, *Software architecture in practice*, 3rd ed. Boston, MA: Addison-Wesley, 2012.

[25] Object Management Group, "Decision Model and Notation," 2014.

[26] Object Management Group, "Semantics of Business Vocabulary and Business Rules," 2013.

[27] K. Smit, M. Zoet, and J. Versendaal, "Identifying challenges in BRM implementations regarding the verification and validation," in *Twenty First Pacific Asia Conference on Information Systems*, 2017, p. 4.

[28] A. Tarantino, *Governance, risk, and compliance handbook: technology, finance, environmental, and international guidance and best practices*. Hoboken, NJ: John Wiley & Sons, 2008.

[29] A. Rula, A. Maurino, and C. Batini, *Data and Information Quality: Dimensions, Principles and Techniques*, 1st ed. New York, NY: Springer, 2016.

[30] G. Bevan and C. Hood, "What's measured is what matters: Targets and gaming in the English public health care system," *Public Adm.*, vol. 84, no. 3, pp. 517–538, 2006.

[31] R. Parasuraman, T. B. Sheridan, and C. D. Wickens, "A model for types and levels of human interaction with automation.," *IEEE Trans. Syst. Man. Cybern. A Syst. Hum.*, vol. 30, no. 3, pp. 286–297, 2000.

[32] T. Bucher and R. Winter, "Taxonomy of business process management approaches," in *Handbook on Business Process Management*, New York, NY: Springer, 2010, pp. 93–114.

[33] P. R. Newsted, S. L. Huff, and M. C. Munro, "Survey Instruments in Information Systems," *MIS Q.*, vol. 22, no. 4, p. 553, 1998.

 ISBN: 978-1-61208-620-0