

Data governance capabilities

Citation for published version (APA):

Merkus, J., Helms, R. W., & Kusters, R. J. (2023). Data governance capabilities: empirical validation in case studies of large organisations. In A. Pucihar, M. K. Borštnar, R. Bons, G. Ongena, M. Heikkilä, & D. Vidmar (Eds.), *36th Bled eConference Digital Economy and Society: The Balancing Act for Digital Innovation in Times of Instability* (1 ed., pp. 35-48). University of Maribor Press. <https://doi.org/10.18690/um.fov.4.2023>

DOI:

[10.18690/um.fov.4.2023](https://doi.org/10.18690/um.fov.4.2023)

Document status and date:

Published: 01/06/2023

Document Version:

Publisher's PDF, also known as Version of record

Document license:

Unspecified

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

<https://www.ou.nl/taverne-agreement>

Take down policy

If you believe that this document breaches copyright please contact us at:

pure-support@ou.nl

providing details and we will investigate your claim.

Downloaded from <https://research.ou.nl/> on date: 16 Jul. 2023

Open Universiteit
www.ou.nl



DATA GOVERNANCE CAPABILITIES; EMPIRICAL VALIDATION IN CASE STUDIES OF LARGE ORGANISATIONS

JAN R. MERKUS, REMKO W. HELMS, ROB J. KUSTERS

Open Universiteit, Faculty of Science, Dept of Information Science, Heerlen,
Netherlands
jan.merkus@ou.nl, remko.helms@ou.nl, rob.kusters@ou.nl

The exponential growth of data within organisations necessitates the implementation of effective data management practices, which in turn necessitates the establishment of data governance. The evaluation of the maturity of data governance can be carried out using maturity models. However, the existing data governance maturity models are limited in their consistency in terms of data governance capabilities used and lack empirical validation. To address this gap, this study aims to validate the set of data governance capabilities identified in prior research within large organisations. This study employs a case study research design, using semi-structured interviews with experts in data governance. As a basis for the semi-structured interviews, maturity models are designed as questionnaires to discuss the relevance of each data governance capability. The results of this study provide empirical validation of the set of data governance capabilities and contribute to the advancement of both data governance research and practice by providing a comprehensive, validated set of data governance capabilities for maturity model design to advance data governance within and between organisations.

Keywords:

data
governance
capabilities,
empirical
validation,
maturity
model



University of Maribor Press

DOI <https://doi.org/10.18690/um.fov.4.2023.3>
ISBN 978-961-286-751-5

1 Introduction

The growing amount of data in organisations, due to the increasing digitization of processes, necessitates the implementation of proper data management (Weber et al., 2008). Data governance (DG) must be established to ensure proper data management. DG is defined as “*establishing management of data in an organisation assuring quality and access during its life-cycle to be accountable for data assets*” (J. Merkus et al., 2019). Maturity models, which are used to measure and improve organisational performance in various application areas (Rosemann et al., 2004; a. van Looy et al., 2011), aid in implementing DG.

Maturity models are based on organisational capabilities, which are the collective abilities of an organisation to carry out business processes that contribute to its performance (Brennan et al., 2018; J. R. Merkus et al., 2020). These capabilities are used to measure organisational maturity by evaluating organisational activities against staged levels of maturity (Becker et al., 2009; J. R. Merkus et al., 2020, 2021; Paulk et al., 1993). Maturity models can also focus on specific capabilities like for instance data governance. Hence, Data Governance Capabilities (DGCs) can be used to measure DG maturity (Merkus et al., 2021).

Research on Data Governance Maturity Models (DGMMs) has identified several sets of DGCs for maturity model design (J. R. Merkus et al., 2021; Olaitan et al., 2019; Permana & Suroso, 2018). However, the DGCs used in existing DGMMs are inconsistent, resulting in different sets of DGCs for each DGMM in the literature (Heredia-Vizcaíno & Nieto, 2019; Permana & Suroso, 2018; Rivera et al., 2017). Furthermore, only a few DGMMs have been validated in practice, and, when validated, they only did so in a single or small organisations (J. R. Merkus et al., 2020; Olaitan et al., 2019; Permana & Suroso, 2018; Rivera et al., 2017). Thus, there is a need for a more comprehensive DGC model validated in practice (J. R. Merkus et al., 2021).

To address this gap, we aim to empirically validate the set of 34 DGCs that we developed in our earlier, theoretical study. That study used a systematic literature review to identify DGCs from a broad range of literature (J. R. Merkus et al., 2020). However, the resulting set of DGCs was based solely on literature and requires proper validation in practice. Therefore our research question is: *To what extent*

are the Data Governance Capabilities for Maturity Model design valid in practice?

This paper provides new knowledge through the empirical validation of the previously proposed set of DGCs, resulting in a set of DGCs that can serve as a reference for other studies in the area of Data Governance. The practical significance of this research lies in the contribution of a more comprehensive and validated set of DGCs that can serve as to assess the status quo of DG in organisations more accurately e.g. as the basis for a DG maturity model. Validated DGCs also enable more precise benchmarking with other organisations.

The remainder of this paper is structured as follows. The literature review on DGMM and DGC is presented in section 2. Then in section 3, we present our research methodology to validate our DGCs, followed by the validation results in section 4. Finally, the conclusions are presented in section 5.

2 Background

This section provides a theoretical foundation for our research. First, we define the concept of DG capabilities and subcapabilities as the cornerstone of our study. Second, we identify a gap in the literature regarding the validation of existing DGCs. Third, we present the set of DGCs we developed in an earlier study and will be validated in this research.

DG Capabilities (DGCs) encompass an organisation's collective abilities to govern data assets effectively (Brennan et al., 2018; J. Merkus et al., 2019). A DGC indicates what an organisation is capable of doing concerning specific DG activities. For example, the DGC *establish data stewardship* describes an organisations ability to set up data stewardship functions. Subsequently, each DGC can be broken down into subcapabilities, a term also used by other authors (Bandara et al., n.d.). The term subcapability refers to a set of subdimensional capabilities that specifies in more detail what makes up the capability dimension.

DGCs are used in Data Governance Maturity Models (DGMM) to measure the maturity of data governance in an organisation (J. R. Merkus et al., 2021; Rosemann et al., 2004; a. van Looy et al., 2011; A. van Looy et al., 2011). To date, only a few

peer-reviewed DGMMs have been developed, with widely differing sets of DGCs selected as the basis for each model (Dasgupta et al., 2019; Heredia-Vizcaíno & Nieto, 2019; Olaitan et al., 2019; Permana & Suroso, 2018; Rivera et al., 2017). Nevertheless, there are also common DGCs in these models and the most common DGCs are: establishing policies, principles, and procedures and managing metadata. The other DGCs used vary widely and some DGCs have been used in one DGMM only. Based on this, one can conclude that there is a lack of agreement amongst researchers on a single set of DGCs. This is further illustrated by comparing existing sets of DGCs from different DGMMs, as presented in Table 1.

Despite recent progress in DG research, which has focused on DG mechanisms and DG activities between organisations, the validation of these mechanisms, activities and the capabilities to execute them is still lacking (Abraham et al., 2019; Jagals et al., 2021; Lis & Otto, 2021). A limited number of researchers have identified certain principles, activities, and critical success factors for Data Governance (DG) as Data Governance Capabilities (DGCs) (Alhassan et al., 2016, 2018, 2019). These DGCs have been validated in a few individual case studies. Other researchers have discovered DGCs as mechanisms from DG-related research area of information technology governance, aimed at planning and controlling data management activities (Abraham et al., 2019). However, these mechanisms are yet to be validated in practical settings. Recently, DG research has outlined DG activities that take place between organizations (Lis & Otto, 2021). However, the execution of these activities and the capabilities required to carry them out need to be empirically validated in practice. So, although some DGCs have been identified by recent DG research, the empirical validation of these DGCs is still limited.

In previous research, we have identified an extensive set of DGCs based on a systematic literature review (J. R. Merkus et al., 2021). Table 1 provides an overview of this set of DGCs and compares it with the DGCs that have been identified/used in other research. The vertical axis in Table 1 lists the 34 DGCs we identified in earlier research. On the horizontal axis, the existing DGMMs are mentioned. Hence, the cells in Table 1 show the mapping of the DGMMs from the literature with our set of DGCs. Green cells indicate that the DGCs in the literature are validated, and orange cells indicate those DGCs that are not validated. An empty cell means that our DGC is not found in the DGMM found in the literature. The comparison demonstrates that existing DGMMs use different sets of DGCs and none of the

DGMMs is as exhaustive as our list of DGCs. Furthermore, table 1 also illustrates the majority of these DGCs have yet to undergo empirical validation. This study aims to empirically validate the comprehensive set of 34 DGCs within large organisations. The research method applied for the validation of the DGCs is presented in the next section.

Table 1: DGMM capability sets comparison (Merkus et al., 2021)

Data Governance Capabilities Merkus et al.	Rifae 2009	Rivera 2017	Permana 2018	Dasgupta 2019	Heredia 2019	Olatun 2019
2021	2009	2017	2018	2019	2019	2019
Establish Leadership						
Establish & manage Communicate						
Establish & manage Train						
Establish & manage culture						
Establish & manage awareness						
Quantify data value						
Align with the business						
Formulate data strategy						
Make business case						
Set goals & objectives						
Establish accountability						
Establish decision making authority						
Establish committees						
Establish roles & responsibilities						
Establish data stewardship						
Establish policies, principles & procedures						
Establish KPI's						
Establish performance management						
Establish Monitoring						
Establish Auditing						
Manage processes						
Manage organisation						
Manage data						
Manage metadata						
Manage risk						
Manage issues						
Establish & manage DG tools						
Establish & manage security & privacy						
Establish & manage Data Technology						
Organize people						
Align & integrate data						
Contract data sharing agreements						
Comply with regulations						
Government						

	Validated in practice
	Not validated in practice

3 Method

To empirically validate the DGCs for relevance, we have selected the case study strategy as our research approach. According to Yin (2014), a case study is "an empirical method that investigates a contemporary phenomenon (the case) in-depth and within its real-world context." Using the case study approach enabled us to identify DG activities in practice (practices) that make up each of the 34 DG capabilities we derived from the literature and hence to validate the capabilities. Furthermore, other researchers in our field recommend using case studies with expert interviews to design and evaluate capability models (Legner et al., 2020).

Since validation of a single capability takes considerable time. It was decided to divide the DGCs among a group of researchers that used different organizations as case studies. The case organisations were found using convenience-based sampling, i.e. organisations in the networks of the researcher. However, each organisation should have at least 500 employees and there should be a need for data governance to participate in the research.

Semi-structured expert interviews were used as the main method for data collection. The interviewees were DG experts, which are individuals with at least five years of experience in DG, data management, or similar positions. To structure and compare the results of the interviews, pre-defined questionnaires were used, allowing open-ended questions to facilitate in-depth discussions.

To further facilitate the interview process, Maturity Models (MMs) were developed for each DGC by means of a scoping literature review. The aim of the literature review was to identify the subcapabilities of each DGC, which will form the basis of a DGC-specific MM (Munn et al., 2018). The resulting MMs have been used during the interviews to uncover DG practices, or reveal new DGCs, and thus provide experience-based information to support the validation of the DGCs. We validated each subcapability by an expert's work experience with DG practices in large organisation. By validating each subcapability, we validate the overarching DGC of which subcapabilities are part of.

Finally, all empirically validated DG subcapabilities were categorised using a card sorting approach with applying the Metaplan technique (Howard, 1994; Spencer & Warfel, 2004). Using the original set of 34 DGCs as a reference, we eliminated any misconceptions that may have arisen during the scoping literature reviews. Furthermore, it helped to reveal new DGCs and hence to enrich the set of DGCs from literature with DGCs found in practice.

4 Results

A total of 16 researchers each conducted a study of one or two DGCs in 19 large organisations over the course of a five-year period. Initially, each researcher conducted a scoping literature review to identify the relevant subcapabilities for DGCs. Examples of subcapabilities found for DGC *Align and integrate external data* are (1) interaction and cooperation processes management, (2) Standardise data exchange, (3) Policies for data integration and use, (4) Data provider management, and (5) improve customer satisfaction. Next, each researcher designed an MM for their DGCs using the same design methodology and five stages of maturity levels, yielding 16 distinct MMs (Becker et al., 2009; Rosemann et al., 2004). Thirdly, three to five respondents were interviewed for the validation of each DGC, generating 70 expert interview reports, with an average interview duration of approximately two hours and up to four hours in some cases. These reports provide the basis for the validation of all DG capabilities. The interview reports are accessible from the author.

The participating organisations all employ more than 500 employees, reflecting the need for governance awareness in such large organisations. Additionally, the participating organisations represent a diverse range of business sectors, allowing for the measurement of the DGCs and DG in various business activities, and operate at various geographical scales, as indicated in Table 2 *Case organisations*.

Table 2: Case organisations

Sector \ Scale	International	National	Regional	Total
Bank	1			1
Bio industry	2			2
Education			2	2
Energy		1	1	2
Government		4		4
Insurance	1	1		2
Manufacturing	1	1		2
Retail		1		1
Wholesale	2			2
Union		1		1
Total	7	9	3	19

Additionally, DG jobs were scarce ten years ago as the field of DG only began to gain recognition in 2007 (Otto et al., 2007). As a result, some interviewed experts gained relevant experience in DG-related employment, such as data management. Despite these pragmatic adjustments, our research was carried out in accordance with the previously described methodology.

In a peer-led card sorting exercise, we categorized all 231 subcapabilities derived from the 16 substudies using the Metaplan technique described in the methodology section. To eliminate misconceptions for more unambiguous language, we reclassified 47 subcapabilities to other existing DGCs as they fit better with those DGCs. Our analysis revealed no duplicates among the subcapabilities, but six subcapabilities had to be redefined to better differentiate them from each other. Additionally, the researchers identified ten suggestions for new subcapabilities and one suggestion for a new DGC during their substudies. Card sorting revealed that all eleven suggestions were addressed in one of the other substudies. So, no additional new (sub-)capabilities were identified.

The validation of the DGCs in interviews, along with a subsequent hybrid card sorting exercise, resulted in the outcomes depicted in Table 3 *DGC validation results*. This table lists in column 1 all 34 DGCs in the DGC model, sorted according to Table 1. Column 2 lists the number of DG subcapabilities per DGC. Column 3 lists the number of case organisations where the subcapabilities have been validated. Column 4 lists the number of interviews in which a DG subcapability has been discussed. Column 5 lists the number of DG practices per DG subcapability noted during the interviews.

We empirically validated each subcapability by (a) having the researchers registered a DG expert's experience and reasoning of a DG practice happening in the organisation of his employer by the researchers during the interviews, (b) having the author analyse the transcripts of the interviews for DG practices and reasoning for each subcapability after the interviews, and (c) finally, having the author discuss the findings with the peer authors. This resulted in a database of DG practices, including their reasoning when known, sorted per subcapability and the overarching DGC. So, when a DG practice occurred in a large case organisation and already one relevant DG practice was registered, the number of practices is irrelevant because we conducted qualitative research, the subcapability is empirically validated, hence empirically validating its overarching DGC.

For example, for DGC *Manage Metadata*, we revealed three subcapabilities from literature; metadata, metadata management, and data standards. Next, we validated these three subcapabilities in the form of a maturity model in three different, large case organisations during 16 interviews with one DG expert each. During those interviews, the researchers noted eight different DG practices. Examples of the DG practices for each subcapability are a.o. (a) the presence of a data dictionary, or (b) business definitions being aligned with technical data definitions by data lineage, (c) or metadata management being administered in a central system. The reasoning we found for each subcapability is resp. (a) a data dictionary is needed to integrate processes, mutually understand what data means and align data between departments, legal requirements, and internal control reasons, and (b) integration of departments and divisions but also classification for privacy (c) to run queries. Consequently, these three DG practices validate the three subcapabilities, hence validating the DGC *Managing metadata*.

Our overall research results show that each of the 34 DGCs has been validated by at least one practice, but most DGCs are validated by many more DG practices. All 34 DGCs are validated by a total 840 DG practices.

Table 3: DGCs validation results

DG Capabilities	# DG	validated in #	discussed in #	# DG practices
	Subcapabilitie	Cases	interviews	
Establish Leadership	1	1	3	3
Establish & manage culture	4	3	13	15
Establish & manage awareness	4	4	10	15
Establish & manage Train	8	3	14	36
Establish & manage Communicate	13	7	23	44
Specify data value	19	6	24	53
Set goals & objectives	6	3	11	20
Make business case	1	1	3	3
Formulate data strategy	4	4	12	13
Align with the business	14	8	24	44
Establish roles & responsibilities	13	8	24	53
Establish policies, principles, procedures	11	7	31	51
Establish performance management	3	1	5	15
Establish Monitoring	1	1	3	4
Establish KPI's	1	1	3	2
Establish decision making authority	10	8	24	35
Establish data stewardship	5	3	13	28
Establish committees	1	1	3	4
Establish Auditing	7	4	18	23
Establish accountability	1	1	5	3
Manage risk	8	6	26	36
Manage processes + lifecycle	14	6	24	43
Manage organisation	7	3	11	23
Manage metadata	3	3	16	8
Manage issues	1	1	3	4
Manage data	20	5	19	74
Setup security & privacy	11	4	18	45
Setup IT	8	5	21	24
Setup DG tools	1	1	3	1
Organize people	9	3	11	23
Contract data sharing agreements	7	2	5	34
Align & integrate data	5	5	16	21
Comply with regulations	9	6	28	36
Establish environmental response	1	1	3	4
	231			840

Significantly, the majority of 26 out of 34 DGCs have been validated with sometimes many subcapabilities and even more DG practices. The much higher number of expert DG practices in column five #DG practices is caused by the number of three to five experts being interviewed per subcapability. And although not all experts recognized each subcapability in practice, each subcapability was validated (sometimes by many experts). The many different subcapabilities in column four #DG Subcapabilities are the result of the separately conducted literature reviews. However, nine DGCs were validated by only one relevant subcapability. Based on our overall research results, we conclude that all 34 DGCs found in literature are valid in practice. Furthermore, we did not identify any new DGCs, as the new DGCs suggested in interviews were already covered by the existing DGCs. This does not imply it can be used as a normative model that is fully applicable in all situations. Local context may impact this. But it can be used as a reference providing helpful suggestions for an individual organisation.

5 Discussions, Limitations & Conclusions

Our findings reveal the following remarkable outcomes, thereby adding new knowledge. First, the existence in the practice of large organisations of certain new DGCs which we predicted earlier based on our theoretical DGC model in Table 1 (J. R. Merkus et al., 2021). Moreover, the findings of this study align with the capability groups and clusters in that DGC model, and further validate several previously unknown capability groups such as Leadership, Culture, Communication, and Value Chain, with substantial evidence. Remarkably, none of the 17 substudies did identify any new DGCs in practice, confirming the comprehensiveness of our theoretical DGC model.

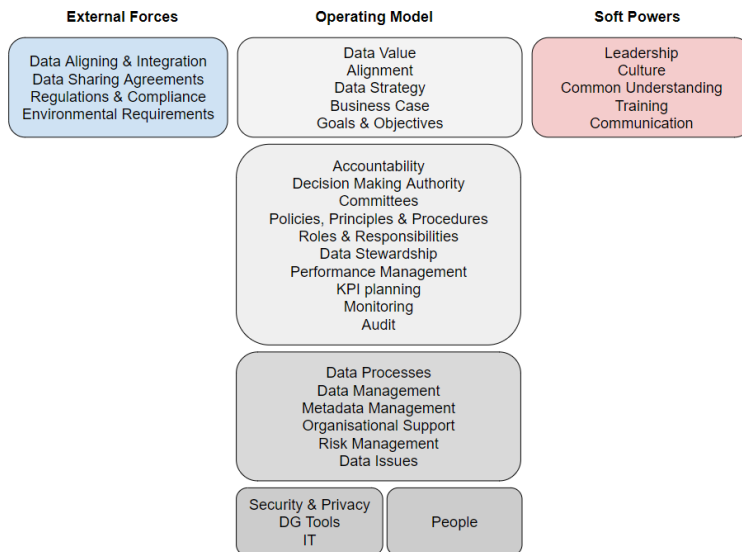
Second, the DGCs from previously unvalidated DGMMs present in literature have been subject to validation too. The results of our research have validated these DG capabilities with empirical evidence from practice. So, our research confirms the validity of the few existing, empirically unvalidated DGMMs in literature too.

Third, framing our research results against the DGC model from Table 1 results in the DGC T-model as reflected in Figure 1 *Data Governance Capabilities T-model* (J. R. Merkus et al., 2021). This model reflects the 34 DGC concepts which make up DG according to our findings. In addition, Figure 1 groups the DGC concepts in a T-shaped model according to the Generic Capabilities Reference model from our earlier research, and with a division of the DGCs into more strategic, tactical, and operational groups according to an organisational chart (J. Merkus et al., 2020; Mintzberg, 1980).

Given the limitations of our study, we have identified some shortcomings. Firstly, the internal validity of our research was improved through the use of case study methodology, and construct validity was strengthened through the scrupulous administration of the results from semi-structured questionnaires. However, each DGC was validated separately and the entire set of DGCS was not validated as a whole. And although the DGCs were selected using a reference model, the underlying concepts of each DGC are based on literature, and each DGC has been validated individually with practical evidence, the internal validity of the set of 34 DGCs as a whole could be improved in further research. Secondly, the external validity of the results could be enhanced, even though the DGCs have been validated

in various organisations. Therefore, further research to validate the set of DGCs as a whole is necessary, with case studies as a suitable research strategy again.

Figure 1 Data Governance Capabilities T-model



In conclusion, we can deduce from the results of our study that all the known DGCs from literature have been validated in practice. Furthermore, no other DGCs were discovered during the empirical validation, which suggests that, although a claim for completeness can never be proven, at least the most relevant capabilities have been identified.

This set of DGCs can be used as a reference to construct a locally relevant measure or benchmark for DG e.g. a DGMM. The theoretical implication is that our research adds new knowledge with the empirically validated comprehensive set of 34 DGCs. Further research could focus on the empirical validation of this set of DGCs as a whole.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgments

The case studies for this research were conducted by the following researchers (in alphabetical order): F.Alberts MSc, J.Amghar MSc, F.Badloe MSc, R. van den Bos MSc, J.G.Boomgaarden MSc, H.Breunissen MSc, S.Cerimovic MSc, Ö.Karaca MSc, P.Kroos-Kerpershoek MSc, S.Martin MSc, M.Meijer MSc, M.van Sambeek MSc, J.Soukhou MSc, J.Standhart MSc, M.Veenstra MSc, K.Wouters MSc.

Paragraphs were submitted to AI-based translators Grammarly, DeepL and ChatGPT for language improvement only. No content was added by the tools.

References

- Abraham, R., Schneider, J., & Brocke, J. vom. (2019). Data Governance : A conceptual framework , structured review , and research agenda. *International Journal of Information Management (IJIM)*, 49(December 2019), 424–438.
- Alhassan, I., Sammon, D., & Daly, M. (2016). Data governance activities: an analysis of the literature. *Journal of Decision Systems*, 25(S1), 64–75.
- Alhassan, I., Sammon, D., & Daly, M. (2018). Data governance activities: a comparison between scientific and practice-oriented literature. *Journal of Enterprise Information Management*, Vol 31(2), 300–316.
- Alhassan, I., Sammon, D., & Daly, M. (2019). Critical Success Factors for Data Governance: A Theory Building Approach. *Information Systems Management*, 36(2), 98–110.
- Bandara, W., van Looy, A., Merideth, J. C., & Meyers, L. (2020). Holistic Guidelines for Selecting and Adapting BPM Maturity Models (BPM MMs). In D. Fahland, C. Ghidini, J. Becker, & M. Dumas (Eds.), *Business Process Management Forum: BPM Forum 2020 Proceedings* (pp. 263–278). Springer.
- Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). Developing Maturity Models for IT Management – A Procedure Model and its Application. *Business & Information Systems Engineering*, 1(3), 213–222.
- Brennan, R., Attard, J., & Helfert, M. (2018). Management of data value chains, a value monitoring capability maturity model. *ICEIS 2018 - Proceedings of the 20th International Conference on Enterprise Information Systems*, 2(January), 573–584.
- Dasgupta, A., Gill, A., & Hussain, F. (2019). A conceptual framework for data governance in IoT-enabled digital IS ecosystems. In *Proceedings of the 8th International Conference on Data Science, Technology and Applications (DATA 2019)*, Data, 209–216.
- Heredia-Vizcaíno, D., & Nieto, W. (2019). A Governing Framework for Data-Driven Small Organizations in Colombia. In Á. Rocha, H. Adeli, L. Reis, & S. Costanzo (Eds.), *New Knowledge in Information Systems and Technologies. WorldCIST'19 2019. Advances in Intelligent Systems and Computing* (Vol. 930, Issue 1, pp. 622–629). Springer.
- Howard, M. S. (1994). Quality of Group Decision Support Systems: a comparison between GDSS and traditional group approaches for decision tasks. *Technical University Eindhoven*.
- Jagals, M., Karger, E., & Ahlemann, F. (2021). Already grown-up or still in puberty? A bibliometric review of 16 years of data governance research. *Corporate Ownership & Control*, 19(1), 105–120.
- Legner, C., Pentek, T., & Otto, B. (2020). Accumulating design knowledge with reference models: Insights from 12 years' research into data management. *Journal of the Association for Information Systems*, 21(3), 735–770.
- Lis, D., & Otto, B. (2021). Towards a Taxonomy of Ecosystem Data Governance. In *Proceedings of the 54th Hawaii International Conference on System Sciences (HICSS 2021)*, 6067–6076.

- Merkus, J., Helms, R. W., & Kusters, R. J. (2019). Data Governance and Information Governance : Set of Definitions in Relation to Data and Information as Part of DIKW. ICEIS 2019 - Proceedings of the 21th International Conference on Enterprise Information Systems, 12.
- Merkus, J. R., Helms, R. W., & Kusters, R. J. (2020). Reference Model For Generic Capabilities In Maturity Models. In Proceedings of the 2020 12th International Conference on Information Management and Engineering (ICIME 2020), 10–17.
- Merkus, J. R., Helms, R. W., & Kusters, R. J. (2021). Data Governance Capabilities; Maturity Model design with Generic Capabilities Reference Model. In Proceedings of the 13th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (KMIS 2021), 102–109.
- Mintzberg, H. (1980). Structure in 5's: A Synthesis of the Research on Organization Design. *Management Science*, 26(3), 322–341.
- Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18(1), 1–7.
- Olaitan, O., Herselman, M., & Wayi, N. (2019). A Data Governance Maturity Evaluation Model for government departments of the Eastern Cape province, South Africa. *South African Journal of Information Management*, 21(1), 1–12.
- Otto, B., Wende, K., Schmidt, A., & Osl, P. (2007). Towards a Framework for Corporate Data Quality Management. In Proceedings of 18th Australasian Conference on Information Systems (ACIS 2007), Dec 2007, 916–926.
- Paulk, M. C., Curtis, B., Chrissis, M. B., & Weber, C. V. (1993). wrong The capability maturity model for software. In *Software Process Improvement*.
- Permana, R. I., & Suroso, J. S. (2018). Data Governance Maturity Assessment at PT. XYZ. Case Study: Data Management Division. In Proceedings of 2018 International Conference on Information Management and Technology (ICIMTech 2018), 15–20.
- Rivera, S., Loarte, N., Raymundo, C., & Dominguez, F. (2017). Data Governance Maturity Model for Micro Financial Organizations in Peru. In Proceedings of the 19th International Conference on Enterprise Information Systems (ICEIS 2017), 203–214.
- Rosemann, M., de Bruin, T., & Hueffner, T. (2004). A Model for Business Process Management Maturity. In Proceedings of 15th Australasian Conference on Information Systems (ACIS 2004), Paper 6, 1–7.
- Spencer, D., & Warfel, T. (2004). Card sorting: a definitive guide. In *Boxes and arrows* (p. 2). <http://www.iimagineservicedesign.com/wp-content/uploads/2015/07/Card-sorting-a-definitive-guide-«Boxes-and-Arrows.pdf>
- van Looy, a., de Backer, M., & Poels, G. (2011). Questioning the Design of Business Process Maturity Models. In Proceedings of the 6th SIKS Conference on Enterprise Information Systems, 51–60.
- van Looy, A., de Backer, M., & Poels, G. (2011). Defining business process maturity. A journey towards excellence. *Total Quality Management and Business Excellence*, 22(11), 1119–1137.
- Weber, K., Cheong, L., Otto, B., & Chang, V. (2008). Organising Accountabilities for Data Quality Management-A Data Governance Case Study. *Data Warehousing*, 347–362.