DOI: 10.47743/eufire-2024-1-26

# OPTIMIZATION OF MASTER DATA MANAGEMENT: A MATURITY MODEL

**MATTHIAS SCHMUCK**
*Alexandru Ioan Cuza University din Iasi*
*Iasi, Romania*
*rsrch@bid-intelligence.com*

**Abstract**
*Master data management forms the foundation for the success of modern organizations by ensuring the quality, consistency and availability of data. Determining the maturity level of this management system is crucial to identify weaknesses and potential for improvement. This study presents a model for assessing the maturity of master data management because of analysing previous research findings on maturity models in general, master data management maturity models in particular, data governance and practical experiences. The proposed model provides a comprehensive assessment framework according to which various aspects of master data management can be analysed and evaluated to identify the current state and potential development paths. It provides a tool to gain insights into best practices and challenges that organizations should consider when optimizing their master data management. Furthermore, the results serve as a basis for further research. The aim is to construct an artifact for measuring the success of master data management that is influenced by data governance experiences.*
**Keywords:** *data management; data governance; maturity assessment.*
**JEL Classification***:* C80, O10, O25, O33.

## 1. INTRODUCTION

In the era of digital innovation and data-driven decision-making, Master Data Management (MDM) is becoming increasingly important for organizations of all sizes and industries. Master Data (MD) is the backbone of any organization, it is the digital DNA (BearingPoint, 2016) as it contains essential information about customers, products, suppliers and other business partners. Effective MDM is crucial for ensuring data quality, consistency and availability in MD, which in turn forms the basis for sound analysis, operational (process) efficiency and strategic decision-making. A scientometric analysis of research has shown that this topic has not only come into the spotlight due to the increasing digital transformation of recent years, MDM has been part of operational data management (DM) ever since information technology (IT) has been used in operational organizations.

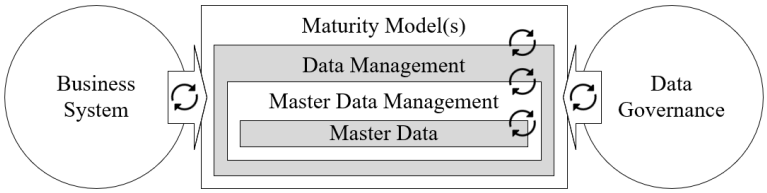
Determining the maturity level of MDM is a critical step for organizations to understand their current capabilities and identify potential areas for improvement. A higher level of MDM maturity is typically associated with better utilization of data resources, increased business agility and an improved customer experience. It is therefore crucial to gain a comprehensive insight into the current state of MDM and define a clear roadmap for its further development.

This study presents a model for measuring the maturity level of MDM. It is the result of an analysis of previous maturity models in DM and MDM as well as findings from ongoing research on data governance (DG) and practical experience. The researcher was guided by the following questions: (RQ1) What is understood by the maturity level in general and in the focus of DM in general and MDM in particular? (RQ2) Are there reference models for measuring maturity in MDM, and if so, what are they? (RQ3) Which elements provide the basis for maturity measurement in MDM?

The study follows the classic structure of scientific studies. First, the theoretical background is discussed (section 2). This is followed by a presentation of the methodology and the material used (section 3), a description of the model development (section 4) and model evaluation (section 5). The paper concludes with a summary and thoughts on future research.

## 2. THEORETICAL BACKGROUND

The researcher will begin by introducing key concepts using a theoretical framework (Figure 1).




Source: contribution of the author

**Figure 11. Theoretical framework**

A BS is an open, goal-oriented and socio-technical system (Ferstl and Sinz, 2012; Benker and Jürck, 2016). It is open because they interact with their (relevant) environment via communication and performance relationships (= behaviour of BS). In doing so, an BS is guided by defined goals and objectives. The tasks of a BS are performed jointly by humans (labour) and machines; in their interaction, they form a socio-technical system (= structure of BS). These characteristics influence the DM or MDM and thus the maturity level determination in a cybernetic sense.

The Data Governance Institute provides a useful definition for this article: Data governance is a system of decision-making rights and responsibilities for information-related processes that are executed according to agreed models that describe who can perform which actions with which information, when, under which circumstances and using which methods (DGI, 2024). This system of rules also influences the DM or MDM in a cybernetic sense.

MD is fundamental information about business-critical business entities in the real and/or operational world, such as customers, suppliers, products, employees and other business partners, on which a company's business activities are based (Mertens *et al.* 2004). This data forms the basis for daily business processes and decisions and normally remains relatively stable over a longer period (it is semi-static). Their quality, consistency and timeliness are therefore crucial for the smooth running of business processes and the accuracy of information in reports and analyses (Beckmann, 2019).

DATA MANAGEMENT (DM) AND MASTER DATA MANAGEMENT (MDM): Data management (DM) encompasses all operational tasks that serve company-wide data storage, data maintenance and data use (Meier and Kaufmann, 2016). Master Data Management (MDM) as a special DM is a sub-area of operational information management (Krcmar, 2010) and a comprehensive and systematic approach to managing and maintaining master data within operational organizations. The aim of MDM is to ensure the quality, consistency, accuracy and availability of master data across all systems and processes and to view and treat it as a company-wide resource (Otto and Hüner 2009). In addition to defined organizational regulations (including defined responsibilities, guidelines and standards), companies find support in special MDM systems, central IT platforms for the management of master data, which are often used to automate MDM tasks (Beckmann, 2019).

Maturity model M are used to evaluate the working methods of companies or projects - as a benchmark for the maturity of a company - especially in the development of software and systems (Jacobs, 2019). The models offer a subdivision into different maturity levels, whereby the exact names of the individual levels can vary from model to model. To determine the maturity level, specific requirements are defined and then placed at different maturity levels. Depending on which requirements are fulfilled, a certain maturity level, a grade, is assigned and thus a classification is made. From this classification, companies should derive actions that they need to implement to improve their maturity level. In research and practice, reference models exist for various domains, e.g. project management (Capability Maturity Model Integration, CMMI) or business process management (EFQM Excellence Model or DIN EN ISO 9004:2018). In the context of this study, various models exist, each with different dimensions (DIM), main focus (MF), maturity levels (ML) and assessment questions (A-Q; if available), which were analysed for the development of the model (Table 1).

**Table 3. Maturity models in DM, MDM and DG**

| # | REFERENCE | FAM | ABBRV | ELEMENTS | | | |
|---|---|---|---|---|---|---|---|
| | | | | DIM | MF | ML | A-Q |
| 1 | ORACLE (2013) | MDM | ORACLE | 5 | ./. | 4 | ./. |
| 2 | DATAFLUX (2010) | MDM | DATAFLUX | 6 | ./. | 5 | ./. |
| 3 | KUMAR (2010) | MDM | KUMAR | ./. | ./. | 6 | ./. |
| 4 | GARTNER (2015) | MDM | GARTNER | 7 | ./. | 6 | ./. |
| 5 | SPRUIT AND PIETZKA (2015) | MDM | MD3M | 5 | 13 | 5 | 69 |
| 6 | MERKUS (2015) | DG | MERKUS | 8 | 29 | 5 | 27 |
| 7 | FIRICAN (2011) | DG | FIRICAN | 3 | 6 | 5 | ./. |
| 8 | MECCA (2014) | DM | CMMI | 6 | 25 | 5 | ./. |
| 9 | DAMA (2017) | DM | DAMA | 11 | >4 | 6 | ./. |
| 10 | BITKOM (2022) | DP | BITKOM | ./. | ./. | 5 | ./. |

LEGEND: FAM (FAMILY) ABBRV. (ABBREVIATION) | DIM (DIMENSIONS) | MF (MAIN FOCUS) | ML (MATURITY LEVEL) | A-Q (ASSESSMENT-QUESTIONS) | MDM (MASTER DATA MANAGEMENT) | DG (DATA GOVERNANCE) | DM (DATA MANAGEMENT) | DP (DATA PROTECTION)

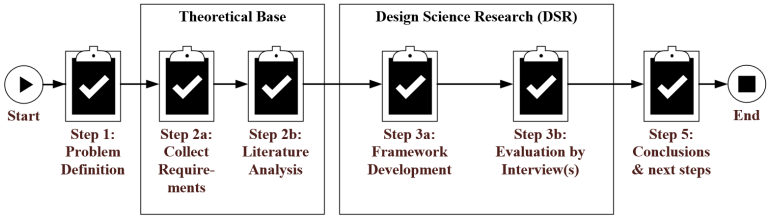
Source: contribution of the author

The methodology and material used are presented below.

## 3. METHODOLOGY AND MATERIAL

The study develops a MM for MDM based on Design Science Research DSR (Hevner *et al.,* 2007; Hevner, 2007; Peffers *et al.,* 2012; Doyle *et al.,* 2016) and process models for MM (Becker *et al.,* 2009). In addition to previous research results in MDM and DG, the researcher's practical experience was also incorporated into the development. The developed model was then evaluated in expert interviews. This study can therefore be classified as mixed-qualitative research.

It begins with the problem definition (step 1), followed by the survey of the requirements for a successful MDM (step 2a), the literature analysis (step 2b), the development of the framework (step 3a) and the evaluation through interviews (step 3b). The study concludes with a discussion of the results of the analysis and the derivation of conclusions (step 4).




Source: contribution of the author (taking Hevner, 2007 into account)

**Figure 12. Research design**

The literature review was conducted using established methods (Webster and Watson 2002; Kitchenham 2004; Fink, 2014). The researcher used digital libraries for scientific publications, including Scopus, as well as digital libraries for gray literature, e.g. Google Scholar. The search terms were "maturity level", "maturity models", "maturity", "maturity model", also in combination with "master data" or "master data". The results of the review were incorporated into the model development. The MDM-MM according to DSR was developed in three phases. At the beginning, the design levels for the MDM were determined. Evaluation factors for assessment were then derived and maturity levels defined for further operationalization of these levels. Influencing organizational factors form the framework. Finally, everything is orchestrated into an entire model.

To evaluate the MDM-MM, the researcher used semi-structured interviews (Saunders *et al.,* 2019). The researcher selected participants with different positions in companies, from different industries, with different ages, different professional experience and different professional values/backgrounds to cover as broad a spectrum as possible (Saunders *et al.,* 2019). The interviews were conducted partly as video conferences and partly in person, then transcribed and agreed with the participants. Finally, the relevant information for the evaluation of the model was extracted from the results (thematic coding according to Braun and Clarke 2006).

## 4. MODEL

The model construction is presented below. The factors influencing the organization are characterized by the characteristics present in the company that can influence the MDM. These include industry, headcount, turnover (last financial year) as well as the structure of company, their tasks and their resources. As a result of the analysis of existing MM, the researcher derived eight design levels that are relevant for his model and are supported in the analysed MM (Table 2). These design levels are (I) master data, (II) data culture in MDM, (III) data quality in MDM, (IV) data protection in MDM, (V) data security in MDM, (VI) organization of MDM, (VII) resources in MDM and

(VII) controlling in MDM. Compared to the previous models, the protection, security and control levels have been strengthened.

**Table 4. Design areas of the MDM**

| FAMILY | | MDM | | | | | DG | | DM | | DP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MODEL | | ORACLE | DATAFLUX | KUMAR | GARTNER | MD3M | MERKUS | FIRICAN | CMMI | DAMA | BITKOM |
| DESIGN AREAS | MASTER DATA | X | X | X | X | X | X | X | X | X | X |
| | DATA CULTURE | X | X | X | X | X | X | X | X | | |
| | DATA QUALITY | X | X | X | X | X | X | X | X | X | |
| | DATA PROTECTION | | | | | | | | | | X |
| | DATA SECURITY | | | | | X | | | | | |
| | ORGANIZATION | X | X | X | X | X | X | X | X | | |
| | RESOURCES | | | | | | X | X | X | | |
| | CONTROL | | | | | | X | | | | |

LEGEND: MDM (MASTER DATA MANAGEMENT) | DG (DATA GOVERNANCE) | DM (DATA MANAGEMENT) | DP (DATA PROTECTION)

Source: contribution of the author

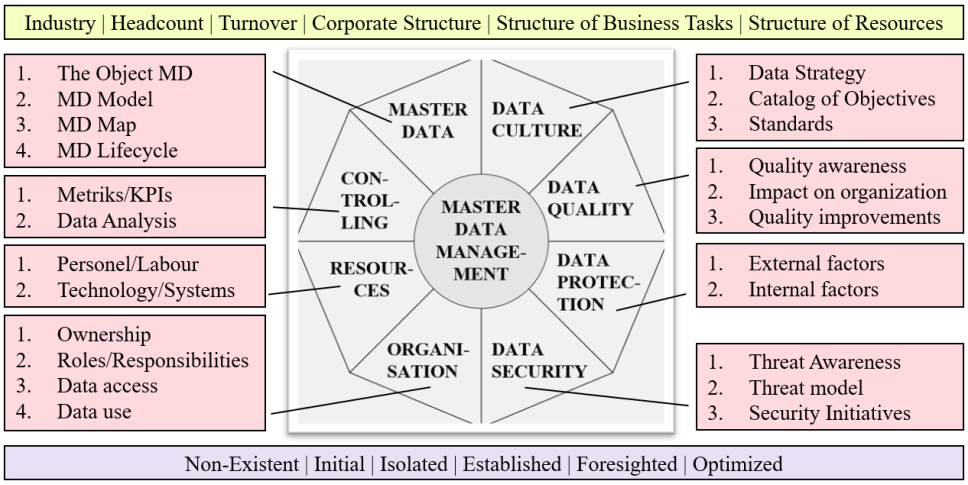
To make the design levels operable, the researcher defines evaluation factors on the base of which the assessment (questionnaire) can be developed:

1. Master Data (I): the object MD (I-1); MD model (I-2); MD map (I-3); MD life cycle (I-4).
2. Data Culture (II): Data strategy (II-1); Catalogue of objectives (II-3); Standards (II-3).
3. Data Quality (III): Quality awareness (III-1); Impact on the organization (III-2); Quality improvements (III-3).
4. Data Protection (IV): External factors (IV-1); Internal factors (IV-2).
5. Data Security (V): Threat awareness (V-1); Threat model (V-2); Security initiatives (V-3).
6. Organization (VI): Ownership (VI-1); Roles/Responsibilities (VI-2); Data access (VI-3); Data use (VI-4).
7. Resources (VII): Personnel/Labour (VII-1); Technology/Systems (VII-2).
8. Controlling (VIII): Metrics/KPIs (VIII-1); Data Analysis (VIII-2).

In the eight design levels, 23 evaluation factors were identified and defined.

Regarding the maturity levels, the researcher is guided by the "Capability Maturity Model (CMM)", which was developed in 1984 by the Software Engineering Institute at Carnegie Mellon University, USA, to assess the maturity level in various application areas, including software and program development, IT service management processes and project management. In this regard, the researcher derived the following six maturity levels in a third step: (0) non-existent, 1-initial, 2-isolated, 3-established, 4-foresighted and 5-optimized.

The MM (Figure 3) proposed by the researcher consists of (a) six organisational factors (yellow), (b) eight design levels (grey), (c) 23 assessment factors (red) and (d) six maturity levels (blue).




Source: contribution of the author

**Figure 13. Proposed MDM maturity model**

The MM takes previous research results into account, expands resp. sharpens already known MM and fits seamlessly into the research landscape.

## 5. CONCLUSION

This study makes a proposal for an MM for MDM. MDM as a management system is a critical success factor in coping with increasing digitalization in corporate environments of all sizes. The aim of this study was therefore to derive a model based on existing MM that helps companies to determine their level of maturity in MDM, taking current challenges into account. The starting point was a comprehensive literature review to identify existing MM in MDM. These were then analysed. It was found that existing MM in MDM do not address all the design levels that are relevant today regarding digital transformation progresses. Increasing cybercrime activities are forcing data protection and data security to

be included to a greater extent. Measuring success - not only for data quality - is also important, as MDM activities are investments that need to be justified to top management on an ongoing basis. Therefore, control mechanisms that not only improve the external image of MDM, but also promote motivation, are relevant. For this reason, the information base was expanded to include MM of the DM in general, the DG and data protection. The proposed MM comprises six organisational factors, eight design levels with a total of 23 assessment factors and six maturity levels. In addition to the above-mentioned results of previous research, the researcher's practical experience was also incorporated into the creation of the MM.

The model is currently a proposal and must be validated in real and different company environments. For this purpose, an assessment - consisting of a sufficient number of questions for each evaluation factor of each design level - is designed in advance and put online. At the same time, other experts can be involved to discuss the model. They can contribute their experience, develop their own criteria and compare them with the proposed model. Currently, all design levels and evaluation factors are weighted equally. Consideration can be given to weighting the levels and factors according to their importance.

## References


1) BearingPoint (2016). *Reifegrad und Relevanz des Stammdatenmanagements Stammdaten als unabdingbare Basis für die Digitalisierung, Prozesseffizienz und Compliance.* [online] Available at: https://www.bearingpoint.com/de-de/insights-events/insights/stammdatenmanagement/ [Accessed 03.03.2024].
2) Becker, J., Knackstedt, R. and Pöppelbuß, J. (2009). Developing Maturity Models for IT Management. *Business & Information Systems Engineering*, 1(3), pp. 213-222.
3) Beckmann, H. (2019). *Stammdatenmanagement*. In: Gronau, N., Becker, J., Kliewer, N., Leimeister, J.M., & Overhage, S. (Herausgeber): Enzyklopädie der Wirtschaftsinformatik – Online-Lexikon", Stand 11. April 2024. [online] Available at: https://wi-lex.de/index.php/lexikon/informations-daten-und-wissensmanagement/informationsmanagement/informationsmanagement-aufgaben-des/stammdatenmanagement/ [Accessed 11.04.2024].
4) Benker, T. and Jürck, C. (2016). Das betriebliche Informationssystem. In: Benker, T., Jürk, C. and Wolf, M., *Geschäftsprozessorientierte Systementwicklung. Von der Unternehmensarchitektur zum IT-System*. Wiesbaden: Springer Vieweg.
5) Bitkom (2022). *Datenschutz-Reifegradmodell. Reifegradmodell zur Abbildung von technisch-organisatorischen Maßnahmen bei der Auftragsverarbeitung. Betaversion zum Review*. [online] Available at: https://www.bitkom.org/sites/main/files/2022-08/220802_LF_Datenschutz-Reifegradmodell%20Betaversion.pdf [Accessed 11.04.2024].
6) Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), pp. 77-101.

7) DAMA (2017). Data Management Body of Knowledge Version 2 (DAMA-DMBOK2). [online] Available at: https://www.dama.org/cpages/home [Accessed 22.06.2022].
8) DataFlux (2010). *MDM Components and the Maturity Model*. [online] Available at: https://www.knowledge-integrity.com/Assets/MDMComponentsMaturity Model.pdf [Accessed 11.04.2024].
9) DGI (2024). *Defining Data Governance.* [online] Available at: https://datagovernance.com/defining-data-governance/ [Accessed 06.05.2024]
10) Doyle, C., Sammon, D. and Neville, K. (2016). A design science research (DSR) case study: building an evaluation framework for social media enabled collaborative learning environments (SMECLEs). *Journal of Decision Systems,* 25(1), pp. 125-144.
11) Ferstl, O.K. and Sinz, E.J. (2013). *Grundlagen der Wirtschaftsinformatik*. 7., aktualisierte Auflage. München: Oldenbourg Wissenschaftsverlag.
12) Fink, A. (2019). Conducting Research Literature Reviews - From the Internet to Paper. 5th Edition (14. Februar 2019). Los Angeles: SAGE Publications Inc. 2020
13) Gartner (2015). *Use the Gartner MDM Maturity Model to Create Your MDM Roadmap*. [online] Available at: https://www.gartner.com/en/documents/3044517 [Accessed 11.04.2024].
14) Hevner, A. (2007). A Three Cycle View of Design Science Research. Scandinavian *Journal of Information Systems*, 19(2), pp. 1-6.
15) Hevner, A. R., March, S. T., Park, J. and Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), pp. 75-105.
16) Jacobs, S. (2019). *Reifegradmodell*. In: Gronau, N., Becker, J., Kliewer, N., Leimeister, J.M. and Overhage, S. (Herausgeber): Enzyklopädie der Wirtschaftsinformatik – Online-Lexikon", Stand 11. April 2024. [online] Available at: https://wi-lex.de/index.php/lexikon/entwicklung-und-management-von-informationssystemen/systementwicklung/reifegradmodelle/ [Accessed 11.04.2024].
17) Kitchenham, B. (2004). *Procedures for performing systematic reviews.* [online] Available at: https://www.inf.ufsc.br/~aldo.vw/kitchenham.pdf [Accessed 15.04.2024].
18) Krcmar, H. (2010*). Informationsmanagement. Fünfte Auflage*. Berlin: Springer.
19) Kumar, S. (2010). MDM Maturity Model. *Information Management Newsletters*, March 15, 2010.
20) Mecca, M. (2014). *Data Management Maturity Model Introduction*. [online] Available at: https://cdn.ymaws.com/www.globalaea.org/resource/collection/68814379-BF7E-41C8-B152-18A617F9C0AA/Data_Management_Maturity_Model_Introduction_-_Dec_12_2014.pdf [Accessed 11.04.2024].
21) Meier, A. and Kaufmann, M. (2016). *SQL & NoSQL-Datenbanken*. Verlag Berlin Heidelberg: Springer.
22) Merkus, J. (2015). *Data Governance Maturity Model*. [online] Available at: https://www.researchgate.net/publication/322024180_Data_Governance_Maturity_Model_-_english_version [Accessed 11.04.2024].

23) Mertens, P., Bodendorf, F., König, W., Picot, A., Schumann, M. and Hess, T. (2004). *Grundzüge der Wirtschaftsinformatik*. Berlin: Springer.
24) Oracle (2013). *Oracle MDM Maturity Model. An Oracle White Paper, June 2017*. [online] Available at: https://de.scribd.com/document/82739843/Mdm-Maturity-Model-Wp-414600 [Accessed 11.04.2024].
25) Otto, B. and Hüner, K.M. (2009). Funktionsarchitektur für unternehmensweites Stammdatenmanagement. Bericht Nr. BE HSG/CC CDQ / 14. Universität St. Gallen. 2009.
26) Peffers, K., Rothenberger, M., Tuunanen, T. and Vaezi, R. (2012). Design Science Research Evaluation. In: K. Peffers, M. Rothenberger and B. Kuechler (eds.), *Design Science Research in Information Systems. Advances in Theory and Practice.* Berlin, Heidelberg: Springer, pp. 398-410.
27) Saunders, M.N.K., Lewis, P. and Thornhill, A. (2019). *Research Methods for Business Students*, 8th Edition. Harlow: Pearson.
28) Spruit, M., and Pietzka, K. (2015). MD3M: The Master Data Management Maturity Model. *Computers in Human Behavior*, 51(B), pp. 1068 - 1076. https://doi.org/10.1016/j.chb.2014.09.030.
29) Firican, G. (2011). *Stanford data governance maturity model*. [online] Available at: https://www.lightsondata.com/data-governance-maturity-models-stanford/ [Accessed 11.04.2024].
30) Webster, J. and Watson, R.T. (2002). Analyzing the past to prepare the future: writing a literature review. *MIS Quarterly,* 26(2), pp. xiii-xxiii.