

# A model for data management and governance practices for everyday business\*

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## Abstract

Managing data in the right way to harness its value and use the latest digital tools creates valuable opportunities for growing organizations to manage their operations effectively. Data ownership in a data governance context is a widely discussed topic, and implementing data governance models in specific organizational environments faces different challenges. In this paper, we add knowledge to the existing literature by providing a detailed explanation of the steps of implementing a data organizational structure in a data governance model, specifically focusing on data ownership and improving its usability. We applied the action design research (ADR) method to create an IT artifact that offers effective data management solutions and enhances operational efficiency within the organization. The results show that proposed data governance practices help improve data quality and lead to improved decision-making, while highlighting the impact of clearly defined data ownership, roles, and responsibilities on data governance.

## Keywords

Data ownership, Data governance, Data quality, Action design research

## 1. Introduction

In today's business landscape, organizations consider their data as one of their most valuable assets, and the data provides crucial insights into customer behavior, product performance, and operational performance, enabling companies to make informed decisions and achieve better outcomes [1]. Enterprises should handle this information responsibly and carefully to ensure organizational success [2]. A careful planning approach is essential for data management in organizations [3]. Also, a dedicated team or group of people capable of making decisions regarding organizational data and data functions, aligning with the organizational strategy, is necessary for successful data management [4]. Consequently, organizations strive to establish robust data governance frameworks and integrate effective data management and governance practices into their daily operations with dedicated personnel. [5].

Data governance involves meticulous organization to ensure data is understood, trusted, of high quality, and usable for enterprise purposes [6]. Data governance frameworks proposed by various scholars mention different interconnected decision domains or knowledge areas that define the functional areas of data management in data governance. Organizations can significantly reduce costs associated with these domains in data management by implementing an effective data

governance practice that clarifies data ownership, stewardship, and decision-making authority over data [7].

High-quality data is essential for maximizing operational efficiency in businesses [8]. Amidst the various discussions on upholding data quality to drive business growth and enable effective decision-making, data governance emerges as a pivotal factor in elevating data quality [4]. Strong data ownership and accountability for data assets within an organization can positively impact data governance. However, the definition of data ownership and stewardship within an organizational context can often be unclear [6,7].

There are questions surrounding the definition of data ownership and stewardship, and how responsibilities are assigned to tackle data quality issues that can affect operational efficiency. The concepts and approaches of data ownership are often not clearly defined [4]. Additionally, not every data governance framework and the established connections between decision-making domains are universally applicable to all organizations. Therefore, the specific data needs of each organization should be considered when defining data ownership and establishing connections between decision domains [4,7,8]. Furthermore, Abraham et al. (2019) suggest that further research is needed to determine the scope and approach of data ownership in relation to organizational effectiveness. Accordingly, a research

gap was identified, and we strive to answer the following research questions.

Research Questions (RQ): RQ1: How to build and implement a model that can address data quality issues that arise with the missing data ownership of organizational data assets? RQ2: How to improve the overall efficiency of such a model that can be utilized in everyday business?

The structural model for data governance organization and its automated solution for improving operational efficiency, which are presented in this paper, were developed through an Action Design Research (ADR) project [9] conducted by the authors. From the organizational side, the project team consisted of an enterprise architect, a senior IT analyst, a project manager, and senior managers of a medium-sized Finnish manufacturing company. The team from the case organization started to tackle the data management issue as part of an enterprise architecture (EA) project, within which this research project was conducted. The significance of this research is building a data governance model to tackle data ownership in data assets for a medium-sized manufacturing company, expecting to assist the company in achieving strategic objectives related to data quality and operational efficiency.

We structured this paper as follows: first, we give a brief overview of the data management and governance principles from the existing literature, and subsequently, we undertake an assessment of the research gap. Next, we describe ADR as our adapted research methodology and briefly outline the applicability of the research methodology. Then, we explain the ADR method in a more detailed level, describing the four stages of the ADR project. Accordingly, the solution that addresses the research problems is presented, along with the learning resulting from ADR. Next, in the discussion section, we present our main findings and discuss the generalizability of the study, highlighting the limitations and future work. Finally, we close with a short summary.

## 2. Background

Data governance can be described as the exercise of authority and control over the management of data [7]. Data governance is exercised through policies, standardizing data to ensure data stewardship and data quality [10]. It refers to what decisions must be made and who makes those decisions, defining the actions taken to maintain data integrity, and encompassing how data reliability, security, availability, and usability are managed [1,5]. Data

quality refers to the state of organizational data, including its accuracy, completeness, relevance, and fitness for purpose [11]. A conceptual architecture for data governance, which emphasizes structural governance mechanisms such as reporting lines, governance bodies, and decision-making authorities, aligns data asset ownership with data governance practices [7]. Successful data governance programs within organizations rely on organizational support and the delineation of key roles, such as data owners, stewards, and consumers [7].

Data stewards should ensure responsible information sharing [6] and formalize accountabilities for managing information resources on behalf of, and in the best interest of, others [10]. The concept of business and technical stewardship involves business stewards ensuring data quality within their respective domains, while technical stewards manage IT systems. This serves to define the scope of data stewardship more clearly [6].

DAMA-DMBOK offers another influential framework, advocating for clear role definitions and presenting ten knowledge areas crucial for effective data management. These frameworks collectively stress the importance of establishing roles and responsibilities, underscoring the criticality of data governance in enhancing operational efficiency and addressing data quality concerns [1].

The success of data governance initiatives relies on structural frameworks, behavioral aspects, and technological infrastructures. Maintaining data quality through trusted practices emphasizes the critical role of human behavior, enabling organizations to succeed in data governance [10].

Common goals of a data governance program include increased operational efficiency and addressing data quality issues [1]. With proper data management and governance, organizations can deliver measurable improvements and empower organizational data users with decision-making power [12].

Data governance is crucial for improving the value of data and reducing associated costs and risks [7]. As companies grow and adopt new technologies, establishing good data practices becomes even more important. Maintaining data quality and encouraging user compliance are critical factors for success in data governance [10]. As businesses grow and expand into new geographic areas, there is a greater need for standardization. Data governance plays a crucial role in enabling medium-sized enterprises to expand globally through data harmonization [12]. This underscores the strategic significance of data governance in driving organizational growth and

competitiveness. As companies expand, the organizational hierarchical structures often become more complex, necessitating robust solutions when introducing data governance roles [10].

Previous literature highlights the significance of data governance in data management, particularly in maintaining data quality through governance practices. It also underscores the success factors that help organizations manage their data through data governance as they grow. The existing literature lacks discussions on how data stewardship and ownership align with organizational structures and the impact of governance practices on data quality and organizational changes. Additionally, there is a gap in the literature regarding how organizations with different strategies and resources can adapt data stewardship practices.

While our study was conducted in a specific organization, it explores how roles, responsibilities, and core data concepts can be tailored to suit various organizations with similar contexts in data management. The literature also falls short in outlining common roles adaptable to different data governance organizations and their implementation to enhance data quality in an organizational setting.

In contrast to many existing data governance frameworks and studies, our study has implemented a data governance program, evaluated the outcomes, and proposed solutions to enhance the program's overall effectiveness.

### 3. Methodology

Our research project focuses on addressing an organizational problem by developing a solution tailored to the organizational context and incorporating user feedback throughout the process. ADR guides the development of IT artifacts within organizational settings [9]. Our goal is to create an IT artifact that offers effective data management solutions and enhances operational efficiency within the organization. Continuous user feedback and iterative development are essential for the successful implementation of data governance solutions in organizations [1]. Additionally, we aim to enhance the overall efficiency of the proposed IT artifact in daily operations and user involvement. Our solution is a result of both design and practical application, following an iterative development and evaluation approach with diverse stakeholders within the organization [14].

ADR is used to develop and evaluate a set of IT artifacts within an organizational setting to generate prescriptive design knowledge [9]. This process

involves creating, intervening, and evaluating an artifact that not only embodies the researchers' theoretical foundations and intentions but also incorporates feedback from users and ongoing usage within a specific context. Furthermore, ADR is a method that can effectively address specific problems encountered within an organization by intervening, evaluating, and developing an IT artifact to tackle the class of problems identified in the given situation.

Because ADR aims to design a problem-solving artifact through iterative evaluation and learning [15], we followed the four stages of the ADR cycle as our research methodology. These include: 1) Problem Formulation, 2) Building, Intervention, and Evaluation (BIE), 2) Reflection and Learning, and 4) Formalization of Learning [9]. Our four-stage ADR process is exhibited in Table 1.

It briefly explains the research task in each stage. Also, we introduce the corresponding research principles and their consequences for the research.

### 4. ADR for data governance metamodel development

The research opportunity: Our case company is a medium-sized tech-based manufacturing company with around 300 employees and a moderate global market presence. They have a strong market presence in the Nordic countries, and their expectation is to grow in new geographic markets while expanding their core business. With their current growth over the last 2-3 years, a strong data culture is in demand because of the organization's high-tech production environment. Also, for market and customer segmentation and identifying new leads, they desired to have a suitable analytics platform. Hence, maintaining the data quality, accessibility and data discoverability becomes crucial for data management in the case organization. The case company is equipped with various information systems, such as an on-premise Enterprise Resource Planning (ERP) system, a cloud-based Customer Relation Management (CRM) system, and a Product Lifecycle Management (PLM) system. In addition, the organization has a centralized cloud data warehouse and data lake support for reporting with Power BI. All of these information systems generate a large volume of data points, and the organization's main concern is to manage this data properly, maintain the data quality, and help business users locate data sets, identify the contact person for data access, and generate reports

**Table 1**

ADR stages, Research tasks, Outcomes and actions based on Sein et al. (2011)

Stage	Research tasks	Outcomes and actions
Problem formulation	Conceptualize the research opportunity.	The need for the IT artifact of the case organization to improve the discoverability and accountability of the data assets was the initial trigger of this research.
	Formulate the research questions	Two research questions are formulated with reference to the class of the problem. RQ1: How to build and implement a model that can address data quality issues that arise with the missing data ownership of organizational data assets? RQ2: How to improve the overall efficiency of such a model that can be utilized in everyday business?
	Cast the problem as a class of problem	Achieving data quality and operational efficiency through data governance.
	Theoretical bases and prior technology advances	The DAMA-DMBOK framework [1] and the conceptual framework provided by Abraham et al., (2019) were used as the main theoretical base for the governance framework.
	Define scope Setup roles and responsibilities	Initially focusing on operation data assets The team was structured into three groups. The research team, the EA team, and an IT analyst from the case organization.
Building, intervention and evaluation	Initial design of the target	The data governance organization structure and automated workflow.
	Customized BIE form	The artifact design and evaluation are done with the ADR team as a combined approach from researchers and practitioners.
	Evaluation, repeat	Based on three criteria explained in the 'Results' section, continuous evaluations and improvements were applied to the artifact. Agile scrum framework followed.
Reflection and learning	Reflect upon design	Continuous intervention and evaluations, and the introduction of design principles. The verification of the reality of the solution.
	Analyze intervention	Compare the newly generated knowledge from the continuous intervention with the problem class.
Formalization of learning	Share outcomes	The alpha-version of the artifact was evaluated during the BIE cycle, and the beta-version was expected to be introduced to the end-users in the case organization.
	Articulate the design principles and generalize the outcome	We discuss the learning relating to the existing literature in the 'Discussion' and generalized design principles applicable to the class of the problem.

The case organization faces challenges in managing high data volume and streamlining data operations toward achieving operational efficiency. As a result, business users face difficulties with accessing data, especially when generating reports. Often, they have to spend a considerable amount of time finding the correct owners and requesting access to particular data. This has become a significant concern for the organization, and the research team identified missing data governance, in particular, the missing ownership of data assets, as one of the reasons for this issue. Also, different departments in the case organization generate inconsistent statistics over the same topic with different data sets. This raises a critical data quality issue requiring immediate action as it may lead to incorrect organizational statistics.

Hence, the need for a meaningful data governance organizational structure was needed to improve the ownership of data assets. In addition, the case organization maintains an old Excel sheet as the system register even though it is equipped with modern data architecture. Because of the lack of collaboration, advancement with new technologies, and tracking issues such as unnoticed errors, the case organization needed a new overall solution that could address all of these issues. Inspired by this knowledge-creation opportunity and practical-inspired research problem in an organizational domain, we formed our two research questions. RQ1: How to build and implement a model that can address data quality issues that arise with the missing data ownership of organizational data assets? RQ2: How to improve the overall efficiency of such a model that can be utilized in everyday business?

**Class of problem:** In this research, we aim to create a general structure to achieve data quality and operational efficiency through data governance and building and proposing a relationship between business processes and information systems (metamodel).

**Theoretical base:** We built a metamodel using a data management tool to identify data assets and create relationships among the data assets. The organization aims to use this model to help business users find specific data sets, identify the users who own them, and define responsibilities to maintain the data quality. Our research has enabled them to establish a relationship with data assets by building the metamodel on the tool and assigning data ownership to each data asset. To determine ownership and data stewardship, we utilized the data governance framework developed by Abraham et al. (2019) with a structural governance framework and

organizational structure mapping to data organization following Ladley, J. (2020) and Plotkin, D. (2021).

**Scope:** Incorporating the proposed meta model and data governance organization structure into the comprehensive EA was our primary objective. Initially, our efforts were concentrated within the operations department, encompassing purchasing, manufacturing, business excellence, and customer service teams. Furthermore, in alignment with the organizational strategy and requirements at the time, the primary emphasis within the proposed model was on data quality [4,10] and structural data governance, which dictates reporting structures and accountabilities, including roles, responsibilities, and decision-making authority allocation [7].

**Roles and responsibilities:** The EA project team of the case organization and research team are the participants of the research project. The team was structured into three groups. The research team represents the theoretical aspects. The EA team represents the practical aspects, and analytics from the case organization provide the technical aspects. **Building Intervention and Evaluation:** During the second stage of the ADR approach, 'Building, Intervention and Evaluation', the artifact is designed, iteratively refined, and evaluated. As Sein et al. (2011) suggested, we created the initial design of our IT artifact using the problem framing and theoretical background presented in stage one. We carried out our BIE stage with the iterative processes to build the artifact, perform the intervention, and analyze the BIE. In relevance to our problem formation, our research focused on IT Dominant BIE. We built the IT artifact design as a solution to the organizational problem described in Stage 1.

The project was conducted for five months within the case organization working in scrum cycles as part of an EA development project. The two-week sprints were planned, and we presented the progress of the initial model during the scrum meeting. The evaluation was conducted after each meeting, and the feedback was taken as notes. The duration of the meetings was approximately 120 minutes. In addition to the continuous meetings, we had three more meetings, including the kick-off, mid-way evaluation meeting and the final evaluation meeting. We evaluated our artifact and implemented necessary interventions based on the recommendations collected from the meetings.

First, we built the initial metamodel (Figure 1), aligning with the current organizational structure and data structure. The meta model builds the connections between the main components in the organization

[1,10]. Furthermore, we adapted the concepts Abraham et al. (2019) described for a conceptual data governance model that organizations can adapt and modify based on their data governance program objectives.

Then we followed the procedural governance mechanisms [7] and the principle of top-level design [10] to build a data governance organizational structure (Figure 2) that aligns with our proposed metamodel. This data governance structure helps to build authority over data assets and enhance the transparency within the case organization, being able to answer these questions: WHO owns WHAT? WHO is responsible for WHAT? WHOM should I contact? and WHO has access to WHAT?

The proposed metamodel illustrates the hierarchy of data ownership and decision-making authority within our IT artifact. Data owners expected to be selected for each main business process of the organization and data stewards were selected to be in each business function managed under each business process. The relationship between a business process and business function was a one-to-many relationship.

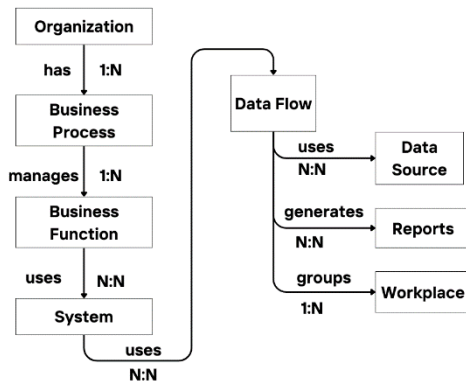


Figure 1: Metamodel

As an example, during our artifact-building phase, the artifact was introduced to the operations department in the case organization. The head of operations was a C-level executive officer, and the Chief Operations Officer (COO) was the Executive sponsor of our governance model. The operations department is involved with different business processes, such as logistics, customer service, and sourcing. These main business processes were handled by senior managers (e.g., Logistics manager, Customer service manager, Sourcing manager, etc.), and we decided to assign them as the data owners, since they were technically

responsible and accountable for several data assets. Data owners communicate broad data requirements and risks [6]. They also own and make decisions about the data that the business process produces [6]. Data stewards are key representatives in the business functions that belong to business processes. The data assets binding with the business functions do not belong to the appointed data stewards, but they work closely with the data and understand the business data [6]. We added another role to the structure, data expert, to support the technical aspects of the data requirements. The experts support maintaining the data quality in the technical aspect, playing a role as a technical data steward. The data management tool was used to scan the available data in the case organization, and we assigned the roles and people according to the metamodel and data governance organization structure.

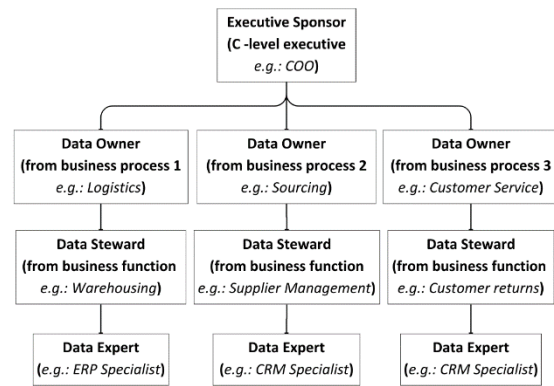


Figure 2: Data Governance Organizational Structure

Furthermore, we present detailed information on the roles and responsibilities of the data governance organization structure we proposed for the case organization in Table 2. We adapted the descriptions from Abraham et al. (2019), and the responsibilities from Ladley, J. (2020) and Plotkin, D. (2021). To address our second research question, we introduced an automated cloud-based solution that registers the data owners whenever a new data asset is created to the system register. We took the initiative by introducing a solution as a collection of data in a cloud space to replace the legacy system register at the case organization. As described in Stage 1, the case organization used an Excel sheet as their system register and was unable to maintain it properly.

Our cloud application served as the easy maintenance system for the system register.

**Table 2**

Data governance organization – roles and responsibilities based on Abrahm et al. (2019), Ladley, L. (2020) and Plotkin. (2021)

Role	Description	Responsibility	Assign to
Executive sponsor	One of the highest-level executives in the organization who has the authority to change the organization and support the program enterprise-wide.	Provide strategic direction to data governance and management. Business prioritization Funding for data management initiatives	COO
Data owner	A senior executive who is accountable for one or more data sets, business lines, and business assets.	Communicate broad data requirements and risks. Owns and makes decisions on the data of the business processes. Select data stewards	Customer Service manager, Logistics Manager, Sourcing Manager, Production Manager
Data steward	The key representative in a specific business area who takes care of data assets that do not belong to themselves but work closely with that data. The business leaders or subject matter experts.	Responsible for quality, use and meaning of the specific business data. Make recommendations about the data. Communicate data requirements. Execute the policies and standards agreed upon to maintain the data quality and operation efficiency. Maintain agreed-upon data definitions and formats. Identify data quality issues and ensure that business users adhere to specified data standards. Collaborate with other data governance team members to uphold data consistency and data quality metrics. Create, update, and delete data assets in the asset register.	Customer service executive, Sourcing executive, Production Supervisor
Data expert	The designated enterprise application owners in the case organization.	Control data access of the assigned applications. Collaborate with data stewards who work with the applications, and fix data quality or integrity issues. Communicate technical overview and requirements of the applications. Provide support to maintain the overall data quality for data stewards.	ERP specialist, CRM specialist

During the evaluation meetings, the project team was satisfied with the functionality of the application, and we improved the process by automating the ownership assignment with the data management tool. For the automation, we used a Python script. It was tested appropriately, and the results were verified before being presented during the evaluation.

The initial model was refined with the iterative BIE cycles. According to the feedback, we needed to decide the granularity of the data asset scan by the data management tool and assign the data owners and experts first to the metamodel.

Evaluate the artifact: As explained in the BIE cycle, we evaluated the IT artifact based on the formal

feedback sessions of the project team stakeholders. We used 3 evaluation criteria to understand the feedback of the stakeholders and do the interventions during the iterations.

1. Understandability of the artifact concepts to the business users.
2. Usability of the IT artifact to the business users.
3. Practicality of the artifact to the organization culture.

Most of the received feedback was positive. Some of the project members did not agree with having extra work added to their teams, such as data stewards playing a role in supporting the data quality. However, everyone agreed with the practicality of the artifact and its usability. Concept-wise, everyone agreed and understood the concepts and the reason for implementing such a system to overcome the identified issues in the case organization.

During the alpha-version, practitioners were provided with positive feedback. The beta-version

**Table 3**  
Design principles

Implementor, aim and user	Context	Mechanisms	Rationale
For IT domain experts (Technical user) (implementers), to reduce the amount of data access requests received (aim), from business users in the organization (users)	In report generating systems	Designate and make visible the correct contact points	Because doing so improves efficiency in data discovery
For business domain experts (implementer), to improve the data accessibility(aim), from internal and external users (users)	Accessing data as inputs for different processes	Improve data accessibility	Because by doing so, the organization can improve data sharing.
For senior executives (implementer), to improve the report data quality(aim), from the report generators (Users)	In Report generating systems	Ensure accuracy of the statistics of the reports	Because data accuracy increases the quality of the decisions.
For data users(implementer), to follow the governance structure(aim), of data governance practitioners (Users)	In data governance structures	Automate data ownership assignment and ensure usability of the process	Because by doing so, data governance practices are easily followed.

During the early interventions of the IT artifact, which assigned roles with responsibilities and decision-making authority over data within the organizational structure, many practitioners expressed concerns

was implemented in the case organization, allowing it to be used by other users. Due to the time limitations, we couldn't collect feedback from the end-users regarding the artifact. However, some of the practitioners were representing the end users' perspectives and acted as end users for some systems. Hence, we believe the feedback could be accepted as a general evaluation of the artifact.

Reflection and Learning: This study may motivate and help other researchers interested in implementing data governance practices, particularly within organizations with growth potential and an interest in data-driven decision-making. While previous studies provide conceptual frameworks and models for implementing structural data governance to improve the overall quality of such governance programs, the proposed IT artifact is a practical example of such a model.

about the additional steps introduced into existing processes. Based on this feedback, we incorporated a detailed role description (Table 2), which clarified responsibilities and improved data stewardship.



Despite the organization already having privacy and security controls in place technically, the clarification of responsibilities and reporting structure ensured proper adherence to data quality, security, and privacy controls.

Moreover, we received positive feedback from senior managers to IT experts when the workflows were automated compared to the early iterations when only the structural model was introduced. Design Principles: The anatomy of the design principles [16] is structured in the following table, Table 3. We adopted multiple design principles that can be used for artifact refinement [16]. The four design principles outlined below were developed to meet the objectives of the data governance program and effectively address the research questions

## 5. Discussion

Strong ownership over data in a data governance framework would benefit the whole data governance program [7]. Even though it requires careful planning, data management provides the authority and control over data [7] and having a decision-making structure with data governance provides support to expand medium-sized companies to grow [12]. At first, adapting data governance practices to daily operations would be hectic. However, people, processes and technologies are bonded together for any successful IS implementation. Hence, introducing automation tools to governance practices would motivate users to adopt the new workflows and improve their effectiveness. Being able to know whom to contact to access specific data makes a favorable impact on data discoverability, accessibility, and effective report generation.

Each business process within the operations department has a designated data steward from the corresponding business function. A governance model provides guidance for those overseeing data quality and security.

Main Findings: The ADR project's findings underscore the profound impact of clearly defined data ownership, roles, and responsibilities on data governance. The implementation of an automated solution can greatly enhance overall efficiency and the user-friendliness of governance practices. These strategies have not only improved operational efficiency and data quality, but also fostered a culture of accountability and adaptability among users.

Defining specific responsibilities for data stewards in each business function has been observed to enhance accountability and data quality. This has resulted in more accurate and timely data entries and

has facilitated data access for users without unnecessary communication. The implementation of automation, such as streamlined processes, has reduced manual workload and ensured compliance with data governance policies. Moreover, assigning data ownership to the data assets, particularly for dashboards, has improved data accessibility effectively, thus significantly enhancing productivity. Regular feedback iterations have further facilitated user adaptation to the new practices, creating an environment of continuous improvement and ensuring that the implemented solutions are user-friendly and effective.

Limitation and Future Research: Due to time and other organizational constraints, we could not evaluate the beta-version of the artifact with the case organization end-users nor evaluate the alpha version of the artifact quantitatively. We would like to propose studying the correlations between data governance organization and overall organizational efficiency quantitatively.

## 6. Conclusion

The research is focused on addressing the key considerations for designing and implementing a data governance model in an organization with strong data ownership and stewardship. Our study explores how such a model can enhance data quality, discoverability, and sharing while adapting to evolving data governance practices. We emphasize the process of structuring a data governance framework for a growing manufacturing organization and enhancing its effectiveness. By understanding the organizational needs and context, IS implementors can integrate governance practices that support continued growth through digital technologies and fully utilize data within the organization. Additionally, the fundamental principles of data stewardship and the methodologies identified in this study, along with the design principles of ADR, are applicable across various organizational contexts beyond manufacturing. These insights offer a framework that can assist different industries in refining their data governance practices, ensuring effective and sustainable utilization of data assets across organizations of diverse sizes and sectors.

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## References

- [1] Dama International. (2017). DAMADMBOK: Data management body of knowledge (2nd ed.)
- [2] Gregory, A. (2011). Data governance — Protecting and unleashing the value of your customer data assets. *Journal of Direct, Data and Digital Marketing Practice*, 12(3), 230-248. <https://doi.org/10.1057/dddmp.2010.41>
- [3] Al-Ruithe, M., Benkhelifa, E., & Hameed, K. (2018). A systematic literature review of data governance and cloud data governance. *Personal and Ubiquitous Computing*, 23(5-6), 839-859. <https://doi.org/10.1007/s00779-017-1104-3>
- [4] Khatri, V., & Brown, C. V. (2010). Designing data governance. *Communications of the ACM*, 53(1), 148-152. <https://doi.org/10.1145/1629175.1629210>
- [5] Ladley, J. (2019). Data governance: How to design, deploy, and sustain an effective data governance program. Academic Press
- [6] Plotkin, D. (2021) Data stewardship: An actionable guide to effective data management and data governance. Elsevier.
- [7] Abraham, R., Schneider, J., & Vom Brocke, J. (2019). Data governance: A conceptual framework, structured review, and research agenda. *International Journal of Information Management*, 49, 424-438. <https://doi.org/10.1016/j.ijinfomgt.2019.07.008>
- [8] Chengke Wu , Peng Wu , Jun Wang , Rui Jiang , Mengcheng Chen & XiangyuWang (2020): Critical review of data-driven decision-making in bridge operation and maintenance, *Structure and Infrastructure Engineering*, DOI:10.1080/15732479.2020.1833946
- [9] Sein, Henfridsson, Puroo, S., Rossi, C., & Lindgren. (2011). Action Design Research. *Management Information Systems Quarterly*, 35(1), 37. <https://doi.org/10.2307/23043488>
- [10] Janssen, M., Brous, P., Estévez, E., Barbosa, L. S., & Janowski, T. (2020). Data governance: Organizing data for trustworthy Artificial Intelligence. *Government Information Quarterly*, 37(3), 101493. <https://doi.org/10.1016/j.giq.2020.101493>
- [11] Wang, J., Liu, Y., Li, P., Lin, Z., Sindakis, S., & Aggarwal, S. (2023). Overview of Data Quality : Examining the dimensions, antecedents, and impacts of data quality. *Journal of the Knowledge Economy*. <https://doi.org/10.1007/s13132-022-01096-6>
- [12] Ribeiro, V., Barata, J., & da Cunha, P. R. (2023). Creating Data Policies for Digital Business Ecosystems. [https://doi.org/https://www.researchgate.net/profile/VitorRibeiro24/publication/372090525\\_Creating\\_Data\\_Policies\\_for\\_Digital\\_Business\\_Ecosystems/links/65281d14bc063850eaba7a26/Creating-DataPolicies-for-Digital-Business-Ecosystems.pdf](https://doi.org/https://www.researchgate.net/profile/VitorRibeiro24/publication/372090525_Creating_Data_Policies_for_Digital_Business_Ecosystems/links/65281d14bc063850eaba7a26/Creating-DataPolicies-for-Digital-Business-Ecosystems.pdf)
- [13] Erkkä, N. (2013). Working Paper: Designing a Data Governance Framework. [https://doi.org/https://www.researchgate.net/publication/257194534\\_Working\\_Paper\\_Designing\\_a\\_Data\\_Governance\\_Framework](https://doi.org/https://www.researchgate.net/publication/257194534_Working_Paper_Designing_a_Data_Governance_Framework)
- [14] Sein, M., and Rossi, M. 2019. "Elaborating ADR While Drifting Away from Its Essence: A Commentary on Mullarkey and Hevner," *European Journal of Information Systems* (28:1), pp. 21-25.
- [15] Peffers, K., Tuunanen, T., Gengler, C. E., Rossi, M., Hui, W., Virtanen, V., and Bragge, J. 2006. "The Design Science Research Process: A Model for Producing and Presenting Information Systems Research," *First International Conference on Design Science in Information Systems and Technology (DESRIST 2006)*, S. Chatterjee and A.R. Hevner (eds.), Claremont, CA, pp. 83-106.
- [16] Gregor, S., Kruse, L. C., & Seidel, S. (2020). Research Perspectives: The anatomy of a design principle. *Journal of the Association for Information Systems*, 21, 1622-1652. <https://doi.org/10.17705/1jais.00649>