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Towards a Data Management Capability Model

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Abstract

Technological progress and change urge organizations to restructure their approach on business. The management of data as a strategic asset becomes more and more vital for the survival and success of enterprises. However, scientific work on data management capabilities of organizations is scarce in the research field of Information Systems. Motivated by this gap in research, we derive a theoretical causal model that relates to data management capabilities under the lens of the Resource-based View. We discuss relevant constructs regarding data usage and management and derive hypotheses that form our proposed research model to enable deeper investigation in the respective research field. Furthermore, our study provides substantial arguments for IT and Applications as moderating constructs, thus, data management cannot be researched individually.

Keywords

Data Management, Resource-based View, Capabilities, IT and Applications.

Introduction

The role of data for organizations increases constantly and, thus, becomes crucial for developing data-driven services, business models, and—more generally—innovation (Azkan et al. 2020; Guggenberger et al. 2020a). Technology enhances data collection and inter-organizational data sharing, offering companies the possibility to, among other, substantiate decisions on a comprehensive data basis (Legner et al. 2020). Sharing data across organizational boundaries enables access to a wide variety of sources to complement existing data resources and amplifies the emergence of so-called data ecosystems (Guggenberger et al. 2020b). To harness the variety and amount of data available today and its potential to create and sustain competitive advantages (Otto 2015), it is elementary that data management is effective in supporting the business strategy and facilitating adaptation to changing environments (Legner et al. 2020).

Several articles in information systems research emphasize the importance of data-related capabilities on business performance, drawing on the Resource-based View (RBV) of the firm, sometimes extended by the theory of dynamic capabilities. The most prominent capability under research is analytics of (big) data and its correlation to operational performance (Akter et al. 2016; Gupta and George 2016). Other scholars examined the basis of utilizing data in organizations, as they focus on data quality and governance as a prerequisite for any data-related operation (Otto 2015). Therefore, high data quality is essential for operational performance (Chae et al. 2014) and data governance practices are a crucial prerequisite for the return on invest for any organizational investment (Mikalef et al. 2018). Furthermore, Ashrafi et al. (2019) and Park et al. (2016) investigated the role of business analytics and communication technologies on dynamic capabilities, which are central for an organization's reconfiguration of resources and capabilities.

However, although data capabilities have received increasing research attention in the last decades (Legner et al. 2020), there has not been a comprehensive investigation of what they encompass and how they are interrelated. From a strategic management perspective, it is necessary to understand how different

capabilities of firms interact in creating a supportive data management for other business functions. This enables firms to analyze and develop their composition of data capabilities and foster the utilization of data resource regarding their specific needs. Thus, derived from the aforementioned, we present the following research questions: *What encompasses data capabilities in organizations* ***(RQ1)*** AND *what relationships can be identified between the individual components?* ***(RQ2)***

Data Management and the Resource-based View

The RBV, whose perspective is inward looking and explains an organization's competitiveness in terms of its unique combination of (tangible and intangible) resources and (operational) capabilities (Barney 1991; Peteraf 1993). According to Barney (1991), a temporary competitive advantage is achievable based on valuable and rare resources; to maintain these advantages, resources must be inimitable and non-substitutable. While RBV is a static consideration, the theory of dynamic capabilities extends RBV in terms of "purposeful modifications of this resource base" (Schilke et al. 2018, p. 392). Dynamic capabilities exploit internal and external resources and capabilities to create and sustain competitive advantage by responding to changes in the environment (Teece et al. 1997; Teece 2007, 2012). From the lens of dynamic capabilities, two classes of capabilities can be differentiated: Ordinary (or operational) capabilities maintain the status quo of the organization; dynamic capabilities enable strategic change (Schilke et al. 2018; Winter 2003).

Data Management is the business function of planning for, controlling, and delivering data and information assets (Mosley et al. 2010). It aims at the efficient usage of data as it includes several functions for the formulation of a data strategy, the definition of management processes, measures, standards, the assignment of roles and responsibilities (Otto 2011), and management of applications and systems (Pentek et al. 2017). Legner et al. (2020) examined the evolution of the role of data management in the business context, showing the transformation of data as a prerequisite for application development towards a strategic asset and enabler of firm's business models and value propositions (Legner et al. 2020, p. 738). Studies like Hurley (2018) use empirical data to show the value of profound data management, demonstrating that companies with advanced data strategies and investments in data management consistently outperform. Nevertheless, companies struggle to implement sufficient and effective data management activities due to manifold reasons (Hurley 2018; Legner et al. 2020). Thus, there is a need for a set of capabilities that relates to this sub-set of management activities. We address this issue by developing a theoretical causal model that relates to data management capabilities under the lens of the RBV.

Research Model and Hypothesis Development

Building on the emerging literature on data management and organizational capabilities, we propose the research model shown in Figure 1. Based on the arguments generated in this study, we analyze the relationship between ordinary, organizational, and dynamic data management capabilities. Furthermore, we examine the impact of data management capabilities on firm performance.

Drawing on the RBV, firm performance in the data economy increases when an organization exploits the full potential of resources (Akter et al. 2016). **Firm performance** describes the value donated to shareholders, customers, owners and managers and comprises competency to generate outcomes, change existing processes better than competitors and create business learning (Akter et al. 2016; Anwar et al. 2018). **Ordinary data capabilities** inherit the firm's data governance practice and data quality. According to literature, data quality is considered crucial to organizational capabilities and firm's performance, as poor data quality is costly and has consequences on decision making and operations (Chae et al. 2014). As elaborated by Chae et al. (2014) and Otto (2015) data quality is strongly linked to organizational decision-making, therefore affecting dynamic data capabilities. Furthermore, poor data quality impairs operations and communications, hence affecting organizational structure and personnel capabilities. High-quality data and its engineering in business intelligence and communication tools enables organizations to perform and transform internal processes and resources efficiently (Park et al. 2016). Beyond that, data governance affects the structure, processes and personnel of an organization through data policies, monitoring activities and user education (Mikalef et al. 2018). Following these studies and arguments, we propose the following hypotheses:

HP1a: There is a positive influence of ordinary data capabilities on organizational data capabilities

HP1b: There is a positive influence of ordinary data capabilities on dynamic data capabilities

HP1c: There is a positive influence of ordinary data capabilities on firm performance

According to the RBV, **organizational capabilities** allocate superior performance (Bharadwaj 2000). The capacity to shape value, rarity, and inimitability of resources, structure, and processes plays an important role in enhancing firm performance (Akter et al. 2016). According to Anwar et al. (2018), data personnel capabilities have significant positive impacts on firm performance (Anwar et al. 2018). Organizational personnel capabilities inherit the data skills and mindsets of employees needed to perform data mining, visualization and warehousing tasks. These skills are crucial in order to sense trends and changes in the external and internal environment. Additionally, the structural capabilities of an organization in terms of authority and locus of power influence the decision-making activities, as the structure determines how information flows within an organization and decisions are made. Thus, we propose the following hypotheses:

HP2a: There is a positive influence of organizational data capabilities on dynamic data capabilities

HP2b: There is a positive influence of organizational data capabilities on firm performance

Extending the RBV, **dynamic capabilities** are considered as a source of firm performance and competitive advantage (Helfat and Peteraf 2003; Teece 2012; Winter 2003). The capacity to integrate, build, and reconfigure resources to address environmental changes, reflects the ability to achieve and maintain competitive advantage and firm performance (Teece et al. 1997). Furthermore, this correlation is suggested Information Systems Research (Akter et al. 2016; Kim et al. 2011). Regarding data management and data analytics, Davenport (2006) explains how several organizational functions such as supply chain management, customer relations, or product quality profit from data analytics and modeling and, therefore, enhance firm performance (Davenport 2006). The ability to sense changes in customer, competitor and internal behavior through data mining, analytics, and modeling activities enables organizations to react appropriately to these changes (Ashrafi et al. 2019; Chae and Olson 2013). Dynamic data management acting capabilities enable organizations to reconfigure data resources and, e.g., create new data-driven services or products (Anwar et al. 2018). Considering these arguments, we propose:

HP3: There is a positive influence of dynamic data capabilities on firm performance

Finally, our research model examines the **moderating effects of IT**. The idea of a moderating variable relates to the premise of contingency theory, that the effect of a variable on another variable can be stronger or weaker depending on other factors, which are moderators (Chae et al. 2014).

IT ensemble of software and hardware used by an organization to support business processes. In data-driven organizations, IT is crucial as it provides the infrastructure enabling data processes and fully automated activities like data generation, analytics, visualization, or warehousing (Ashrafi et al. 2019). Gupta and George (2016) argue, that (big) data management requires novel technologies, which can handle volume, variety, and velocity to extract valuable insights from data (Gupta and George 2016). In order to realize superior performance, organizations need IT-competencies across all structural levels and IT managers for investment and deployment decisions. Studies like Cragg et al. (2002) show that IT investments and IT alignment can be crucial for organizational performance. IT is required for the usage of analytical tools and techniques to enable data capabilities for processing, analysing, visualizing, storing and sharing data (Ashrafi et al. 2019). Following these studies, we argue:

HP4a: The higher the IT Hardware and Applications maturity, the stronger the positive relationship between ordinary capabilities and organizational capabilities.

HP4b: The higher the IT Hardware and Applications maturity, the stronger the positive relationship between ordinary capabilities and dynamic capabilities.

HP4c: The higher the IT Hardware and Applications maturity, the stronger the positive relationship between organizational capabilities and dynamic capabilities.

HP4d: IT Hardware and Applications moderate the role of data capabilities on firm performance

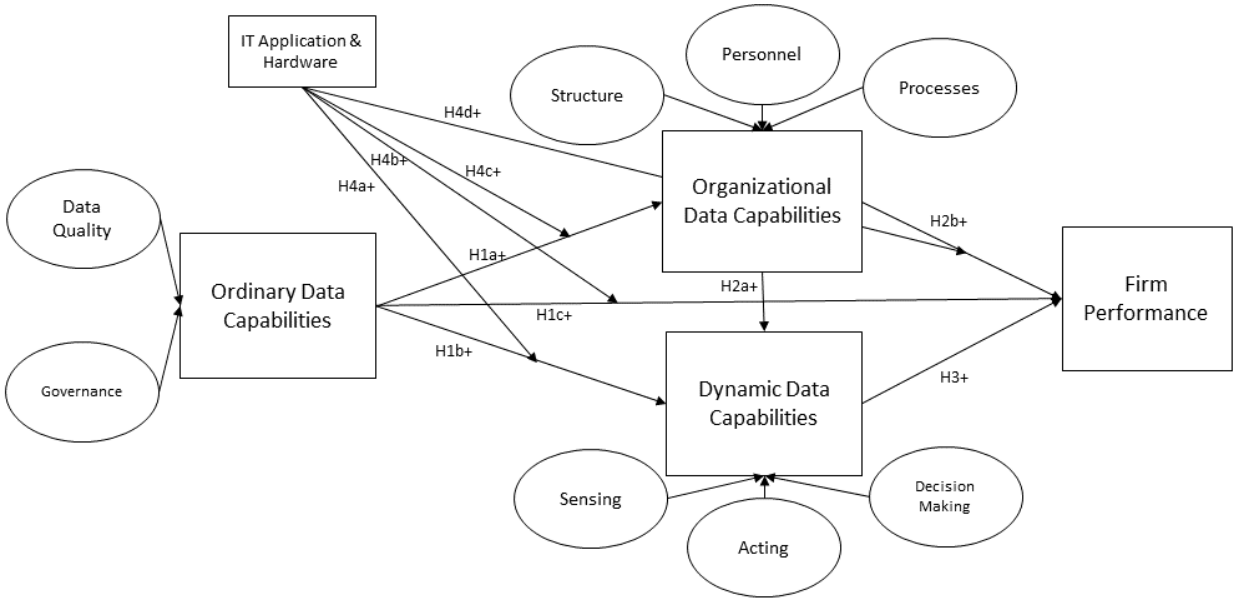

Figure 1 Data Management Capability Research Model

Research Method

We plan to test the proposed research model by conducting a qualitative analysis using statistical data extracted from a structured Likert-survey. The empirical data will be analyzed using Partial Least Squared Equation Modeling. We are collecting data from enterprises in the European area with >100 employees. The results will show indications whether the hypotheses prove to be true or show reverse or even negative correlations of the proposed constructs.

Conclusion

Our article attempts to answer questions on the capabilities required for organizational data management and their interrelationship. Therefore, we developed a causal model of data management capabilities grounded on the theory of the RBV and dynamic capabilities. To address the research questions of interrelationships among constructs, we propose hypotheses derived from theory and literature and correlated the model with firm performance. Finally, as we identified the role of information technology and applications as important for studying data management, we further elaborated both as moderators in our model. We will conduct a pretest of our measurement instrument, adjust our model with test data, and finally collect data to test our hypotheses.

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