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From data to data asset: conceptual evolution and strategic imperatives in the digital economy era

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Abstract

Purpose – The purpose of this paper is to explore the concept of data assets and how companies can assetize their data. Using the literature review methodology, the paper first summarizes the conceptual controversies over data assets in the existing literature. Subsequently, the paper defines the concept of data assets. Finally, keywords from the existing research literature are presented visually and a foundational framework for achieving data assetization is proposed.

Design/methodology/approach – This paper uses a systematic literature review approach to discuss the conceptual evolution and strategic imperatives of data assets. To establish a robust research methodology, this paper takes into account two main aspects. First, it conducts a comprehensive review of the existing literature on digital technology and data assets, which enables the derivation of an evolutionary path of data assets and the development of a clear and concise definition of the concept. Second, the paper uses Citespace, a widely used software for literature review, to examine the research framework of enterprise data assetization.

Findings – The paper offers pivotal insights into the realm of data assets. It highlights the changing perceptions of data assets with digital progression and addresses debates on data asset categorization, value attributes and ownership. The study introduces a definitive concept of data assets as electronically recorded data resources with real or potential value under legal parameters. Moreover, it delineates strategic imperatives for harnessing data assets, presenting a practical framework that charts the stages of "resource readiness, capacity building, and data application", guiding businesses in optimizing their data throughout its lifecycle.

Originality/value – This paper comprehensively explores the issue of data assets, clarifying controversial concepts and categorizations and bridging gaps in the existing literature. The paper introduces a clear

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conceptualization of data assets, bridging the gap between academia and practice. In addition, the study proposes a strategic framework for data assetization. This study not only helps to promote a unified understanding among academics and professionals but also helps businesses to understand the process of data assetization.

Keywords Data assets, Conceptual evolution, Strategic imperatives, Literature review

Paper type Literature review

1. Introduction

The current wave of the global scientific and technological revolution has ushered in a novel era governed by digitalization and intelligence (Oztemel and Gursev, 2020; Shi *et al.*, 2022). The mounting importance of data in virtually all facets of a digital society, spanning government, business, finance and education (McAfee *et al.*, 2012; Gunther *et al.*, 2017). As data continues to be harvested for value, its significance has assumed new dimensions, with implications beyond its utility as a mere commodity (Leonelli, 2019). As market mechanisms and laws surrounding data have been established, it has become a widely accepted notion that data possesses asset properties. Various metaphors have been used to underscore the importance and value of data as a critical resource for companies, with some equating the significance of data to that of human and financial resources (Grover *et al.*, 2018; Rajnoha and Hadac, 2021). In response, enterprises are looking to capitalize on their data assets to generate novel value and acquire a competitive edge (Brinch *et al.*, 2021). The focus on data assets is reflective of their strategic significance for businesses in the current digital milieu.

However, the definition and scope of enterprise data assets have been widely debated in academic literature. The origins of this notion can be traced back to 1974, which initially introduced the concept with a relatively limited scope (Peterson, 1974). Because then, as technological advances enabled greater data processing capabilities, the significance of data assets became increasingly apparent. In 2009, the International Data Management Association recognized data as an essential corporate asset in the information age, underscoring the critical need for effective data management across all organizations (Brackett and Earley, 2017). Building on this foundation, Fisher (2009) posited that data assets were non-exhaustible and non-diminishing long-term resources for organizations. After that, the connotations of the concept of data assets have continued to evolve and expand, reflecting the growing recognition of the pivotal role that data plays in contemporary society. Although it is generally accepted that data assets are an important resource for companies and can be used to gain a competitive advantage, there is still no consensus in the existing literature on the definition of data assets.

In addition, how to effectively leverage the value of data assets at a strategic level has also emerged as a pressing topic of discussion. The existing literature extensively examines the strategic imperatives that firms must embrace to achieve data assetization (Awan *et al.*, 2021). For instance, Li *et al.* (2022a) assert that companies must adopt a data-driven approach to business, focusing on data quality, governance and analysis. Dubey *et al.* (2019) underline the importance of fostering a data-literate culture whereby all members of the organization are equipped with skills in data analysis and interpretation. Additionally, scholars emphasize the need for companies to invest in technologies for data management and analysis, as well as the human capital and processes required to efficiently manage data assets (Janssen *et al.*, 2017; Wamba *et al.*, 2017; Vial, 2019).

Although prior research has discussed the notion of data assets and strategies for data assetization to some degree, there are still gaps that require further investigation. Specifically, there are numerous controversies rather than consensus in understanding the definition of data assets. Furthermore, current studies have yet to offer a comprehensive

view of the strategic process of data assetization. To address these gaps, this study uses a literature review methodology to examine the definition of enterprises' data assets and outline the strategic imperatives for achieving data assetization. This study aims to answer the following research questions:

RQ1. What are the evolution and controversies of the concept of data assets?

RQ2. How to define data assets in the context of the digital economy?

RQ3. What are the strategic imperatives for enterprises to achieve data assetization?

This paper uses a literature review to address the above research questions related to the concept of data assets and data assetization strategies. Section 2 provides an overview of the research methodology used. In Section 3, the conceptual evolution and the controversies for understanding data assets are presented. The definition proposed by this paper is listed in Section 4. Section 5 elaborates on the strategic imperatives for enterprises to achieve data assetization, detailing the process from a strategic perspective. Finally, Section 6 presents the conclusions and implications of the study.

2. Methodology and data

2.1 Methodology

This paper uses a systematic literature review approach to address the three research questions. To establish a robust research methodology, this paper takes into account two main aspects. Firstly, it conducts a comprehensive review of the existing literature on digital technology and data assets, which enables the derivation of an evolutionary path of data assets and the development of a clear and concise definition of the concept. Secondly, the paper uses Citespace, a widely-used software for literature review, to examine the research framework of enterprise data assetization.

2.2 Data collection

This study focuses on a core collection derived from the Web of Science, encompassing prominent journal source databases such as social science citation index, science citation index and emerging sources citation index. These databases are widely recognized for their meticulous selection criteria and rigorous peer-review processes, which serve to guarantee the publication of articles that adhere to high-quality standards. In addition, supplementary records from diverse sources, including white papers, working papers, reports and website articles, were also identified and considered. The detailed selection procedure and the conclusive outcomes of this process are visually depicted in Figure 1.

The search criteria for relevant articles were set as the inclusion of search terms "data assets," "digital assets" or "big data" in conjunction with "strategy," with articles published between 2012 and 2022. The selected timeframe is justified for two main reasons. Firstly, the year 2012 marked a significant milestone with the launch of the "Big Data Research and Development Initiative" by the US federal government. This initiative prompted various countries to formulate their own action plans and strategies in the field of big data. Secondly, the past decade has witnessed the remarkable advancement of digital technologies, which have played a crucial role in supporting the development of data assets. In conducting our literature search, the research team strategically filtered the database classification to concentrate on the management and business areas. This refinement was driven by our specific interest in exploring the issue of data assets at the corporate level, focusing on the strategic implications and managerial aspects within organizations.

Source: Figure by authors

Figure 1.
Process of selection of the literature

3. The evolution and contradictions of data assets (*RQ1*)

3.1 The evolution of data assets

Data has been a fundamental aspect of human activity since ancient times. As technology has advanced, the amount and complexity of data that can be collected, stored and processed have grown significantly, as demonstrated in Figure 2. In the early 19th century, researchers used various tools to observe and study data related to the workings of the universe, seeking to understand the underlying principles (Gantz and Reinsel, 2011). During the 20th century, advancements in computer science facilitated the development of increasingly sophisticated data processing capabilities. The advent of the internet in the latter part of the century revolutionized data dissemination, leading to an exponential growth in the amount of data available for analysis and interpretation (Ghobakhloo and Ching, 2019).

Since the turn of the 21st century, advancements in technology such as cloud computing, the Internet of Things and artificial intelligence have greatly enhanced data processing capabilities, leading to a significant increase in the value of data (Li *et al.*, 2021). These technological innovations, combined with changes in the perception of data, have driven the emergence of data as a resource for organizations (Rialti *et al.*, 2019a). As data continues to

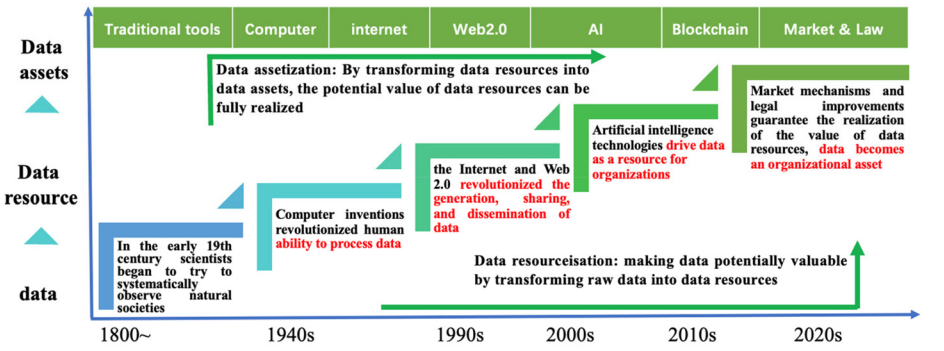


Figure 2.
Evolution of data assets and digital technology

Source: Figure by authors

be harvested for value, its significance has assumed new dimensions, with implications beyond its utility as a mere commodity (Leonelli, 2019). As market mechanisms and laws surrounding data have been established, it has become a widely accepted notion that data possesses asset properties.

3.2 The controversies of understanding data assets

Data assets play a vital role in modern organizations, enabling informed decision-making, innovation and competitive advantage. However, a lack of consensus regarding their definition hinders a unified understanding and effective management of these valuable resources. This section aims to identify and examine the contradictions in the understanding of data assets, shedding light on the varying perspectives and interpretations in the field.

3.2.1 Types of data considered. The definition of data assets presents a notable contradiction regarding the types of data encompassed. Some scholars assert that data assets should solely encompass electronically recorded data, particularly emphasizing digitized data (Wang, 2019; Ye *et al.*, 2019; Veldkamp, 2023). This viewpoint highlights the convenience and ease associated with managing digitized data. For example, Wang (2019) believes that the value of data must be realized on the basis of large-scale analysis, thus, electronic records are necessary.

Conversely, alternative research posits the inclusion of all recorded data, regardless of its format, encompassing both paper and electronic records. This perspective recognizes that paper records can still possess significant information and value within specific contexts (Birch *et al.*, 2021; Hannila *et al.*, 2022). Such a comprehensive stance acknowledges the diverse and intricate nature of data assets.

3.2.2 Assessment of economic value. The valuation of data assets is subject to differing perspectives, giving rise to various viewpoints. One camp maintains that only data that directly contribute to business revenue or decision-making should be classified as data assets. This perspective accentuates the immediate economic value and practicality of data, establishing a correlation between the value of data assets and their impact on an organization's business objectives (Li *et al.*, 2022b). Within this framework, data assets are regarded as resources whose worth resides in their direct influence on enterprise operations and decision-making processes (Xie *et al.*, 2016; Birch *et al.*, 2021; Hu *et al.*, 2022). Conversely, proponents of an alternative stance argue that certain data may currently lack direct economic value but possess the potential to yield benefits and create value for the business

as data accumulates over time (Hannila *et al.*, 2022). This viewpoint underscores the long-term prospects and strategic value inherent in data assets.

3.2.3 Consideration of data ownership. The issue of data ownership is also an area of current controversy regarding the definition of a data asset. Some argue that only data that is owned, controlled and at the disposal of the business itself can be defined as a data asset, as only this data can be effectively managed and used to achieve the business objectives of the business (Hannila *et al.*, 2022; Hu *et al.*, 2022; Li *et al.*, 2022b). This view emphasizes the importance of ownership and controllability of data assets.

However, others argue that the definition of data assets should be broader to include all data that is useful to the business and not just limited to data owned by the business itself. For example, public data and open data can also be data assets for businesses, as they can provide valuable information and insights (Douglass *et al.*, 2014; Birch *et al.*, 2021). In addition, as there is no clear legal basis for defining data ownership, it has become common practice to obtain authorization from the relevant subjects. To hedge the risks associated with the use of data, the concept of usage rights for data has been introduced, which means that data with the right to use should also be considered as data assets (Perrons and Jensen, 2015; Xu *et al.*, 2022).

4. The definition of data assets (*RQ2*)

Based on the discussion of the above points of contention this paper defines data assets as follows:

Data assets are data resources that are owned or controlled by an enterprise and have real or potential value, comply with data laws and are recorded electronically.

As an important asset of an enterprise, data assets are of great significance in decision-making, business development and innovation. Such a definition highlights the importance and strategic value of data assets to the business, while also focusing on legality, electronic records and the value potential of the data. Such a definition can help businesses to clarify the scope of their data assets and provide guidance on how to manage, protect and effectively use their data. To be specific:

Firstly, data assets, as resources owned or controlled by the business, emphasize the ownership or control that the business has over these data. This means that the business has the right to decide how to use, manage and protect these data resources to achieve its business objectives and strategic vision. It should be noted that the management and use of data have to comply with the legal requirement, including data privacy protection, data security and compliance requirements.

Secondly, data assets have real or potential value. Real value refers to the direct economic and business benefits of the data at the current stage to the operations, decision-making and revenue generation of the business. Potential value refers to the growth, innovation and competitive advantage that data may bring in the future. The definition of data assets places the focus on both real and potential value, emphasizing the strategic importance of data assets to the business and their impact on long-term growth.

Finally, the definition of a data asset emphasizes the use of electronic means of recording data. This reflects modern trends in data processing and storage for businesses, with electronic records providing greater reliability, accessibility and manageability. Through electronic records, data assets can be better analysed, integrated and shared, leading to more efficient data utilization and value creation.

5. The strategic imperatives of data assetization (*RQ3*)

The recognition of data assets as a fundamental concept has instigated a significant emphasis on the process of transforming data into valuable assets within the context of business operations. To address the third research question pertaining to the strategic imperatives necessary for enterprises to attain data assetization, the Citespace was used as a visual tool to analyse prominent keywords in the extant literature. This analysis served to facilitate the development of a comprehensive data assetization strategic framework, as visually depicted in Figure 3.

Notably, the analysis of high-frequency words reveals prominent terms such as "resources", "technology", "capabilities" and "business model", among others. Through a more refined categorization of these keywords, it becomes evident that they can be effectively grouped into three main categories: resources, capabilities and applications, as outlined in Table 1.

Drawing inspiration from the identification of high-frequency keywords, this study posits that the process of enterprise data assetization can be condensed into three distinct steps: data resource investment, data capability building and data application, as shown in the Figure 4. In this context, the term "resources" encompasses the human, technical and data-related assets that companies use to effectively analyze and leverage data assets. The notion of "capabilities" pertains to the problem-solving proficiencies that companies develop

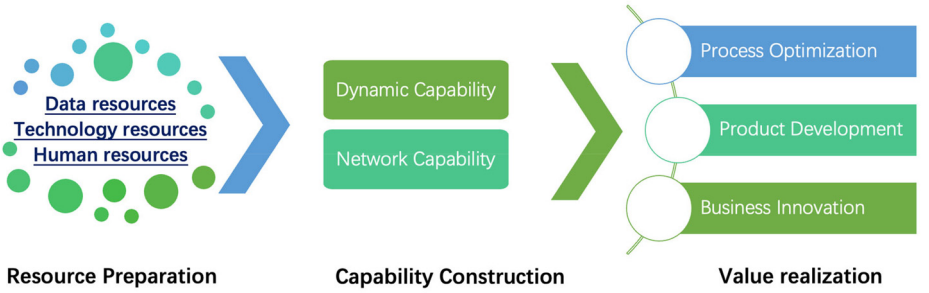
Figure 3.
High-frequency keywords

Source: Figure by authors

Resources	Big data, information technology, artificial intelligence, human resources and data quality
Capabilities	Dynamic capability, big data analytics, predictive analytics and innovation
Data applications	Business model, decision-making, supply chain management, competitive advantage and firm performance

Table 1.
Classification of high frequency keywords

Source: Table by authors



Source: Figure by authors

Figure 4.
Data assetization framework

to overcome the obstacles and challenges encountered during the data assetization process. Within the scope of this paper, the realization of value from data predominantly manifests in the data application phase. These applications empower firms to augment net revenues and reduce net costs, thereby enabling firms to capitalize on opportunities and mitigate potential threats.

5.1 The preparation of the resource

In the modern landscape of information-centric economies, the strategic optimization and utilization of enterprise data have emerged as pivotal elements. Recognizing the growing imperatives of harnessing data for competitive advantage, it becomes essential to comprehend the foundational resources that underpin successful data capitalization within businesses. This section endeavours to encapsulate these critical prerequisites for the efficacious assetization of enterprise data. Specifically, this paper will explore three core components: the imperative of pristine data quality, the necessity of a robust infrastructure and the value of interdisciplinary expertise. By drawing upon a synthesis of extant research and academic literature, this discourse not only offers an exhaustive insight into the significance of these resources but also elucidates their integral role in facilitating data-centric decision-making processes, thereby fostering enterprise expansion and innovation.

5.1.1 High-quality data resources. High-quality data serves as the foundational resource for enterprise data assetization. Scholars have emphasized the importance of accurate, complete and timely data for informed decision-making (Taleb *et al.*, 2021; Li *et al.*, 2022a). Quality data enables organizations to gain valuable insights, understand market trends and predict customer behaviour. It provides a solid foundation for data analysis, modelling and visualization, enabling organizations to make data-driven decisions with confidence (Escobar *et al.*, 2021; Li *et al.*, 2022a).

According to Caballero *et al.* (2022), organizations have to implement effective data quality management measures to ensure data reliability and trustworthiness. It involves defining data standards and implementing data quality controls, including data collection, cleansing, integration and maintenance (Anil and Satish, 2019). Organizations need to designate data stewards who are responsible for ensuring data quality, resolving data-related issues and promoting data governance practices within the organization (Caballero *et al.*, 2022).

5.1.2 Well-established infrastructure. The researchers also stress the presence of robust infrastructure is imperative for successful data assetization (Gunther *et al.*, 2017; Wamba *et al.*, 2017). Organizations must possess appropriate hardware and software infrastructure

to support data storage, processing and analysis. Sound infrastructure provides the necessary computational power, storage capacity and network connectivity to handle large volumes of data and perform complex data analytics tasks (Gupta and George, 2016).

From the existing literature, several key characteristics a sound infrastructure are summarized. Firstly, it should be scalable to accommodate the ever-increasing data volumes and processing requirements. As organizations collect and analyse more data, their infrastructure should be able to scale up or down to meet the changing demands (Helfat and Raubitschek, 2018). Secondly, it should be secure to protect sensitive data from unauthorized access, ensuring data privacy and compliance with relevant regulations (Shamim *et al.*, 2019). Thirdly, it should be reliable to ensure uninterrupted data access and availability. Downtime or system failures can result in significant disruptions and financial losses for organizations.

5.1.3 Cross-disciplinary digital talents. Interdisciplinary talent is also recognized by researchers as playing a pivotal role in driving enterprise data assetization (Wamba *et al.*, 2017; Shamim *et al.*, 2019; Vial, 2019). The process requires expertise from various domains, including data science, statistical analysis, machine learning and business acumen. Cross-disciplinary talent brings diverse perspectives and skills to the table, enabling organizations to extract meaningful insights from data and derive actionable recommendations. Collaborative teamwork enables a holistic approach to data assetization, combining technical skills with domain knowledge to uncover valuable insights and develop data-driven strategies. Effective communication and collaboration among team members are crucial to ensure the successful implementation of data assetization initiatives (Vial, 2019).

5.2 The construction of the capability

Despite the limited published research on the process of data assetization, some studies have focused on the challenges that companies face during the implementation of big data projects (Hariri *et al.*, 2019; Qi and Luo, 2020). Especially in the information system area, practitioners and researchers recognize that realizing the value of data assets is not only a result of the data and the analytical tools and processes but also includes a broader range of aspects (Hummel *et al.*, 2021). The big data analytics (BDA) capability has been proposed and defined as an organization's ability to mobilize and deploy data analytics-related resources in combination with marketing resource and capabilities, which constitutes an innovative information technology (IT) capability that can improve firm performance (Gupta *et al.*, 2020). The notion of BDA capability extends the view of big data to include all related organizational resources that are important in leveraging data resources to their full strategic potential (Bertello *et al.*, 2021).

This section aims to provide a systematic understanding of BDA, which has been further decomposed into dynamic capabilities to adapt to the digital economy and network capabilities to connect the digital ecosystem. It is believed that in industrial practice, as the recognition of the importance of data assets, the organization started to pay attention to the construction of data asset capability. With the deepening of cognition and understanding of data resources, capabilities are also continuously accumulated in data assetization. It is also a process to solve the organization's problems and concerns during its data assetization journey. Dynamic capability and network capability are the key capabilities that firms need to have in this process.

5.2.1 Dynamic capability to adapt to digital economy. Teece put forward the concept of dynamic capabilities, defining dynamic capabilities as "the firm's ability to integrate, build and reconfigure internal competencies to address, or in some cases to bring about, changes in the business environment (Peteraf, 1993)". Thus, dynamic capabilities analyse a firm's renewing ability to create and capture value in response to the ever-changing external

environment. Digital technology is changing with each passing day, which also makes the environment of the digital economy constantly updated and changed. As Tabrizi *et al.* (2019) noted, the extended use of advanced IT, such as analytics, mobile computing, social media or smart embedded devices and the improved use of traditional technologies, such as ERP, enable significant business improvement. While facing these digital technology evolutions, organizations must decide what capability a firm needs to develop in data assetization (Chanias, 2017).

Dynamic capability is defined in this paper as an organization's ability to adapt and effectively manage data in a rapidly evolving digital age. It includes aspects such as real-time data acquisition and integration, data quality management, agile data exploration and analysis and adaptive decision-making. Dynamic capabilities enable organizations to leverage the value of evolving and fluid data sources and ensure that their data assets remain relevant and valuable. In this paper, by combing the existing literature, the corresponding dynamic capabilities are summarized in Table 2. The first and second columns of the table contain the names and descriptions of the competencies, and the third column contains the context of the capabilities required for data assetization in the context of the digital economy.

5.2.2 Network capability to connect to the digital ecosystem. In a digitally intensive world, organizations operate in a digital ecosystem that is loosely coupled with its ecosystem partners. These digital business strategies are far more complex than tight supply chains with partners in traditional industries. The digital business strategy extends the scope beyond firm boundaries and supply chains to the dynamic ecosystem that crosses conventional industry boundaries; however, this requires a rethink of how to standardize IT infrastructure and the business processes around it (Bharadwaj *et al.*, 2013). It also requires digital agility to respond to rapidly changing ecosystem conditions. Strong network capability helps organizations adapt to the new environment and emerging digital ecosystem, and at the same time, data asset supports the organization's robust IT infrastructure.

In this paper, network capability is defined as an organization's ability to connect and collaborate with external platforms and ecosystems. It includes aspects such as collaboration and partnerships with businesses, data sharing and integration and platform and ecosystem integration. Network capabilities enable organizations to share data, knowledge and resources with other entities, expanding the scope and reach of their data assets. The three network capabilities mentioned in this paper are shown specifically in Table 3. In Table 3, the first and second columns are the names and descriptions of the capabilities, and the third column is the context of the capabilities required for data assetization.

5.3 Application of data assets

In the process of data assetization, with the preparation of resources and the construction of capabilities, the assetized data will also provide the enterprise with enhanced potential to derive business value from its value chain and from a broader business ecosystem level (Mazumdar *et al.*, 2019; Nadal *et al.*, 2019). Concurrently, a data asset strategy introduces additional dimensions that transform the nature of value creation and capture. Through the application of data asset, companies can optimize each link in the value chain, improve efficiency, reduce costs, increase revenue and create greater business value together with partners in the business ecosystem (Faroukhi *et al.*, 2020; Line *et al.*, 2020). Cross-organizational data sharing and integration can also bring broader opportunities for business ecosystem collaboration and innovation, promoting the development of the entire

Table 2.
Dynamic capability to adapt to digital economy

Capability	Description	Environmental requirements	References
Real-time data acquisition and integration	Timely capture and integration of real-time data from various sources	Robust and highly available data architecture and technologies	Pigni *et al.* (2016) Brinch *et al.* (2021)
Scalable data storage and processing	Efficient storage and processing of large volumes of data using technologies such as distributed computing and cloud infrastructure	Scalable storage and processing capabilities, support for cloud computing and distributed computing platforms	Akter *et al.* (2016) Mikalef *et al.* (2018)
Data visualization and reporting	Presenting data in visual and easily understandable ways, facilitating data-driven insights and effective reporting	Powerful data visualization tools and techniques, report generation functionality that is easy to understand and use	Lin and Kunnathur (2019) Shamim *et al.* (2020)
Data privacy and security	Protection practices and measures for sensitive data, ensuring compliance and guarding against unauthorized access or violations	Data encryption and access control mechanisms, organizational culture and policies emphasizing compliance and security	Brinch *et al.* (2021) Quach *et al.* (2022)
Data quality management and governance	Implementation of practices and processes to ensure data accuracy, consistency, completeness, and timeliness	Clear data quality standards and specifications, establishment and enforcement of data quality monitoring and governance mechanisms	Kwon *et al.* (2014) Taleb *et al.* (2021)
Agile data exploration and analysis	Rapid use of agile methods and advanced analytical techniques for data exploration and analysis	Flexible data access and analysis tools, agile development processes with fast iteration and real-time feedback	O'Driscoll (2016) Rialti *et al.* (2019b)

Source: Table by authors

Capability	Description	Environmental requirements	References
Partnership and collaboration	Establishing strategic partnerships and collaborations with external platforms and ecosystems to leverage resources and co-create value	Identification and selection of compatible partners, establishment and maintenance of collaborative relationships	Du *et al.* (2012) Akhtar *et al.* (2019) Junaid *et al.* (2022)
Data sharing and integration	Enabling seamless data sharing and integration with ecosystem partners to facilitate mutual benefits and value creation	Adoption of data sharing standards and protocols, compatibility with partners' data systems and technologies	Li *et al.* (2016) Mazzei and Noble (2017)
Platform and ecosystem integration	Developing and managing platforms that facilitate connections and interactions with external platforms and ecosystems, enabling value exchange and innovation	Development and maintenance of scalable and adaptable platforms, effective governance and management of platform ecosystems	Rong *et al.* (2013) Bourne *et al.* (2015) Clough and Wu (2022)

Source: Table by authors

Table 3.
Network capability to connect to the digital ecosystem

ecosystem (Mazumdar *et al.*, 2019). This section reviews and summarizes the key advantages that data assets can bring in assisting organizations to achieve value realization.

5.3.1 Process optimization. Data assets underpin the strategic recalibration of operational processes within organizations, acting as catalysts for informed decision-making, fostering operational efficiency, curtailing operational expenditure and forecasting emergent trends. These assets catalyse a coherent integration of endeavours within the organization and throughout the value chain, bolster strategic approaches to supply chain management, stimulate initiatives geared towards revenue augmentation and enhance the quality quotient of customer service (Verma *et al.*, 2020). These assets engender a harmonious synchronization of activities within the organization and across the value chain, fortify supply chain management strategies, invigorate revenue-generating initiatives and elevate the calibre of customer service. The ultimate implication is a tangible enhancement in profitability (Dicuonzo *et al.*, 2019).

Drawing upon an extensive review of extant literature, it is possible to distill three quintessential tiers at which data assets can induce a positive metamorphosis in the realm of internal process optimization within an organization. These levels reflect the transformative capacity of data as an asset, and their intricate interplay could furnish organizations with a competitive advantage in an increasingly data-centric business landscape. Firstly, data can improve operational efficiency by providing real-time insights into various processes. For instance, in manufacturing, data from internet of things devices can be used to monitor machine performance, enabling predictive maintenance and reducing downtime (Dubey *et al.*, 2019). Secondly, at the managerial level, data assets provide crucial insights for informed decision-making and strategic planning. Managers can use performance metrics, financial data and other internal data to set realistic goals, allocate resources efficiently and monitor progress effectively

(Tabesh *et al.*, 2019; Huang *et al.*, 2021). Thirdly, at a strategic level, data assets inform long-term planning and direction. Data on market trends, competitive forces and internal capabilities can be used to formulate strategies that align with the organization's overall goals and the market landscape (Sestino *et al.*, 2020).

5.3.2 Product development. In the domain of product development, the importance of data assets is self-evident. They furnish pivotal insights that drive optimization of existing products and innovation in new product development (Ghasemaghaei and Calic, 2020). In the context of existing product improvement, data assets unveil valuable information about user experiences and product performance. For instance, customer feedback, usage statistics and fault reports can spotlight areas that necessitate refinement (Dai *et al.*, 2020). Consequently, enterprises can continuously ameliorate their products, augment user satisfaction, reduce attrition and ultimately elevate the market value of the product. In terms of new product development, data assets deliver critical insights into the market and consumer predilections. They aid in discerning emergent trends, comprehending unmet customer needs and assessing the competitive environment. These insights propel the ideation process for new products and streamline product testing and roll-out procedures, increasing the probability of success in the marketplace (Kamble and Gunasekaran, 2020).

5.3.3 Business model innovation. Business model describes how organizations create and capture values (Osterwalder *et al.*, 2005) and represents the realized strategy (Casadesus-Masanell and Ricart, 2010). In this context, it is useful to discuss business model to gain a general understanding of how data asset help organizations identify opportunities and the numerous routes to their realization. Although big data or data asset business model is still in its infancy, there has been a significant growth in studies on the subject (Wiener *et al.*, 2020).

Wixom and Ross (2017) highlighted three ways that businesses can benefit from data. Firstly, organizations can use data and analytics to enhance internal processes in terms of efficiency and effectiveness (Woerner and Wixom, 2015). Secondly, they can use data to enrich their products, services and customer experiences. Thirdly, organizations can profit from its internal data by offering it for sale to external parties. It should be noted that various business models do not necessarily conflict with one another and that many organizations participated in the digital economy through a variety of channels. Schroeder (2016) summarized three types of data roles. Firstly, data user, leverage data for internal strategic decision and building data into products. Secondly, data supplier gathers raw data and packaging data for sale. Thirdly, data facilitator provides services for users and suppliers on infrastructure and analysis.

Accessing new data sources and techniques and using them to improve the efficiency and effectiveness of current processes is one way to use analytics of the data asset. This approach allows organizations to leverage data while essentially maintaining their current operations but doing it more effectively and efficiently (Gunther *et al.*, 2017).

This paper argues that data assets empower organizations more effectively to drive business model improvement and innovation. *When data becomes an asset, it encourages organizations to securely store their data and monetize their data resource, stimulating the liquidity of the data asset and effectively governing its data asset.*

6. Conclusion and discussion

The paper makes significant contributions to the field of data assets, which are summarized as follows.

Firstly, the paper elucidates the evolving perceptions of data assets in tandem with the advancement of digital technology. Additionally, it addresses contentious issues found in the existing literature regarding the perception of data assets, such as the categorization of data assets, attributes of value and data ownership. By clarifying these debates, the paper enhances understanding in the field and establishes a shared comprehension among researchers and practitioners, thereby promoting further discussion and research in this domain.

Secondly, the paper provides a clear and comprehensive conceptualization of data assets, addressing the lack of consensus and controversy surrounding their definition. It defines data assets as data resources owned or controlled by an enterprise that possess actual or potential value, adhere to data laws and are recorded in electronic form. This contribution not only fosters a common understanding among scholars and professionals but also facilitates subsequent discourse and research on data assets.

Finally, the paper presents strategic imperatives for data assetization, tracing their development within the context of digital technology advancements and the recognition of big data. This trajectory offers valuable insights into the progressive nature of data assets and their escalating significance in the business realm. The paper introduces a practical framework encompassing stages of "resource readiness, capacity building, and data application". This framework serves as a guide for organizations seeking to effectively harness their data assets throughout the data lifecycle.

In future research, it is imperative to address several key aspects that warrant further attention and discussion. Firstly, there is a need for a comprehensive exploration of the specific challenges encountered by enterprises during the process of data assetization. The rapid advancement of artificial intelligence technologies, particularly the widespread adoption of large-scale generative models like ChatGPT, has presented new challenges to data assetization. These challenges encompass critical areas such as data ownership, data privacy protection and data quality, necessitating in-depth investigations. Secondly, while this paper proposes a data assetization process constructed based on existing literature, its practical applicability within business operations requires thorough empirical validation. Conducting case studies to examine the implementation of the framework across diverse organizational contexts will enhance its practical relevance and effectiveness. Finally, the treatment of data as an asset necessitates the exploration of methodologies to accurately reflect the value of data assets in an enterprise's balance sheet. Achieving this objective will require collaborative efforts among government entities, academia and the business community to develop comprehensive guidelines and standards. Such endeavours will facilitate improved valuation and management of data assets, providing robust support for business decision-making and strategy formulation.

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