

Data Matters: A Strategic Action Framework for Data Governance

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ABSTRACT

While there has been a wealth of research exploring data governance, there are still some gaps in how firms deploy data governance and what strategic actions they take to do so, especially as the volume of data increases dramatically and the pace of data assetization accelerates. To achieve this end, through an in-depth case study of a Chinese gold mining company, namely Shandong Gold, we develop a framework to explain how firms configure data governance activities and conduct related strategic actions. Our study identifies four key data governance activities that are supported by two strategic actions. Overall, we contribute to research in data governance and strategic action fields and also provide an alternative implementation framework for practitioners.

1. Introduction

With the emergence and development of various types of technologies, previously unimaginable data on almost all aspects of business operations and production, organizational behavior, etc. can be collected, stored, and analyzed [1, 11, 35]. According to the Statista reports, the total amount of global data is showing exponential growth, with data volumes set to grow from 33 zettabytes in 2018 to 2,100 zettabytes in 2035 [84]. This has led to a constant need for companies to think about how to derive value from the ever-increasing amount of data [96]. Consequently, these data are also considered the “oil” of the digital age [77, 91]. A persuasive example of this is that the Chinese government released two consecutive guidelines in 2020 that explicitly juxtapose data with factors of production such as land, labor, capital, and technology, further highlighting the critical value of data as a factor [92, 93]. In addition, there is a more general recognition that data are considered a proprietary asset of the organization [53, 67, 95]. Whether it is to cope with the dramatic increase in data volumes or to turn data into an asset, organizations need to formulate a data governance strategy [2].

Data governance is a broad concept, and current research tends to divide it into two streams. One stream of research views data governance as the exercise of decision-making authority and control over data (DAMA [27]) in order to transform it into assets [53, 67, 95]. This stream, therefore, focuses more on the applicability of data and the value attributes of data as an asset. The other research stream sees data governance as addressing data quality, privacy, and security [2, 6, 8] to

ensure data availability [67]. Consequently, this research stream places more emphasis on the application of data governance to data processing.

However, the concepts related to data governance have always been challenging to integrate due to differences in viewpoints. Based on our understanding, we attempt to integrate the two research streams to conduct our work. We consider data governance as the disciplined and legitimate management of data into a strategic asset for the enterprise, with the intervention of certain procedures, rules, and even values [2]. And sound practices of data governance can enable enterprises to transition to the digital track faster [61]. For example, many large enterprises such as IBM, Google, SAP, etc. devote a great deal of attention to data governance. These companies see data governance as an important way to accelerate decision-making, increase legitimacy, and improve collaboration [57]. According to a McKinsey report, however, enterprises spend an average of 30% of their time on non-value-added tasks due to poor data quality and availability [72]. The reason for this is due in large part to vague data governance processes [7]. Moreover, the existing literature on the elements of data governance focuses on its cross-functional domains, models, data standards, and so on (for the recent literature review, see [2, 6, 8]). The scattered research focus hardly provides an integrated analytical framework for academics and practitioners. Further, the lack of research is surprising as the importance of data in business continues to increase. Therefore, we pose our first research question: *how do enterprises deploy data governance?*

We need to acknowledge that the existing literature makes some attempts to address this question. The development of data governance activities can be demonstrated through a range of strategic

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actions—specific actions undertaken by the firm to ensure the smooth deployment of data governance (e.g., [6]). For example, Dai et al. [25] highlighted the importance of digital technologies in improving the data quality in the process of data governance. Additionally, Benfeldt et al. [11] theorized the six challenges of data governance by considering it as a collective action. Micheli et al. [61] also pointed out the arrangement of the roles and relationships between stakeholders required to conduct data governance. All these studies undoubtedly emphasize the importance of technology, participants, and relationships; begin to call for the strategic actions needed to advance data governance (e.g., [55, 61]). Unfortunately, it is not difficult to see from the representative literature above that the research that has been conducted so far is very much focused on a single action that firms undertake to deploy data governance, which tends to emerge in a fragmented manner. However, to benefit from various data (successful deployment of data governance), companies typically need to develop tangible and intangible resources (implement strategic actions), such as technology, collaboration, leadership, corporate culture, etc. to underpin the process [79, 87, 100]. Therefore, to deepen the understanding of strategic actions to advance data governance, we hope to provide a relatively well-developed strategic action framework to explain the key processes of enterprise data governance deployment. Hence, the second research question is a further explanation of *what strategic actions play a crucial role in explaining this importance and how they are sustained*.

Given the limited and vague theoretical insights, we address the above questions and lacunae by examining a single case in depth [30, 31, 80]. We reviewed the practice of data governance at Shandong Gold (hereafter referred to as Gold). As a gold mining company in China, Gold put forward the strategic goal of building digital mines in 2007 and, in addition, international first-rate model mines in 2017, placing digital mine and data governance at the core. After a series of activities and changes, Gold has become a leading global mining company [21]. To present our case, we have assembled our database using interviews, media and press coverage, industry reports, internal documents, and so on.

Our findings inform a deeper understanding of the configuration of data governance and, in addition, contribute to data governance and strategic action fields by developing a framework. Firstly, we provide four aspects of deployment based on an integrated concept of data governance, i.e., data collaboration, perceptions of data potential, developing capabilities, and the establishment of data legitimacy. Secondly, by detecting strategic actions undertaken to configure data governance activities, i.e., investment in digital technologies and design of governance mechanisms, we promote research at the intersection of strategic action fields and data governance. Finally, we enrich the research on the consequences of data governance by proposing a concept of data legitimacy.

2. Theoretical background

2.1. Why data governance matters

As digital transformation is becoming an important way for companies to gain new growth advantages, data has become an essential strategic resource for companies [9, 15, 40]. To this end, many firms have created dedicated departments or teams around data collection, analysis, and integration [96] to coordinate all aspects of data governance, innovation, and strategy implementation [43, 66, 83, 99], as well as to deal with the increasing pressure on data [74, 101]. It is worth noting that China has identified data as another factor of production in addition to land, labor, capital, and technology [92, 93]. This shows that national policy, management practice, and theoretical research have begun to pay much attention to data governance [2].

The growing importance of data governance is a concept that has developed over the past decade and is gradually gaining widespread scholarly attention (e.g., [2]). One research stream considers data

governance as the exercise of rights and control over data management (DAMA [27]) in order to treat data as an important and valuable asset [53, 67, 95]. Its purpose is to implement data-driven and rapid operational and strategic decisions for company-wide processes [89]. Therefore, data governance has become an important way for companies to build new assets and gain unique competitive advantages [96].

Some projections indicate that the total amount of global data will grow exponentially from 33 zettabytes in 2018 to more than 2,100 zettabytes in 2035 [84]. However, data is everywhere, and companies are using multiple channels to collect data widely and quickly [2, 48], which makes data inconsistent, severely affecting data quality and consequently creating problems with data management risks [85]. More seriously, these risks create distrust in data among business managers and decision-makers [74] and consequently increase the cost of data collection and analysis [82, 83]. This gives rise to another research stream that considers data governance as the activity of controlling data quality and preventing data risks [2, 6, 8].

In this study, integrating the two research streams mentioned above, we consider data governance as *the standardized management of data with legitimacy to transform it into a strategic asset for the enterprise, with the intervention of certain procedures, rules, and even values* (e.g., [2]). Our definition specifies four important attributes for deploying data governance activities. In terms of *concepts*, data governance, as a strategic function within the organizational structure, falls under the umbrella of corporate governance [98] and encompasses the activities undertaken to create and execute this function [48]. As such, it inherently encompasses the subject and object of governance: who can make decisions about the use, sharing, etc. of data and holds the rights and control to exercise it [53], and who can use it and how [48]. Data governance is thus the application of different degrees by subject and object participants and can be decided jointly by the actors involved in this activity [76, 96]. *Mechanistically*, to guarantee the proper data governance process, companies usually design a series of mechanisms to ensure the smooth implementation of strategic actions related to data governance. These mechanisms include structures that connect data to the business, procedures, and norms for deploying data governance [2, 7, 52, 95], and relationships that support participants in developing governance collaborations, which together form part of data governance [2]. In terms of *consequences*, deploying data governance around high-quality data ensures that firms build resilient organizations that can quickly adapt to business disruptions [88] while building connections with various governance participants to jointly develop new solutions for future business growth [11]. Thus, companies can build legitimacy around data regulation, data pragmatism, data-related values, and data cognition in their data governance activities [33].

In fact, firms in practice, often face problems with the identification and collection of valuable data [48] as well as analysis and transformation (Morabito, 2015; [100])—the “first mile” and “last mile” of data issues. For the former, companies overcome difficulties in data identification and collection by establishing formal structures that connect “business, IT, and data management functions” (the “first mile” problem) ([2], p. 428). These formal structures describe the roles and responsibilities involved in data governance, as well as the filtering and monitoring of data ([2]; DAMA [27]). For example, companies specify guidelines and rules for the creation, acquisition, storage, security, quality, and permitted use of data (DAMA [27, 87, 95]) by developing standard processes and policies for data and by establishing employee organizations that support dedicated data governance activities (DAMA [27]). The “last mile” problem—how to turn data into an asset and guide business operations and decisions (data analysis and transformation)—is more likely to leave organizations in a data governance quandary. To this end, organizations often develop different data governance scenarios around the business and develop clear data analysis processes [62] by building specialized collaborations [7], such as increased profitability and cost savings, and even social acceptance [89]. There is no doubt that existing research has made significant attempts to address the

“first mile” and “last mile” data issues. But not all these problems can be solved by the rules and procedures established by companies. For example, when companies lack experience in data governance, cross-organizational collaboration may be an effective way to address data silos [2]; when companies gain experience, they may be able to effectively address the risks of data regulation and develop deeper data awareness by establishing legitimacy [33].

2.2. Strategic actions for data governance

As data governance focuses on data as a strategic asset of the enterprise [53, 67–69] and requires the design of standards and processes in line with the objectives of deploying data governance [2, 7, 52, 95], it all needs to be aligned with the organization’s strategy [2] and a series of actions around the achievement of the process [11, 26].

The mechanisms involved in data governance indicate that this is a collective action involving many participants. Companies need to consider the data lifecycle as they move forward with various governance initiatives [28, 89]. Strategic actions—*concrete actions that form data collaboration across departments and organizations in the common pursuit of data governance efficiency* [96]—can illustrate the viability of data and its potential for future growth and application. In line with previous research, strategic actions are considered in this study when they are perceived as influential by actors responsible for the organization’s perspective and overall direction, survival, and competitive position [81]. There is no doubt that deploying and coordinating strategic actions is the preserve of business managers or executives [34]. Still, it requires the complement of many participants—often across hierarchies—to drive collective action [94]. Successful strategic actions can lead to disruptive or stable results, or they can create a shared understanding and consensus among initiators and implementers for specific fields of activity [22].

Governance mechanisms refer to establishing standards and uniform rules, values, procedures, etc. to enable actors to build a consensus for collective action [11, 16]. Many studies have shown that the successful deployment of data governance needs to be secured by governance mechanisms that provide an operational environment for the actors [2, 48]. In some cases, actors’ goals may be ambiguous, making the outcome of data governance unpredictable [11], and designing a governance mechanism that can span the data lifecycle can effectively circumvent these problems. On the other hand, we also need to confront the issue of opportunism in data governance. In the implementation process, individuals may try to maximize their own interests or those of their organizations, but this inevitably undermines the overall interests of the enterprise or the alliance [11, 58], which creates incentive incompatibility. In collective action theory, however, solving similar paradoxical problems requires governance mechanisms to influence and intervene in members’ actions and produce a favorable, joint outcome [46].

Furthermore, datafication related technologies enable companies to access, analyze, and share data at a lower cost [71]. These digital technologies are deeply embedded in an organization’s products and services and rely on the central role in developing and initiating data governance [38]. The role of technology for the enterprise has thus risen from functional to a strategic level. Indeed, data governance in enterprises can be seen as a set of corporate governance activities around data supported by various technologies [25, 98]. Moreover, the design of platform-related technologies can provide complex interactions between multiple parties using or sharing data, thus enhancing data governance’s efficiency and eliminating data privacy hazards [56, 96].

While existing research provides good insights into data governance, the difficulty of understanding and capturing the value of data and data governance activities has made it a constant challenge [11]. Moreover, because of the wide range of actors involved in data governance, how to coordinate the behavior of these actors has also been an area where the existing literature has tried to understand and breakthrough.

3. Research methodology

3.1. Research design

To gain more exploratory insights, we use the longitudinal single case study to increase our understanding of complex social and managerial phenomena [31], common in current research (e.g., [13, 51]). Here, it is the deployment of data governance and the implementation of strategic actions. The single case study supports intensive research and allows for a rich discourse on the case [13, 45]. The use of multiple data sources allows for a comprehensive induction of the activities, objects, etc. that are involved in the case [45]. Furthermore, the company we focus on—Gold—can reflect the criteria of the polar case [105], which can lead us to more disruptive insights. More to the point, the objective of this study is to explore how companies deploy data governance and how it triggers strategic actions in companies. Therefore, the problem of “how” and the process perspective are more suitable for case studies [30, 31]. Overall, we answer our research questions and pry the theory forward by analyzing a case in depth [80].

3.2. Research setting and case selection

Several interrelated motivations drove our focus on, and interest in Gold: in addition to the criteria for polarity case, the selection of Gold involved theoretical sampling [30, 31, 105]—firms had to meet our theoretical expectations and be able to generate theoretical questions or phenomena that sparked interest [10], and the availability of rich data was also a must for the longitudinal case study.

First, we selected China’s gold mining industry as our research setting not only because China is a global leader in gold production (it has been the largest gold producer for 11 years in succession since 2007 when it first overtook South Africa in gold production) [39], but also because the Chinese gold mining industry has been driving digital transformation for many years now. The path and significant events of the digital transformation are clear. More importantly, data shows that profits from mining businesses can be increased by 20–45% in 2–3 years through digital technologies, which has led more and more mining companies to invest in digital transformation [50]. We identified a series of notable events [80] involving a gold mining company, i.e., Gold which started its digital transformation in 2007. Moreover, Gold has partnered with Huawei to co-develop the first big data platform for metal mines in China and is also the first mining company in China to be applying 5G communication technology.

Second, in August 2017, Gold established the strategic goal of building an international first-rate model mine, incorporating digital transformation and data governance into the strategic framework. Moreover, In January 2021, a gold mine explosion disaster occurred in Yantai, Shandong Province, China, due to the illegal use of explosives for civil purposes [103]. Although this was not a Gold-owned mine, it was still forced to shut down for screening. In the interview, an informant revealed that “if it had been fully digitalized, this accident might not have happened (G14)”. Besides, the materials we collected show that Gold has made outstanding achievements in data governance that meet our theoretical expectations. For example, Gold has won many relevant awards at the provincial and national levels after carrying out data governance and has participated in the preparation of the “Guide to the Construction of Intelligent Mines for Non-ferrous Metals” hosted by the Chinese government.

Finally, as members of Gold’s project team, the authors of this study were able to get in touch with several executives, general workers, and collaborators. In addition, the authors visited the site several times and had access to a wealth of data acquisition opportunities.

3.3. Data collection

Our study was conducted based on a broad and rich collection of

Table 1
Overview of data sources.

1) Semi-structured interviews Interviewees ^a	Affiliation ^b	2) Archival materials	3) Observations
Chairman (1, G1) Chief Information Officer (1, G2) General Manager (1, G3) Deputy Manager (2, G4-G5) General Manager (1, G6) Human Resources Director (1, G7) Operation Manager (3, G8-G10) General Manager (1, G11) President (1, G12) Executive President (1, G13) General Manager (1, G14) Business Unit Manager (5, G15-G19) Mine Manager (1, G20) General Worker (9, G21-29) IT Product Manager (1, G30) General Manager (1, G31) In total: 31	Group Headquarters Information Center of Gold Corporate Culture Department of Gold A subsidiary of Gold (Shanghai) A subsidiary of Gold (Beijing) Mining business division (Yantai) First-rate promotion center of Gold A goldfield of Gold (Sanshan Island) Huawei BGRIMM ^c	Web archives (in total 28): • Company websites • Annual reports • Public statements of key executives • Key media and press coverage • Industry research reports Internal documents (in total 80): • The implementation plan of the international first-rate model mine construction (abbreviated as “Implementation plan”) • The 5-year strategic plan • Chairman’s internal statement In total: 108	• Visit of the data scheduling office • Internal meeting • Field observation (3 weeks)

Notes:

^a This column refers to the number of respondents and their role within their company; G1 to G31 in parentheses are our codes of them.

^b Shanghai, Beijing, Yantai, and Sanshan Island in parentheses refer to the locations of subsidiaries or mines.

^c BGRIMM is the largest comprehensive research and design institute in China focusing on mining and metallurgical science and engineering technology and is dedicated to technological innovation in the non-ferrous metal industry.

sources, including semi-structured interviews, archival materials, and on-site observations. The different data collection strategies together form the data sources of this work (Table 1 shows the overview of data sources), and they can develop an effective triangulation validation to enhance the robustness of the theory while ensuring the reliability of this study [10, 49].

First, semi-structured interviews are one of the critical data sources for this study. Based on the interview outline, we conducted interviews at Gold’s headquarters, divisions, branches, and subsidiaries from 2020 to 2021. We sent the initial interview outlines to corporate informants for pretesting before formally interviewing to verify whether our questions were answered in a way that was relevant to our study. Based on the informants’ feedback, we then revised and refined the outline (see Appendix). Our interview questions focused on data governance processes, the effectiveness of data governance, strategic activities around data governance, and so on. Ultimately, we conducted 15 interviews (60 to 180 minutes each) with 29 interviewees of Gold with snowball sampling to increase our interviewee pool [18, 86]. In addition, 2 interviews were also conducted with Gold’s partners—Huawei and BGRIMM (a company dedicated to technological innovation in the non-ferrous metals industry). These respondents ranged from top-ranking executives to highly skilled professionals to those with substantial expertise. They assume the role of “key decision-makers” [5] in the deployment of data governance.

Furthermore, we conducted an extensive search of web archives to analyze Gold’s data governance processes and procedures, including company websites, company annual reports, public statements of key executives, key media and press coverage, and industry research reports. It should be additionally noted that the interviewees provided us with some key documents that are not yet publicly available on the web, including the implementation plan of the international first-rate model mine construction strategy, the 5-year strategic plan of the enterprise, the internal statements of the chairman and so on. In summary, we obtained a total of 108 archival documents/materials.

Finally, we visited their data scheduling office and learned more about the operational logic of the big data platform. Meanwhile, the second author of this work participated in the internal meeting of the company as a project expert. The first author spent 3 weeks of continuous field observation as a member of the project team at one of Gold’s mine management offices.

3.4. Data analysis

Our analysis is based on the thematic analysis and abductive approach resulting from the interplay between existing theoretical frameworks, emerging theories, and data [14, 59]. This means that we developed new theoretical insights by coding, aggregating, and linking categories to emerging theories and reflecting them in existing theoretical frameworks for ongoing abstraction from the raw data [24, 59].

We followed the three data analysis steps in the literature [36]. The first step is the organization of the raw data. In concrete terms, we read all the data carefully, looking for items, key events, or themes in the raw data, then marking them and giving them an initial label. Existing concepts or theories do not influence this label; instead, it is derived from keywords or sentences in the data. After our labeling process, they were transformed into first-order concepts for this study and distributed according to different categories.

The second step of the data analysis is the organization of the first-order concepts. Based on the existing labels and categories, we performed iterative tests of their boundary strengths to investigate the links between the existing categories, thus forming the second-order themes of this study. In this step, we iterated on the data. The authors of this work acted as the primary person for code abstraction and thematic analysis. Other researchers in the research team acted as “outsiders” [32, 65]. At this stage, where the authors and outsiders question each other whether these abstract themes can reflect new phenomena [36] and whether theoretical saturation has been reached [19]. Then, we can judge that theoretical saturation has been reached when it is determined that no new concepts have emerged and that these themes can cover the new phenomena shown by the case [19].

Third, we started searching theoretical and research fields, such as big data collaboration mentioned by van den Broek & van Veenstra [96], Ferreira et al.’s (2021) research on the legitimacy of big data, and so on. Then we use these datasets to connect second-order themes to form aggregated dimensions. Further, we continued to analyze the linkages between the aggregation dimensions to build a theoretical model that explains how a company deploys data governance. We report the data structure used to ground the constructs in Fig. 1.

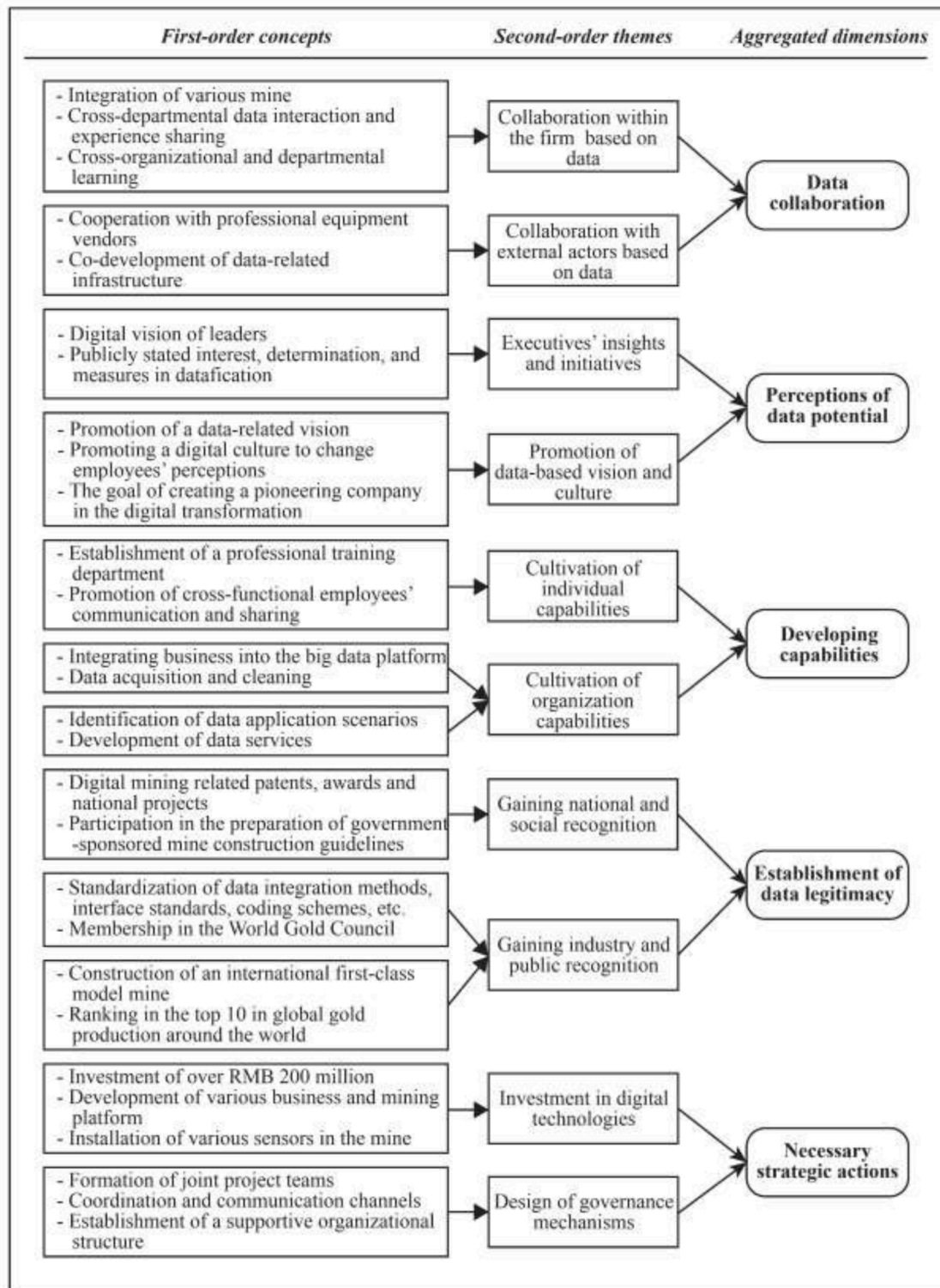


Fig. 1. Data structure.

4. Findings

We investigated the importance of data in Gold and a process for its assetization and revealed how Gold deploys data governance and the related strategic actions taken to achieve it. The study illustrates several aspects necessary for companies to transform data into a strategic asset. In particular, we identify four critical elements of data governance: (1) data collaboration, (2) activating the perception of data potential, (3)

developing data-related capabilities (at the individual and organizational levels), and (4) establishment of data legitimacy. Please see Table 2 for the definitions of these four key elements. We also identify two critical strategic actions to guarantee the implementation of data governance: investment in digital technologies and governance mechanism design. We first report in Section 4.1 on how enterprises are deploying data governance. Then in Section 4.2, we summarize the strategic actions taken by enterprises and explain how this line of action

Table 2

The meaning of the four key elements.

Key elements	The definition
Data collaboration	In this paper, <i>data collaboration</i> refers to a way of organization in which companies form cross-departmental staff organizations internally and collaborative teams with external partners around data governance.
Activating the perception of data potential	In this paper, <i>activating the perception of data potential</i> is an intervention by companies to increase employees' awareness of data and perception of its value with the help of executive guidance, data-related corporate culture, etc.
Developing data-related capabilities	In this paper, <i>developing data-related capabilities</i> means that companies develop specialized capabilities related to data collection, processing, integration, and analysis at the individual and organizational levels with the help of skills training and collaboration.
Establishment of data legitimacy	In this paper, the <i>establishment of data legitimacy</i> refers to gain and the extent to which the data governance activities deployed by the enterprise are recognized by society.

drives data governance.

4.1. Deploying data governance in the enterprise

4.1.1. Laying the groundwork through internal and external data collaboration

The first important aspect of data governance that we investigate is data collaboration, manifested through Gold's interactions with internal staff and external stakeholders. Gold's employees and partners indicated that data governance is a huge undertaking that requires specialized knowledge and skills, which often "*needs to be acquired through collaboration (G14)*". Hence, in two ways, data collaboration lays the foundation for data governance. Firstly, as a traditional mining company, Gold does not have many highly skilled personnel working in information technology, big data, etc., so "*we have to work with specialized companies to develop data-related infrastructures (G2)*". For example, in order to build a data cloud platform and ERP (enterprise resource planning), Gold cooperated with Huawei, SAP, and other companies. "*With the assistance of Huawei, Sanshan Island Gold Mine has realized an internal unified standard data lake; a unified big data platform for the collection, storage, calculation, analysis, and application has been formed based on the construction of the data lake (Internal documents)*". To do this, Gold can make up for its own resource disadvantage and thus rely on specialized external knowledge to break through the bottleneck in the field of data management. As Huawei's IT product manager said about this cooperation,

It is very challenging work, but also a mutual achievement. Through such cooperation, we can prove that it is feasible for us to build a cloud platform in the mining industry and show Gold's trust in Huawei (G30).

Gold provides the vehicle and support for deploying data governance with external collaborations, which preserves and optimizes established resource investments based on a blend of traditional and digital technology architectures. Moreover, by converging external digital services, companies can develop long-term data collaboration with partners to complement more advanced services in the future (e.g., [11]). The informants reported the following:

Through the big data platform and ERP, we have brought together data from various mine areas, such as production, human resources, finance, and materials, and eliminated barriers to business systems. A total of more than 100,000 pieces of data from the entire mine are

brought together on the big data platform, allowing us to respond effectively to cross-departmental business requests (G20).

There is no doubt that this cooperation is crucial and that there is no way for a single company to complete such a large project. One of the biggest benefits of doing this is that we don't have to do things we are not good at (G2).

Second, greater intra-enterprise collaboration allows for rapid integration of data resources and inter-organizational learning to share investments, increases the number of data sets within an organization [96], and deconstructs data silos [2]. This leads directly to more standard and efficient data collection and transformation protocols as well as data exchange and reporting mechanisms [68]. On the one hand, in order to proliferate the benefits of the big data platform, Gold consolidated the various mines under its authority to establish mine divisions to keep data consistent and standardized across the organization. On the other hand, due to the interaction of the mine divisions on the big data platform, Gold's employees can consult to gain consistent insights on data discipline and share data governance experiences on an ongoing basis, thereby enhancing cross-organizational and departmental learning. Another informant explains,

Data governance is an important cross-organizational effort, and as a conglomerate, it is difficult to establish data norms without adequate collaboration between companies across the country. And these standards on data can't be determined by just a few people; they need to involve employees in a way that makes them comfortable (G14).

Data collaboration, as we have explained here, is considered the foundation of data governance, which provides a collaborative environment for internal and external actors to work together on data standards or guidelines.

4.1.2. Activating the perception of data potential

The second data governance focus we offer is to build the perception of the potential of data. It suggests that deploying data governance on a large scale, at least across the enterprise, requires a sense of the potential of data in guiding business operations and process transformation. The informant noted that "*The whole society cares about these things, and there is an increased awareness from this project and the perception of personnel. There is no problem with this path being taken and technical path, coupled with the acceptance of the entire workforce (G2)*". However, Gold believes that developing a positive perception of the potential of data within an organization is not easy because "*everyone has different cognitive boundaries, so their awareness of things is wildly different (G1)*". To achieve that end, Gold focused on two aspects to build and strengthen personnel's perceptions of data potential.

First, in this study, we consider executives' insights and initiatives as an important step in enabling personnel to generate perceptions of data potential. On the one hand, as a gold mining company that started to focus on digital transformation earlier in China, Gold started a project of digital mine construction in 2007, gradually guiding employees to understand and accept the new strategic environment. One informant praised their leadership in digital mines, "*Vision of leaders is important [...] Most people can only see the skin-deep, a few can have insight (G20)*". On the other hand, to show the attitude, everyone from the chairman to the CIO to the division president expressed a high level of interest in data and digitization and showed their determination to deploy data governance while releasing a series of initiatives. This shows that data governance is mainly driven by top management at Gold, and managers have explicitly made data governance a strategic decision for the company on several occasions (internal meetings, public speeches, etc.). As the chairman emphasized in an interview,

It has to be the responsibility of managers. If managers ignore it, then no one will care about it [...] While some highly qualified employees

can perceive the importance of data, it becomes difficult when shared or communicated with others, and that's when managers should come on board (G1).

Second, in Gold's case, we observed that the company had developed and promoted a digitally relevant organization culture to successfully deploy data governance and promote the strategic use of data and business vision. The purpose of this organization culture was *"to develop a strategic vision among employees (G2)"*. As a collective action [11], the company needs to consider the level of acceptance by all members. The informant explained to us the importance of organizational culture in activating and raising the awareness of personnel,

Organizational culture is the universal key, it exists anywhere, and it can work anywhere. I think the role of culture is essential to get employees to realize that data turns out to be so powerful [...]. It [Culture] can't directly provide anything material to employees, but it [culture] can subconsciously lead employees to recognize and believe in something (G3).

Our data also shows that Gold has set out the goal of creating a pioneering company in the digital transformation of the global gold mining industry, with specific implementation plans around technology, resources, organization, capabilities, and operations. With the influence of the organizational culture, *"employees can accelerate their awareness of data governance (G5)"*. These goals and programs make employees aware of the importance of data in the business and drive them to engage more diligently in data governance activities.

4.1.3. Developing data-related capabilities

The third focus of data governance, which we dissected, is developing capabilities. These capabilities are primarily related to organizational and individual levels, are related to data, and are organized around governance activities. These capabilities are critical since they guarantee the micro-foundation for Gold to achieve data governance, *"yet the capabilities are inconsistent across departments, people, and organizations at all levels (G2)"*. Therefore, Gold can quickly coordinate behaviors at all levels by developing data-related capabilities, accelerating the transformation of data into critical assets, and leveraging these assets to serve the various application scenarios in the mine. As the informant mentioned, *"Digital transformation enhances the capability to process data [...]. With the help of data assets some capabilities or common assets that can be shared in common can be distilled (G2)"*. To this end, Gold has developed data-related capabilities in three areas.

Firstly, *"Many of the company's employees are older [...]. They don't even have a bachelor's degree (G16)"*, so Gold had to set up a professional training department to sharpen the personnel's capabilities. As we observed and learned while attending internal meetings, the department exists to train employees around data infrastructure (e.g., technical systems that integrate IT, operating protocols for big data platforms, etc.) to *"make sure they have the ability to operate advanced equipment (G23)"*. This department also has the responsibility of *"communicating and sharing experiences across units and organizations (Internal documents)"*, and the informants explained its importance to us,

This department is mainly responsible for lecturing and skills training [...] We often experience this [...] It gives employees a place to share knowledge, reach out to employees in other departments, and, most critically, promote collective knowledge creation [...] They need such a place to improve themselves (G14).

Secondly, Gold has integrated most of the business and operational data about the mine into the big data platform. *"This is an important step in developing data assets (G2)"*. With Huawei's help, Gold used the big data platform to achieve interoperability of semantics, *"solving the situation where semantics were not interoperable between different business systems (G30)"*. One significant way is that Gold integrated and transformed the various industrial protocols of the mine and interfaced them

with the IT system of the big data platform to implement the collection of data from multiple businesses. Further, the collected data was clarified according to the data rules and standards set in advance by the big data platform to obtain high-quality data with decision value and service attributes. As the informants noted,

When we subsume the business to the big data platform, we also realize the company's digitization. But after we really capture the data, we can't use it directly because it is actually messy and disordered data. We need to govern the data in accordance with the data standards to get clean and practical data. We call this process data assetization (G2).

Thirdly, to maximize the use of data assets, Gold has developed relevant data services for various scenarios. The mines under Gold's jurisdiction are located all over China, and *"while establishing common data standards and rules can help ensure consistent data management and governance, it is a tough task to apply them across the mines in the country (G1)"*. Due to the varying degree of digitization across mines, Gold has to take a point-by-point approach to advance gradually. Therefore, Gold has developed many shared capabilities and services, i.e., sorted out the corresponding service catalog, *"so that we can directly invoke existing data when developing new businesses in the future (G2)"*. Moreover, the informant reports that these shared capabilities and services can be applied to other gold mines as well.

With this big data platform, we have achieved another such capability [...] Why would we want to develop such services and applications? Our platform has this kind of flexible development of such a capability, can be integrated into these services and applications on our platform, so the future is through this kind of service way to quickly develop the corresponding application out (G30).

4.1.4. Establishing data legitimacy

The fourth important element of data governance that we considered is establishing data legitimacy. The data we have observed suggests that Gold focuses on the legitimacy identity associated with data as it deploys data governance. One informant explained to us the importance of this legitimacy, *"In fact, we are very keen to have the recognition of the community and the state, not just to encourage us, but more importantly, we need to be clear about whether this is the right thing to do (G14)"*. To establish data legitimacy and maintain it in the long term, Gold has made efforts in three areas.

Firstly, since starting its digital mine construction strategy in 2007, Gold has received several national patents, awards, and projects related to data governance. Gold, for example, won the first prize for enterprise technology innovation in Shandong Province on the project of research and application of data standards in the mining industry. A series of patents, awards, and projects have enabled Gold to gain national and social recognition and the opportunity to participate in the "preparation of the "Guide to the Construction of Intelligent Mines for Non-ferrous Metals" hosted by the Chinese government (Web archive)". As one of the interviewees pointed out,

This proves that our data governance solution works [...] The state recognizes our contribution to data governance, which is the most delightful thing for us. With the support of the state, we are confident to support the development of relevant data or industry standards (G16).

Secondly, our data also shows that Gold is actively involved in efforts to formulate data standards for the mining industry. *"Mining is a very special industry. Almost all the data comes from mines, but different types of mines and companies will have various standards for data collection, processing, and analysis (G31)"*, said one informant. Therefore, what Gold really wants to do is to establish a common data integration scheme, interface standard and data coding scheme for the whole industry. In

this way, Gold established an identity of data legitimacy within the mining industry and, in addition, became a member of the World Gold Council in 2018. One interviewee recalled excitedly, *“This is the recognition of us by a worldwide organization (G3)”*.

Thirdly, Gold has launched the strategy of “international first-rate model mine” since 2017, with data governance as one of the critical elements of the strategy. It has integrated existing data assets and carried out data governance work on six themes: geology, production, safety, equipment, human resources, and finance. The company’s internal documents explain the importance of data governance in the implementation of this strategy,

The existing business data of each mine is connected, and a high-quality and high-standard data lake of the enterprise is formed through data governance. The data lake brings together the core business data of the enterprise and forms valuable data assets (Internal documents).

In addition, it is worth mentioning that according to data reported by Metals Focus UK, Gold is in the top 10 in global gold production for the second year in a row (2019 and 2020), despite the disruptions caused by COVID-19 and the forced shutdown caused by the Yantai gold mine disaster [21]. One interviewee said excitedly, *“Data contributed to it; that’s the power of data (G14)”*.

4.2. Strategic actions for the deployment of data governance

We then continued our discussion of the strategic actions that Gold has taken to deploy data governance. These can be reflected in two areas: 1) investment in digital technologies and 2) design of governance mechanisms.

4.2.1. Investment in digital technologies

The first type of strategic action we observed to deploy data governance was the investment in digital technologies that mean Gold can provide new application scenarios and infrastructure for data governance (e.g., [104]), thereby conceptualizing governance activities as a collective strategic action (e.g., [11, 22]). *“Technology development and investment are necessary to carry out our data governance activities (G8)”*. From the informant’s report, we can analyze that investment in technology is a strategic action necessary to guarantee the deployment of data governance in the enterprise because *“digital technology provides the operational environment for data collection, storage, and analysis so that data governance can follow standard technical specifications (G30)”*.

Gold’s investment is reflected in three main areas. Firstly, as mentioned earlier, Gold is a labor-intensive state-owned enterprise (SOE) dominated by traditional technology, so *“technological revolution is essential to ensure that we can move forward with data governance and digital transformation (G12)”*. To this end, Gold has invested over RMB 200 million in developing and introducing new digital technologies and equipment. Gold, for example, has introduced *“3D mining software and laser scanning equipment at its Sanshan Island Gold Mine to establish a full lifecycle data management system for the mine (Implementation plan)”*.

Secondly, Gold has developed a big data platform, production technology collaboration platform, ERP, etc., around business operations and mining with the cooperation of external partners. *“The platform is the infrastructure for deploying data governance (G14)”*. These platforms have different technical modules designed by various partners. As a result, a decentralized coupling between these technology modules is formed around the core goal of data governance and drives Gold and partners to build consensus around strategic actions. As one interviewee of BGRIMM mentioned,

Our new technologies such as artificial intelligence, industrial internet, and 5G are developing rapidly. These technologies can be combined with our mining industry faster, which can empower the data governance of enterprises. These technologies can precipitate

some human experience to form a decision-making model and use the feedback to guide and optimize the entire production process and improve operational efficiency (G31).

Thirdly, Gold has embedded various remote monitoring sensors in the central part of the mine and associated mechanical equipment to integrate the data into the platforms. Usage data on installed equipment provided by these sensors was identified as the essential strategic resource [42]. Our informants report that these sensors have the following indicated conveniences and benefits: 1) they can be implemented to monitor the condition of the mine and equipment and then *“reduce production losses due to downtime (G2)”* and 2) the data provided by the sensors is a key strategic resource for the company and an important element of governance activities.

4.2.2. Design of governance mechanisms

As described above, companies have developed a series of mechanisms around data governance structures or elements, data processes and norms, and collaborative relationships among participating parties, which together guarantee the proper process of data governance [2, 7, 52, 95]. Moreover, designing governance mechanisms allows different participating subjects to reach a consensus around a core purpose and form a consistent value proposition, i.e., to deploy data governance together. To this end, Gold designed governance mechanisms in two ways.

Firstly, we argue that necessary strategic action is to establish the relationship mechanism in this study, which can strengthen stakeholders’ awareness of data governance planning, knowledge, skills, and processes through inter- and intra-organizational communication, coordination, and mutual benefit [41, 96], thereby building shared commitment [2]. To this end, Gold has established the relationship mechanism in two ways.

On the one hand, Gold has established partnerships with external participants to develop digital technologies around data infrastructure jointly according to different technology modules. These project teams comprise employees from different units, departments, and even companies who *“exist because of a specific business or activity (G16)”*. On the other hand, Gold has refined the relationship mechanism by establishing fast and efficient communication and coordination channels. One informant explained the importance of communication as a critical element of the relationship mechanism, *“Communication identifies issues in a timely manner [...] It can ensure that the knowledge and skills of data governance flow within the team (G3)”*. Subsequently, another interviewee stated that *“coordination is also important (G4)”*. This is because coordination gives the project team the ability to make decisions without being subject to the strict hierarchy of centralized decision-making. As one business unit manager pointed out,

The purpose of coordination is to facilitate collaboration. We need to take advantage of the resources of other companies to help us accelerate the process [...] Many people are unaware of the data governance process, even managers. In this case, if they [project teams] are not allowed to work flexibly, the process will be very slow (G14).

Secondly, another of Gold’s practices that we observed in service of relationship mechanism building was the establishment of a supportive organizational structure. As this first-order concept suggests, *“we withstood all the pressure to overhaul the organization structure (G1)”* to support the data governance efforts. However, as an SOE, Gold could not afford to build a completely flat organization like Internet companies. The enterprise, therefore, had multiple decentralized governance unit organizations embedded in the original large hierarchical structure. One informant explained to us the benefits of doing so,

Such a structure is the best fit. Managers are able to retain all decision and control rights at the group level, with a unified and

consistent arrangement for the direction and strategy of data governance. In turn, these unit organizations can coordinate and make decisions around the specific activities included in data governance (G2).

From this, it can be seen that Gold uses a semi-decentralized organization structure to strengthen the relationship mechanism among employees. On this basis, Gold's teams and organizations can establish a reciprocal data governance identity, thus resolving the conflict between centralization and decentralization and giving data governance the property of participation by all members. As one informant who has been involved in organization change and data governance efforts stated,

We started in 2017; fortunately, with these years of transformation [...] whether it is digital technology or digital transformation, it is supported by data, and the key here is the support of the organization. Organizational change is important (G12).

5. A strategic action framework for data governance

In this qualitative study, we systematically analyze how Gold deploys data governance and the strategic activities undertaken for this purpose, which guarantee its successful implementation. In order to explain the process of enterprise data governance and the strategic actions carried out, as a result, we drew the analytical framework shown in Fig. 2. In Fig. 2, we show the key elements and aspects of data governance as clearly as possible.

From the era of the industrial revolution to the digital age, the stock of data is growing exponentially [3, 60]; the cost of acquisition, storage, analysis, and sharing of data has decreased dramatically [60, 96]; the increasing importance of data and its analysis has led to dramatic changes in management and production activities and boundaries within the enterprise [62]. These changes have triggered a serious new phenomenon—companies are beginning to pay more attention to the asset-based attributes of data in their operations and are making significant investments around it. Because of this, enterprises have had to invest in deploying and promoting data governance efforts within and outside the enterprise to collect and use trustworthy, big, and open linked data [29, 48].

5.1. The process of deploying data governance

Most enterprises are constrained by industry boundaries (e.g., decoupling from big data technologies, the cost of digital transition, etc.) and do not have the ability to work independently on data governance.

Therefore, they can only seek internal and external cooperation, i.e., *data collaboration*, around adopting datafication technologies, data analysis, application, etc. Suppose collaboration is rejected between different departments, organizations, or even enterprises, the company cannot develop and implement effective data governance principles to the extent that the company cannot effectively share data in a valuable way [11]. Therefore, it is understandable why data governance has become a collective action [11] that encompasses subject companies, employees, partners, government regulators, and even rivals [22]. Different actors play different roles; they collaborate and contribute to data governance, thus driving a great leap forward in the data governance process. In this study, data governance as a collective action is reflected in: (1) collaboration between Gold and external players such as Huawei and BGRIMM to develop data infrastructure; (2) collaboration between different business units within the enterprise to share data governance experience; (3) collaboration between executives and employees—to some extent, executives and employees can be considered as a partnership—to activate perceptions of data potential; and (4) collaboration between the enterprise and government regulators to advance the standardization of data governance experiences. This means that the practical solution of a complex problem depends to a large extent on the interdependence between multiple actors, i.e., collective action [58, 75]. This relationship is based on collaborative governance and data sharing [76, 96], with data governance as the ultimate goal of achievement [2]. It follows that data collaboration is the first step in data governance arrangement for traditional companies, which not only provides the firm with opportunities to leverage external resources and strengths but also provides the infrastructure necessary for the firm to carry out this work.

While data collaboration allows organizations to take the first step toward data governance, the *perceptions of the data potential* within the organization and the *capabilities* developed to orchestrate these activities determine how far that step is. Data-related awareness is critical [26, 54], as it affects the acceptance of data governance and the smoothness of deployment within the organization. It, therefore, places a higher demand on managers [48, 54]. If managers are blind to the importance of data governance, it will be difficult for employees to understand why this work is being done and thus ignore the inherent value of data [11] and vice versa. Moreover, as the volume of data continues to grow, organizations need to be able to keenly perceive which data are valuable and which can be quickly transformed into corporate assets in a short period; this requires a consistent consensus on data across the organization [2]. And this consensus is closely related to the development of relevant data capabilities [11] because the awareness of the potential of data determines that companies can cultivate and develop the skills and

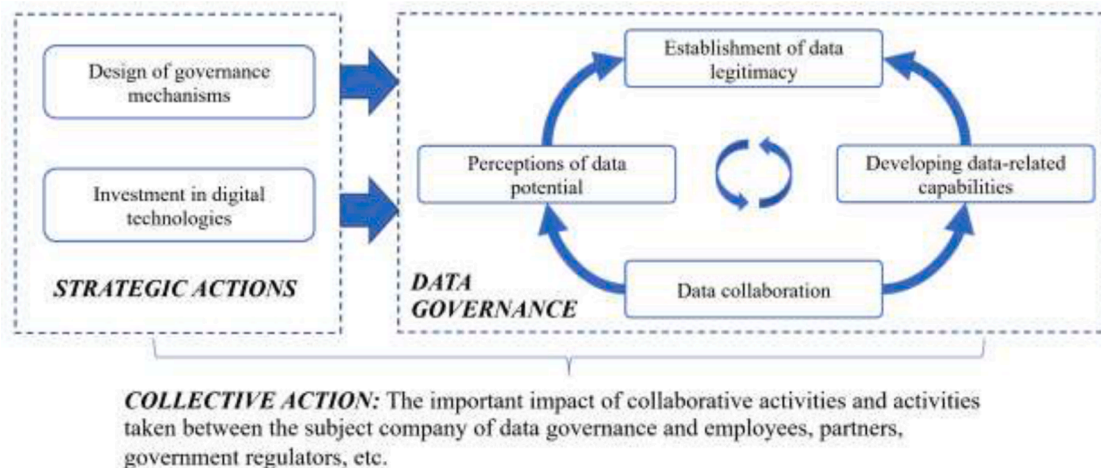


Fig. 2. A strategic action framework for data governance.

ability in a targeted manner to apply data and implement data governance in a way that is beneficial to the organization.

In turning data into assets, companies can easily get involved in the issue of legitimacy. In the legitimacy literature, it has been argued that organizing around data requires a balance between legitimacy and disruption as it relates to the ability of the business to successfully move forward with change [33]. If an organization's actions, fundamental values, culture, etc., are strongly challenged and questioned by the public, it can compromise or even fail its work [33, 102]. Therefore, a good strategy for building data legitimacy is to formulate a compelling blueprint [12]. According to this, it is extremely easy for companies to package their successes in the process of data governance into specialized solutions that can establish an identity of legitimacy among their peers or even across industries. And this requires maintaining a balance between the disruption and the legitimacy of data governance around the entire lifecycle.

5.2. Strategic actions necessary to deploy data governance

In the case observed in this paper, the necessary strategic actions—investment in digital technologies and design of governance mechanisms—ensured the successful deployment of data governance. Data governance is a collective action involving multiple actors [11], and this action can be taken jointly by the key company and partners and sustained by consistent strategic actions. As with the two key strategic actions mentioned in our work, while these strategic actions are often initiated, coordinated, and key decisions made by the manager [34], mutual coordination, collaboration, and complementarity of actors across hierarchies and systems is also necessary undoubtedly [94].

We argue that investment in digital technologies is a fundamental strategic action to secure data governance deployment. The diffusion of digital technologies in organizations transforms strategic activities [23], orchestrates and controls organizational processes promptly by optimizing information exchange and communication [78], drives “changes in governance modes” and “affects collaborative dynamics” ([18], p. 2; also see [4, 17]). Thus, the development of digital technologies offers unprecedented opportunities for the deployment of data governance, which not only means that companies can access more efficient data collection, analysis, and sharing technologies at a lower cost than before [37, 73] but also means that they can enhance the data collaboration by leveraging the coupling between the technologies modular for which different organizations are responsible [90].

On the other hand, we must emphasize the important role of the design of governance mechanisms in the progress of data governance deployment. The two types of mechanisms detected in this paper are mainly related to two types of organizational relationships and organizational structures. The former focuses on the consensus among data governance subjects; the latter is based on the organizational restructuring for carrying out data governance. For organizational relationships constrained by the resources of a single enterprise, enterprises often need the help of external partners, and this process is often always accompanied by communication and coordination [2]. The former ensures the proliferation of data governance knowledge and skills within the organization. The latter allows data governance teams to remain sufficiently flexible. Having iterative communication and coordination makes it easier for organizations to develop consistent solutions with external partners. For organizational structure, a sound organizational structure can resolve conflicts between different hierarchies regarding decision-making authority and between centralization and decentralization, thus autonomously deciding which organizational unit has the authority to take actions related to data governance [53, 67]. Digital technologies not only support the data governance activities but also drive the changes in organizational structures [106]. As a result, organizations are more likely to have a relatively flat structure for achieving an important strategic goal—data governance in this paper. This not only facilitates more efficient information communication [106] but

also enhances data collaboration within the organization through the positioning of decision-making authority [89, 96].

6. Discussion and conclusion

In this qualitative study, we systematically analyzed the key activities of enterprises deploying data governance and the strategic actions designed and implemented for this purpose, using the following theoretical contributions and management insights.

6.1. Theoretical implications

First, our study contributes to the extant literature on data governance. As we clarify in the theoretical background, prior existing literature has examined data governance in detail in two streams (e.g., [2, 8, 11]) – the process of data assetization [53, 67, 69] and the control of data quality [74, 85]. Apart from a little review literature (e.g., [2, 8, 48]), however, few studies have attempted to integrate the two streams and explain clearly where companies need to start to deploy data governance, especially as it becomes gradually a collective action [11]. This study, therefore, hopes to take this critical step. Our study is based on an integrated data governance concept that defines four important components of data governance—data collaboration, perceptions of data potential, developing capabilities, and the establishment of data legitimacy—that epitomize data governance as a collective action spreading from the corporate level to the societal level. Thus, this study contributes to the literature of data governance and the collective action within it. Furthermore, this study contributes to solving the “first mile” and “last mile” data problems. Existing research has focused more on how to address these issues through data-related rules, standards, and procedures. This study offers a new way of thinking. We believe that data collaboration is a very important way for traditional enterprises to provide initial data collection and analysis capabilities to address data silos within the enterprise and accelerate the process of aligning data with the business. Through cognitive transformation and capability development, enterprises can improve employees' perception of data potential and their ability to process data, thereby building data legitimacy to protect against the risks of data stewardship and developing deeper levels of data awareness.

Second, our work contributes to the intersection of data governance and strategic action fields. It has been shown that data governance is a complex project that requires long-term commitment and ongoing engagement [11, 20], and as such, organizations often need to formulate a series of “goal-oriented action(s)” for it ([67], p. 242). However, due to the excessive focus on data governance models and frameworks in existing research, the emphasis on strategic actions to promote data governance activities is missing. However, we need to be alert to the fact that the necessary strategic actions can keep the strategic awareness and direction of the enterprise in an environment of great industry change [64], which in our study is data governance. Consequently, we analyze the strategic actions necessary to carry out data governance in terms of the investment in digital technologies and the design of governance mechanisms. The former not only enables organizations to collect, analyze and share data at a lower cost [37, 73] but also drives data collaboration through the development of technology modules across organizations [90]. The latter, on the other hand, can guarantee the alignment of subject actions and commitments in data governance by strengthening or changing membership relationships and organizational structures (e.g., [2]).

Third, we contribute to the study of the consequences of data governance by proposing data legitimacy. As advocated by Abraham et al. ([2], p. 434), “to fully comprehend data governance, we need to understand how intermediate performance effects impact strategic business outcomes such as revenue growth, cost reduction, and regulatory compliance.” As they emphasize the importance of compliance, we propose data legitimacy to illustrate what the data governance activities

of the enterprise are intended to achieve (e.g., [22, 33]). Data legitimacy is the social acceptance that companies achieve when they deploy data governance around high-quality data. Proposing this concept, we can not only provide an alternative direction for research on the consequences of data governance, but also advance the work of legitimacy in the field of data governance.

6.2. Managerial implications

Evidently, on the one hand, our research encourages companies to engage in data governance—especially in the digital era—to accelerate the process of data assetization. As data becomes an increasingly important source of new competitive advantage for companies [44], it is critical to use it to guide business operations and decisions. One study reported that “Yet having troves of data is of little value in and of itself” ([97], p. 64). Not only that but as data becomes more and more ubiquitous, how to identify valuable data from it and turn it into enterprise assets has become an important way for enterprises to expand their asset capacity [2, 67]. Our research, therefore, provides a possible approach for enterprises to deploy data governance.

Additionally, the current research shows that, except for particular circumstances (e.g., companies outsource all data governance work to a third party), companies still need to provide a range of safeguards, or strategic actions, for their data governance arrangements. In this study, we strongly urge companies to focus on digital technology investments. Digital technologies not only disrupt companies’ access to data through the advantage of more connectivity [47, 73] but also changes the structure of social relationships in traditional areas [70]. Moreover, our research strongly advocates that companies design a range of governance mechanisms around data governance. Proper governance mechanisms can increase communication and coordination among teams while enabling them to ensure sufficiently flexible decision-making authority.

6.3. Limitations and future directions

Although we have presented our research in as much detail as possible, there are still some limitations due to several circumstances, and this provides some directions for future research to consider. First, this is a single-case study that will inevitably be challenged by literal replication (e.g., [105]), despite the rigorous data collection and analysis process we adopted and the focus on the uniqueness of the case itself. Future research, therefore, needs to be expanded with more cases or even mixed research methods. In addition, as mentioned above, this study proposes data legitimacy based on the perspective of the consequences of data governance, which is premised on the assumption that the data itself, as well as the behavior of the enterprise, is legal and compliant. Therefore, the concept of data legitimacy may still need to be extended or updated for specialized studies addressing data quality, security, privacy, etc. Finally, we have probed the strategic actions needed to deploy data governance, but data governance is an ongoing project, and thus the evolution of firms’ digital technology investment strategies and governance mechanisms over time—e.g., the allocation of decision-making authority and the dynamic adjustment of organizational structures—needs further study.

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Declaration of Competing Interest

The authors declare that there is no conflict of interest.

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Appendix. Overview of interview guidelines

1. General Questions.

- 1.1. Please give us a brief description of your position and job description.
- 1.2. Would you please tell us about the history of the company?
- 1.3. Could you please tell us about your company’s main business and the main drivers of business development in recent years?

2. Questions for Gold.

- 2.1. What do you think about the role of data in business operations?
- 2.2. What strategies or initiatives do the company have in place around the application of data? How do employees and collaborators accept it?

2.3. What challenges or obstacles have the company encountered in implementing these strategies or initiatives? And how have they been resolved?

2.4. How is the data shared between different business units? How is a standardized data management system developed?

2.5. What factors (e.g., technology, organization, employees, etc.) do you think have played a key role in this process?

3. Questions for Gold’s partners.

- 3.1. In what areas have you cooperated with Gold?
- 3.2. Which of these collaborations are data-related, and what exactly does each collaboration entail? And what specific work has been done?
- 3.3. What has Gold done to facilitate your work?
- 3.4. Do you have the authority to respond independently to unforeseen situations in the collaboration?
- 3.5. In the course of your work with Gold, what improvements have been made in Gold’s data management and governance?

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