Government Information Quarterly 37 (2020) 101487

Contents lists available at ScienceDirect

Government Information Quarterly

journal homepage: www.elsevier.com/locate/govinf

Towards a comprehensive understanding of digital transformation in government: Analysis of flexibility and enterprise architecture

Yiwei Gong[a,*], Jun Yang[b], Xiaojie Shi[a]

[a] School of Information Management, Wuhan University, Wuhan, Hubei 430072, PR China
[b] Alibaba Cloud Research Center, Alibaba Group, Chaoyang, Beijing 100102, PR China

ARTICLE INFO

Keywords:
Digital transformation
Digital government
Flexibility
Enterprise architecture
Public services
Cloud infrastructure

ABSTRACT

Digital transformation (DT) is a strategic imperative for governments that aim to improve their services and efficiency. Despite high expectations regarding DT practices, there is limited empirical evidence on how governments are approaching DT in a hierarchical bureaucracy context and how flexibility is created to enable progression. In this research, we employed a case study approach to investigate and analyze DT based on relevant events occurring in a five-year period. A conceptual model was created by combining the diamond framework, the technology enactment framework, and enterprise architecture scope to facilitate the chronological analysis of these events and reflect upon the creation of flexibility. The findings indicate that DT in government spreads in waves with adaptations in different organizational elements, impacting the whole administrative system from the provincial level to the country level and including both radical and incremental changes. Flexibility increases alongside progress in DT and can be technology-enabled or policy-enabled. The creation of flexibility also depends on organizational elements and bureaucratic levels. This study advocates a cross-level view to comprehensively understand DT and offers insights to help other governments craft DT agenda.

1. Introduction

As the current digital economy prioritizes seamless and user-centric experiences, citizens expect public services to be highly available, efficient, and flexible (Mergel, Gong, & Bertot, 2018). Governments around the world regard digital transformation (DT) as a strategic imperative to improve service performance, enhance customer experience, streamline operations, and create new business models (Curtis, 2019; Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014). Examples of digital government transformation strategies include the "EU eGovernment Action Plan 2016-2020" (EUROPA.EU., 2016), the US's "Digital Government Strategy" (CIO.GOV, 2012), and the "Internet Plus Government Services" policy in China (GOV.CN, 2016).

Understanding and predicting the development of DT is important for policymakers, government executives, researchers, and all individuals who prepare, make, implement, or evaluate digital government decisions (Janowski, 2015). Despite high expectations regarding DT, failures in transforming public sector organizations in recent years have indicated a lack of understanding of the complexity of DT and the relationships among technologies, information use, organizational contexts, and institutional arrangements (Tassabehji, Hackney, & Popovič, 2016). To date, there is limited empirical evidence on how governments approach DT (Mergel, Edelmann, & Haug, 2019). Existing empirical studies have predominantly focused on a single organization at the country level (e.g., Liu & Zheng, 2018; Tassabehji et al., 2016; Weerakkody, Janssen, & Dwivedi, 2011) without considering the cross-level policy implementation in hierarchical bureaucracy.

DT in government often accompanies cross-level changes that impact multiple organizational elements. Digital technologies can fundamentally transform the infrastructure, products, services, business processes, business models, and strategies of an organization as well as its inter-organizational relationships in extended business networks (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Chanias, Myers, & Hess, 2019; Sebastian et al., 2017). Responses to various forms of transformation require different forms of flexibility, such as infrastructure flexibility and organizational flexibility, to enable adaptations. The concept of flexibility refers to an organization's ability to efficiently respond to a changing environment (Gong & Janssen, 2012). Organizations lacking flexibility are often prone to failure in transformation, and flexibility is needed to explore digital options (Svahn, Mathiassen, & Lindgren, 2017). Although the need for flexibility has been indicated for governments undergoing DT (Nograšek & Vintar, 2014), e-government literature to date has only partially dealt with flexibility, considering it from different and rather isolated

* Corresponding author.
E-mail address: yiweigong@whu.edu.cn (Y. Gong).

https://doi.org/10.1016/j.giq.2020.101487
Received 4 October 2019; Received in revised form 2 May 2020; Accepted 2 May 2020
0740-624X/ © 2020 Elsevier Inc. All rights reserved.

perspectives. Consequently, it is not sufficiently clear which types of flexibility are the most important and how governments should create flexibility for DT in the context of hierarchical bureaucracy.

A powerful tool to support the analysis of flexibility for DT is Enterprise Architecture (EA), which has received limited attention in recent e-government research. EA offers a high-level overview of the business and IT systems of an organization and their interrelationships (Tamm, Seddon, Shanks, & Reynolds, 2011). EA addresses the need for DT by providing a strategic context for the evolution and reach of digital capability in response to the constantly changing needs of the business environment (TOGAF, 2018). EA captures the interactions among business, applications, data, and infrastructure, including stakeholder views at different levels of abstraction. We argue that an analysis of EA can provide insights into flexibility creation in DT, as it provides a comprehensive and integrated overview of the adaptation of those elements (Foorthuis, Hofman, Brinkkemper, & Bos, 2012).

The purpose of this study is to obtain a comprehensive understanding of DT in government. We aim to answer the research question: *how do governments create flexibility to approach digital transformation*? Our basic assumption is that governments need to create flexibility at different levels to progress through their DT. A case study of a provincial government in China was conducted to observe and analyze the government's efforts and the effect of DT. EA was used to analyze the enactment of digital technologies. The organization in focus is a frontrunner in digital government transformation nationwide and represents the best practice in creating flexibility for enabling administrative services reform. This study may provide guidance to other governments in relation to their own future DT initiatives.

The article is structured in the following manner. In Section 2, we briefly discuss the background of DT, flexibility, and EA. Based on these concepts and two theoretical frameworks, we propose a conceptual model for investigating DT in Section 7. Subsequently, the research method is explained in Section 4. Section 5 presents the case study. In Section 6, we discuss the findings of our case study to provide answers to the research question. Finally, we conclude the article by proposing implications, limitations, and future research directions in Section 7.

2. Background

2.1. Digital transformation

Although consensus has not been achieved regarding the definition of DT, it has been discussed in recent literature based on the use of digital technologies (e.g., Fitzgerald et al., 2014; Singh & Hess, 2017). According to Vial (2019), a summative definition based on the analysis of 23 unique definitions of DT describes it as a continuous process "that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (p. 121). This definition is constructed based on two key ingredients: digital technologies and significant changes.

Digital technologies are viewed as combinations of information, computing, communication, and connectivity technologies (Bharadwaj et al., 2013; Vial, 2019). Typical digital technologies are social network technologies, mobile technologies, (big) data analytics, cloud computing, and the Internet of Things, which together are referred to using the popular SMACIT acronym to represent powerful, readily accessible digital technologies including artificial intelligence, blockchain, robotics, and virtual reality (Sebastian et al., 2017). The use of SMACIT technologies distinguishes DT from other IT-enabled transformations in the past (e.g., ERP). For many governments, adopting these technologies is a new journey, as the scale and scope of the changes associated with their use are unclear (Bharadwaj et al., 2013).

The other key ingredient in Vial's definition is the trigger of "significant changes." In the literature, DT is associated with changes in the infrastructure, products, services, business processes, business models, and strategies of an organization as well as its inter-organizational relationships in extended business networks (Bharadwaj et al., 2013; Chanias et al., 2019; Sebastian et al., 2017). However, an isolated view of those changes that does not consider the complex institutional setting of the public sector will underestimate the challenges throughout the governmental transformation (Weerakkody, Omar, El-Haddadeh, & Al-Busaidy, 2016). Transformation in the public sector involves changes in the quality of certain social structures (Meijer & Bekkers, 2015). Rather than a simple improvement in performance, it entails a fundamental change in the structures, processes, and/or culture of public sector organizations, which may involve the organizational structures of agencies, the administrative relationships between citizens using public services and the organizations providing them, or changes in the bureaucratic culture and external relationships between agencies (Pollitt & Bouckaert, 2017).

Discussions about the significance of changes are often presented in the literature on transformation in government. Examples are the comparison between incremental and transformational changes (Meijer & Bekkers, 2015) and between first- and second-order changes (Nograšek & Vintar, 2014). However, changes occurring in transformation are often multifaceted. It can be argued that incremental changes eventually result in transformational change over the long term; "second-order transformation through e-government can result from a long sequence of first-order changes" (Scholl, 2005, p. 6). Furthermore, incremental and transformational changes occur in alternation when organizations move from one stage to another during transformation (Klievink & Janssen, 2009). Previous studies of DT that emphasize a certain significant change often ignore that changes do not occur in isolation. Multiple changes are frequently involved in DT and affect different organizational elements. It is important to understand the relationships between the use of digital technologies and the changes that occur with different organizational elements and how these changes should be addressed during DT.

2.2. Flexibility

DT results in changes, and organizations require flexibility to respond to those changes. Flexibility is the capacity to make a compromise between enabling adaptations when organizational, functional, and/or operational changes occur and maintaining effectiveness (Nurcan, 2008). The term "flexibility" can be defined in different ways depending on the context of the research and connected with the adaptation of different organizational elements. The following examples reflect the pattern of conceptualizing flexibility in the literature.

- Infrastructure flexibility: the ability of IT infrastructure to adapt to environmental changes by enabling the rapid development and implementation of IT applications (Benitez, Ray, & Henseler, 2018)
- Process flexibility by orchestration: the ability to compose new business processes using existing services in an on-demand manner (Gong & Janssen, 2012)
- Functional flexibility: the ability to incorporate alternative execution paths in a process by designing and selecting the most appropriate path (Schonenberg, Mans, Russell, Mulyar, & Van der Aalst, 2008)
- Volume flexibility: the ability to create multiple outputs with the same capacity and reallocate capacity between processes in response to realized demand (Afflerbach, Kastner, Krause, & Röglinger, 2014)
- Labor flexibility: the ability to change the number of workers (Stevenson & Spring, 2007)
- Worker flexibility: the ability of a worker to perform a number of different tasks with different responsibilities (Manders, Caniëls, & Ghijsen, 2016)
- Organizational flexibility: the ability to change organizational structures and resource allocations quickly and efficiently (Dubey, Gunasekaran, & Childe, 2019)

- Network flexibility: the ability to adapt to the cooperation network or inter-organizational relationships (Yousaf & Majid, 2018)

The above definitions of flexibility show that specific flexibility is often associated with certain organizational elements, such as the structure, people, process, and technology (Leavitt, 1965). In the context of DT in hierarchical bureaucracy, we argue that a specific view of flexibility only provides a fragmented understanding for the creation of flexibility, as DT in government might refer to multiple organizational elements and hierarchical levels.

Flexibility is an immature and vague concept. This is reflected by the abundance of both generic definitions and highly specific definitions that focus on single facets of flexibility (Afflerbach et al., 2014). The literature to date has dealt with flexibility only partially, considering it from different and rather isolated perspectives. Simply putting different types of flexibility together into one concept will be problematic and confusing. Some studies, such as that of Cognini, Corradini, Gnesi, Polini, and Re (2018), attempt to provide a more holistic view of flexibility by conducting a literature review. Although these studies identify various concepts of flexibility from existing empirical research, they often ignore the empirical context in which these concepts were developed. By contrast, our study addresses multiple types of flexibility and their connections within a real-life case context. A comprehensive understanding of DT in government should indicate which types of flexibility are needed to enable the adaptation of which organizational elements. For this purpose, we propose a matrix through which adaptation can be expressed in terms of its relevance to the type of flexibility and the organizational element (see Fig. 1).

The development of this adaptation matrix is based on the concept of an activity matrix, which is often used in operation research. Activity matrices are a succinct way to present the activities of an organization and how these activities influence the organization in terms of its different components (Bonney & Jaber, 2013). A typical activity matrix contains a set of inputs and outputs of the organization system with focused activities in the middle. We operationalized this concept in the context of DT and called it the “adaptation matrix” for distinction. The concept of adaptation designates an activity by which a structure is progressively modified to enable better performance in its environment (Holland, 1992). In this sense, a system undergoing adaptation is largely characterized by the mixture of adaptive activities working on its structural elements at each stage. We consider adaptations to be a kind of activity that is associated with certain organizational elements. Flexibility deals with changes and is therefore reflected by these changes. Using this adaptation matrix, we aim to indicate the requirement of certain flexibility to enable the adaptation of a given organizational element. This matrix allows us to address various types of flexibility in the same organizational and environmental contexts. In addition, the matrix enables the investigation of the relationships between different forms of adaptation. The relationships between adaptations could also reflect the connections between different types of flexibility.

2.3. Enterprise architecture

Managers often lack a clear overview of organizational elements as well as their mutual dependencies, preventing their DT initiatives from being executed in the most beneficial manner (Niemi & Pekkola, 2019). EA provides a broader picture of the interdependence between various organizational elements, which is critically important for solving these problems (Gong & Janssen, 2019; Smith & Watson, 2015). EA captures a range of aspects, including business, applications, data, and technical infrastructure (TOGAF, 2018). The architectural views help improve the relevant parts of the organization described above and consider their relationships to create a coherent picture. Given the integrated nature of EA, we posit that EA analysis enables a comprehensive understanding of adaptations that the organization can perform or has completed to reconfigure their digital assets and competences in response to the adoption of digital technologies (Gong & Janssen, 2017), which eventually reflects how an organization is approaching DT by creating various types of flexibility. Specifically, EA documents record the actual adaptations in different organizational elements and when and why they occurred. This makes EA a useful tool for the analysis of flexibility.

EA has two major functions: to provide a clear and comprehensive descriptive overview of the IT landscape and to provide a prescriptive framework to guide and constrain the subsequent development of business and IT solutions (Foorthuis et al., 2012). In practice, change management is positioned in the center of EA development and management (TOGAF, 2018). In this sense, the implemented projects also shape EA (Van der Raadt, Bonnet, Schouten, & Van Vliet, 2010), as EA must accommodate changes, evolving with the application of new technologies and with developments in the business environment (Chen, Doumeingts, & Vernadat, 2008). Therefore, comparing different versions of EA models that reflect the status of the IT landscape at different times could reveal which adaptations were implemented and when they occurred. In this way, the analysis of EA models could provide input for the adaptation matrix. Based on the practice of Buschle, Ullberg, Franke, Lagerström, and Sommestad (2010), our EA

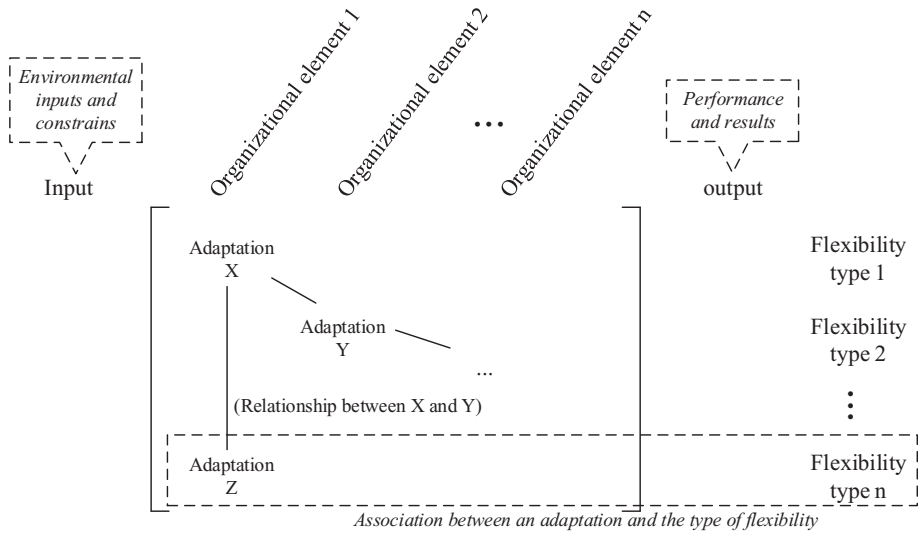

Fig. 1. An illustrative model of the adaptation matrix.

analysis contains three basic steps. In the first step, different versions of high-level EA models are compared to identify significant adaptations that were implemented in the organization. In the second step, the adaptations are detailed by a process of evidence collection, resulting in a description of those adaptations, including the influences of technology and the related organizational elements. In the final step, the influences between adaptations are identified and result in the input of the adaptation matrix.

3. Conceptual model for investigating digital transformation

The literature has indicated the need for a comprehensive understanding and empirical evidence of DT (Tassabehji et al., 2016; Vial, 2019). Investigating and understanding DT in government requires a focus on the organizational context that extends beyond the functionalistic perspective (Meijer & Bekkers, 2015). Two theoretical frameworks have been reported in the literature that assist in framing DT. In this section, we discuss and combine these frameworks with the scope of EA to propose a conceptual model for investigating DT in government.

3.1. Theoretical frameworks for understanding digital transformation

The diamond framework proposed by Leavitt (1965) provides the most recognized conceptual view of organizations as systems with four elements – actors, structure, tasks, and technology – which are used as the basis for analyzing the impact of technologies on organizational changes. According to Leavitt, an effective change is achieved only when these four interrelated elements are in balance. The diamond framework provides an ontological lens to explain changes in organizations. It is simple, extensive, sufficiently well-defined, and can be easily extended with other elements to obtain a richer vocabulary (Lyytinen & Newman, 2008). As shown in the study by Clark (1972), none of the four elements is easily controlled for the purposes of intervening to facilitate organizational changes, and each element may have its own associated change strategies. However, due to their strong interdependences, changes in any one element are likely to impact the other elements. Following the development and application of this framework, “actors” and “tasks” have been renamed as “people” and “process” (Nograšek & Vintar, 2014; Vidgen, Shaw, & Grant, 2017). The framework is also referred to as a presentation of the socio-technical theory that regards an organization as a system built from two correlated subsystems: the social and technical subsystems. Fig. 2 presents the framework in a socio-technical form (Bostrom & Heinen, 1977).

The other framework is the technology enactment framework (TEF) described by Fountain (2001), which is widely recognized as a valuable framework for examining the effects of organizational structures and institutional arrangements on technology implementations in the public sector. This framework analytically distinguishes between “objective technology” and “enacted technology.” Objective technologies refer to technologies such as hardware, software, networks, and other material characteristics, regardless of how people use them, whereas enacted technologies refer to the ways in which users perceive and react to objective technologies. The enacted technology produces certain outcomes in terms of various improvements (Luna-Reyes & Gil-Garcia, 2011). The outcomes also affect the enacted technology. A two-way interaction exists between organizational forms and institutional arrangements. Organizational forms are structural characteristics such as centralization, formalization, and communication channels, and institutional arrangements are laws, regulations, and other cognitive, cultural, or socio-structural constraints located in the public sector (Fountain, 2001). TEF is based on institutional theory to provide a lens for investigating the complexities of “bureaucratic politics amid network formation and technological change.” It highlights how political agendas, organizational characteristics in the bureaucracy context, and existing arrangements shape the process of technology implementation (Cordella & Iannacci, 2010). This lens fits our needs for understanding DT in a hierarchical bureaucracy setting to include influence that crosses bureaucratic levels.

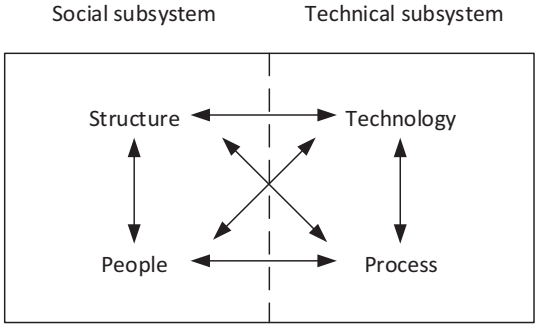

Fig. 2. Elements of a socio-technical system (based on Bostrom & Heinen, 1977, p. 25).

Both frameworks have been employed in existing research examining DT in government (Mergel, Edelmann, & Haug, 2019; Nograšek & Vintar, 2014; Tassabehji et al., 2016). These studies have shown the value of the two frameworks in supporting DT research. However, researchers also revealed the limitations of these frameworks when they are used to explain DT. The lack of a key enabler and the social–technical perspective of the diamond framework falls short of providing a holistic and satisfactory explanation related to the role of technologies in transformation (Nograšek & Vintar, 2014). Furthermore, the interrelationships of the four elements in the diamond framework do not reflect the dependency and readiness of those elements in transformation (Klievink, Romijn, Cunningham, & de Bruijn, 2017). In terms of the TEF, it has been noted to exclude any consideration of the existing socio-technical systems theory, and it does not address how people's ways of working are shifted to enable changes in the functioning of government (Schellong, 2007). Due to the above limitations, most of these studies have not directly applied these frameworks (Tassabehji et al., 2016). In our consideration, investigating DT in a hierarchical bureaucracy should not just rely on the study of intra-organizational elements, but also the impact across levels. This leads to the motivation for proposing a new conceptual model with the combination of the two frameworks in our study.

3.2. Developing a conceptual model

The diamond framework and TEF have different scopes. While the diamond framework focuses on the intra-organizational elements that influence the use of digital technologies, the TEF addresses environmental elements and how governments enact new technologies according to their social features. The TEF has been criticized for being too abstract and general (Bretschneider, 2003), encapsulating the adaptations that occurred inside the organization into a black box. In contrast, the diamond framework helps open up the internal elements that constitute the organizational forms and enacted technologies. The use of both frameworks in combination can enable the coverage of both the internal and environmental elements of organizations that need to be investigated in our study.

Similar to the TEF, a critique of the diamond model indicates that it does not explain how the four elements are interrelated, other than by stating that they affect each other (Hoff & Scheele, 2014). In contrast, EA offers more details on the interrelationships between business, process, data, and infrastructure. We argue that EA details the interrelationships of the four elements in the diamond model by describing how these elements were adapted. For this purpose, we operationalize these two theoretical frameworks in the context of DT and map the scope of EA and possible adaptations from the literature in Fig. 3. Each component of the model is introduced below.

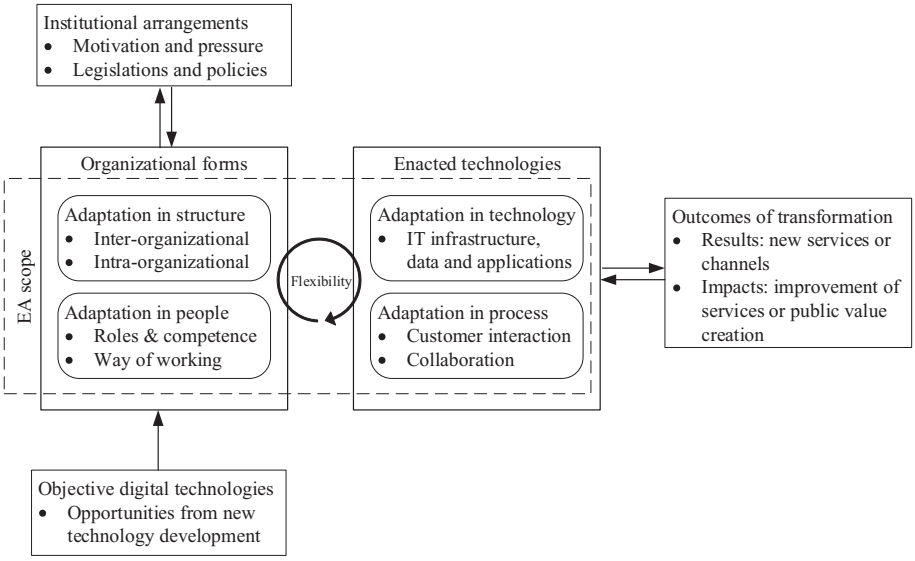

Fig. 3. A conceptual model for investigating DT in government.

Institutional arrangements reflect the reasons governmental organizations initiate DT (projects). With this component, we intend to understand governments' motivations for approaching DT. Examples include demands or pressure from citizens, businesses, or policy enforcement that trigger transformation (Weerakkody et al., 2016). Policy compliance exerts a substantial effect on shaping the choice, design, and adoption of digital technologies (Cordella & Iannacci, 2010). Legislations and policies correspond to regulatory frameworks such as the laws and formal policies that define, regulate, or constrain various aspects of DT, including service delivery, information sharing, and cooperation among public organizations.

The SMACIT technologies that can advance or satisfy the government's needs in DT are examples of objective digital technologies. Governments consider, select, and ultimately adopt a single SMACIT technology or a combination of SMACIT technologies to implement their digital government strategies within the constraints of related policies. The arrow departing from this component represents the strategic choice of digital technologies that will be adopted by the government. This strategic choice also implies the perception and expectation of the selected technology at a strategic level.

The outcomes of transformation are the results of DT that are directly observed as the consequences of the transformational changes. For example, governments might provide new services to citizens and businesses or new platforms or channels through which such services may be delivered. Alternatively, the outcomes of transformation are the impacts of DT for which causal relationships cannot be directly measured. For example, the use of digital technologies might contribute to improving public services by decreasing costs or time, resulting in higher customer satisfaction, better relationships with citizens, or praise from citizens. However, these changes often do not occur with a single step of implementation, but rather as a series of activities that generate those outcomes after a long period. DT in government might also create social value in society, such as improving the business environment or contributing to society, culture, or the economy (Mergel, Edelmann, & Haug, 2019). In the e-government literature, the aforementioned improvements are also regarded as public value, which is defined as citizens' collective expectations with respect to the government and public services (Twizeyimana & Andersson, 2019).

The organizational forms component overlaps with the social subsystem of the diamond model and concerns the structure and people. In this way, we attempt to access a further level of detail in the investigation and understanding.

Intra-organizational and inter-organizational structures are both critical for governments. Originally, Fountain (2001) called these structures “organizations/bureaucracy” and “networks,” respectively. On the one hand, public servants primarily work in bureaucracies (ministries or government agencies) to conduct policymaking or service delivery activities. On the other hand, they increasingly cooperate across agencies and across bureaucratic levels to perform the work of governments. These two structures strongly influence technology enactment and vice versa. Adaptations in the structures reflect the actual changes in these structures and how governments addressed the changes by rearranging their working organizations.

People are involved in the organizational forms component, as we consider people to be the building blocks of different organizational structures. With this element, we examine the adaptations in the roles and competences of public servants. Competence refers to the capabilities of public servants to provide public services, including their availability, adaptability, and productivity from an individual perspective. Observations should also focus on the changes in human resources, such as whether a government is able to perform the same tasks with fewer public servants. In addition, adaptations in the ways in which people work, including communication and knowledge sharing, may also reflect changes in this element.

The enacted technologies component refers to the ways in which technologies are actually used in the organization. This includes the ways in which IT infrastructure, data, and application technologies are implemented within the landscape of the existing systems, and how public servants use those technologies in their daily work, such as combining these technologies in their interactions with citizens or their routine business processes. For the same purpose to reach further details, we mapped the technology and process element onto the enacted technologies.

An understanding of how the elements of structure, people, technology, and process interact as well as the interactions between organizational forms and enacted technologies is essential for investigating DT. An EA analysis can address this need, as its scope covers the four elements. Using EA, we examine how the current working organizational forms and enacted technologies were designed and implemented. The scope of EA is unable to cover the other three components in the TEF because it focuses on the organizational context rather than a societal environment.

According to Fountain (2001), causal arrows in the TEF that flow in both directions indicate “recursive” relationships that influence relationships or causal connections that flow in all directions among the components. As our conceptual model is based on the TEF, the straight-

Table 1
Overview of the collected data.

Data sources	Number	Description
Primary data		
Interviews	7	Semi-structured interviews with government officers, project managers, and architects
Observation[a]	N/A	Observation of customers' interactions at the service desk of administrative service centers and digital channels, including web and mobile channels, in total for about 20 hours
Secondary data		
Government announcements and regulations	26	Government announcements on DT initiatives, including the reviews of previous efforts and outcomes and the plan or specifications of future development
Government reports or gazettes	24	Official government reports at various administrative levels in Zhejiang Province and a few related national government gazettes describing DT
Government meeting records	10	Records from regular ZPG meetings related to the DT
Government news briefing records	6	ZPG news briefings regarding their work in DT
Government news releases	75	News reports from the ZPG news channel, English version available at: http://www.zj.gov.cn/col/col1568565/index.html
Reliable third-party news reports	17	State media reports about the DT of ZPG
Independent reports and evaluations	11	Independent third-party reports describing the observation or evaluation of public services in Zhejiang Province
EA documents and consultancy reports	30	Confidential EA documents and vendor-provided reports on the DT projects of the ZPG

[a] We consider online observation uncountable, as this consisted of iterative work investigating online services.

line arrows presented in Fig. 3 have similar meanings. In addition, we employ a circular arrow between the organizational forms and enacted technologies to present the complex interrelationships among the four elements from the diamond framework. Flexibility is located in the center of the circular arrow to indicate our assumption that various types of flexibility are needed to enable the adaptations of the four organizational elements.

4. Research method

4.1. Research design

This study aims to answer a “how” question that relates to DT in government. An in-depth case study was considered to be an appropriate research method for collecting the necessary data and analyzing the DT phenomenon in hierarchical bureaucracy. The case study research method is suitable for addressing qualitative and “how” research questions by grounding an empirical inquiry to investigate a contemporary phenomenon within its real-life context in which multiple sources of evidence are used (Yin, 2009). Case studies are very useful instruments for examining phenomena in their natural setting and obtaining a deeper understanding of implicit and explicit social processes (Benbasat, Goldstein, & Mead, 1987). The single case study design is also widely used in e-government research (Cordella & Iannacci, 2010).

Our case selection followed an information-oriented strategy that maximizes the utility of information from single cases (Flyvbjerg, 2006). In a comparison with pervious DT studies that focused on a single organization at the country level, our study sought for a government case that has implemented DT across multiple bureaucratic levels to generate a cross-level view of DT. The other criterion of case selection was to have the best practice in DT among the governments that were accessible to the authors.

This case study focuses on the government of Zhejiang Provence, which is located in the Yangtze River Delta on the southeast coast of the People's Republic of China. Similar to many other provinces in China, the administrative divisions of Zhejiang Province consist of three levels of government: provincial, prefectural, and county levels. The hierarchical bureaucracy system of Zhejiang Province includes 1 provincial, 11 prefectural, and 89 county-level government agencies to serve a total population of 57 million (at the end of 2018). At the provincial level, 42 different departments exist. This characteristic allows the investigation of DT crossing multiple hierarchical levels rather than only focusing on an individual organization at a certain level. The Zhejiang Provencal Government (ZPG) started cloud-based online service delivery as early as 2014 to improve the efficiency of administration by implementing a series of innovative reforms. We investigated the efforts of the ZPG's DT over the period from 2014 to July 2019. Both the adoption and implementation of cloud computing and big data technologies in public service delivery were found in the case study; thus, this phenomenon fits the definition of DT. The ZPG is a frontrunner in digital government transformation nationwide. According to a series of annual evaluation reports on the online service capabilities of provincial governments commissioned by the State Council, Zhejiang ranked first for three consecutive years in 2015, 2016, and 2017, and ranked third in 2018.

The typical bureaucratic structure makes the ZPG a representative case of large-size hierarchical bureaucracy. A representative case can provide empirical insights into certain characteristics of the population to which the case belongs (Tsang, 2014). Although other governments with the same characteristics might adopt different digital technologies, their relationships with citizens are similar and they face to similar requirements concerning the creation of flexibility in DT. The long history of DT practices and the outstanding performance of digital services also make the ZPG a critical case to achieve information that permits logical deductions of the type (Flyvbjerg, 2006). Our conclusions do not provide statistical generalization, but rather present an in-depth analysis of DT and the creation of flexibility to provide useful insights for better understanding, planning, designing, and implementing similar DT initiatives in the public sector.

4.2. Data collection

We collected and analyzed both primary and secondary data in this study (Table 1). Primary data were obtained from interviews with different groups of stakeholders in different DT projects and direct observation of offline and online services. We selected interviewees by consulting the ZPG's DT agenda and also through recommendations from other interviewers. In total, two government officers, two project managers, and three architects were interviewed in a semi-structured manner. Each interview lasted about 2 hours. Direct observations were necessary, as we frequently checked if the planned solutions had been implemented on schedule. Secondary data include government policy documents and reports, news briefings, official or independent evaluation reports, confidential EA documents, and related consultancy reports. Official governmental documents legitimize government activities and provide accountability to citizens by declaring institutional aims, plans, strategic objectives, and actions in DT (Tassabehji et al., 2016). EA documents and consultancy reports record how the government adopted the objective technology and made adaptations to enable its use. These confidential documents are important for providing

insights into IT management in the ZPG. One author of this article worked in the software and system vendor company as a strategic director for their public sector business. He participated in and was experienced in many projects related to government DT projects in Zhejiang Province. Thus, we were able to access the EA documents related to the case study from this vendor.

We originally obtained more than one thousand related documents with substantial overlap of information from different data sources through a keyword search. We manually scanned all those documents to remove irrelevant and overlapping documents. Table 1 presents the number of secondary data documents after cleaning. The collection of a combination of primary and secondary data enabled an adequate level of data triangulation, which helped track the variations between primary and secondary data to improve the accuracy, interpretation, and analysis of the collected data (Mingers, Mutch, & Willcocks, 2013). This was done by cross-checking the interview content and the policy documents. During the interview, we also asked interviewees about which policy guides their implementations and how they implement the policy in practice.

We used the conceptual model to ensure the integrity of the data collected in descriptive case studies (Yin, 2009). We ensured that all components of every DT initiative under investigation had sufficient information, and we checked whether every piece of information abstracted from documents or interviews could be categorized into a component of the model.

4.3. Data analysis

Our data analysis followed a hermeneutic process that allowed the researchers to understand, reflect, and improve upon the interpretation of the findings within the case context (Baptista, 2009). Our analysis included three main steps: 1) identifying and abstracting information and categorizing the events according to the conceptual model; 2) conducting chronological analysis of the events, tracking the chains of events to identify adaptations and their connections; and 3) using the adaptation matrix to identify the various types of flexibility and their creation. A chronological analysis in a case study refers to the analysis of the sequence of events as they successively occur or have occurred (Kompf, 2010). A chronological analysis of a DT process makes intuitive sense, as it shows how one event led to or created the conditions for another event (Chanias et al., 2019). Our conceptual model played an ontological role in the chronological analysis and enabled an overview of important events. The adaptation matrix was then created to understand the adaptations that occurred among these events and to identify flexibility. The identification of flexibility is based on the connection between the type of flexibility and adaptation, considering that they both relate to certain organizational elements.

5. Case study

We presented the progress of the ZPG's DT in three periods. The division of the three periods is based on our observation that ZPG had three leading initiatives that pushed forward the transformation and resulted in three waves of movements. The findings are categorized into seven components according to the proposed conceptual model. Events are presented in chronological order to show their influence.

5.1. The first wave: 2014–2016

The announcement of the “Four Lists and One Network” policy initiated a new wave of reforms in government services. This policy intended to clarify the duties of different government departments, to avoid conflicts in administration processes, and to develop an all-in-one portal for service delivery. From 2014 to 2016, the ZPG announced subsequent regulations to implement their online service strategy that aimed to increase the web-based service delivery at all administrative levels of government and to experiment with cross-level and cross-department cooperation to simplify administrative processes.

The ZPG adopted cloud computing technology to create a shared infrastructure for government agencies at all levels and to implement online services. The adoption resulted in the operation of the “Zhejiang Government Administration Service Network” (www.zjzwfw.gov.cn), which was the first public cloud-based government services platform in China to deliver administrative services at the provincial, prefectural, and county levels of government. Both web and mobile applications were provided to create an omni-channel platform. Architectural documents in this period emphasized the migration of information and services to the cloud infrastructure. The use of Infrastructure-as-a-Service (IaaS) allowed the optimization of operation and the use of IT assets. Many government agencies closed their self-built web portals and moved their information and services to the cloud. An architect in a ZPG infrastructure project estimated an approximately 35% reduction in the IT operation costs for the whole administrative system of Zhejiang Province after the adoption of IaaS. Another benefit of online service delivery was the standardization of service procedures, as they became more transparent when monitored online. Service standardization reduced matters that were subjected to approval by governments in the past and streamlined administrative procedures by involving online payment and express delivery services. The number of approval items decreased from approximately 12,300 in 2014 to approximately 4200 in 2016.

5.2. The second wave: 2016–2018

The ZPG announced the “Implementation Plan for Promoting Big Data Development” strategy and decided to create a separate department, the Zhejiang Data Management Center (ZDMC), in early 2016. The ZDMC was responsible for generating data management policies and the top-level design of data-sharing procedures. This initiative aimed to enhance user-centric experiences by implementing a “maximum one visit service procedure,” which was in essence the implementation of one-stop shop services. Subsequently, standards for the “maximum one visit service procedure” were issued from May to December of 2017 to enable and regulate data sharing and coordinate the cooperation between departments and agencies.

The adoption of cloud infrastructure enabled the development of a big data center that aimed to collect, store, and integrate data from all the departments at the provincial level and provided them with data-sharing services on the cloud. The big data center played two important roles: enabling the exchange of required data between departments and providing them identification data and profiles of citizens or businesses, such as text payment or credit information, to accelerate service processes and create convenience. The big data center enabled the construction of the data Platform-as-a-Service (dPaaS) model to allow the creation of flexible business processes. Architectural documents in this period emphasized the design and implementation of the data architecture.

A cross-platform office application based on the application Platform-as-a-Service (aPaaS) model was initially introduced in several prefectural government agencies as pilots in the mid-2017 and then popularized to all the departments of the ZPG and other prefectural governments. This application allowed public servants to access information via computers, tablets, or mobile devices. It became embedded in their daily work and became the main working application. The use of this application also changed the cooperation and communication between public servants. A government officer of the ZPG commented that this application flattened the lines of communication between different hierarchical layers of governments and made the flow of information and responses much faster and easier. This proved to be extremely useful in emergency management.

The deployment and use of dPaaS created flexibility for the fast implementation of new business processes that deliver one-stop shop

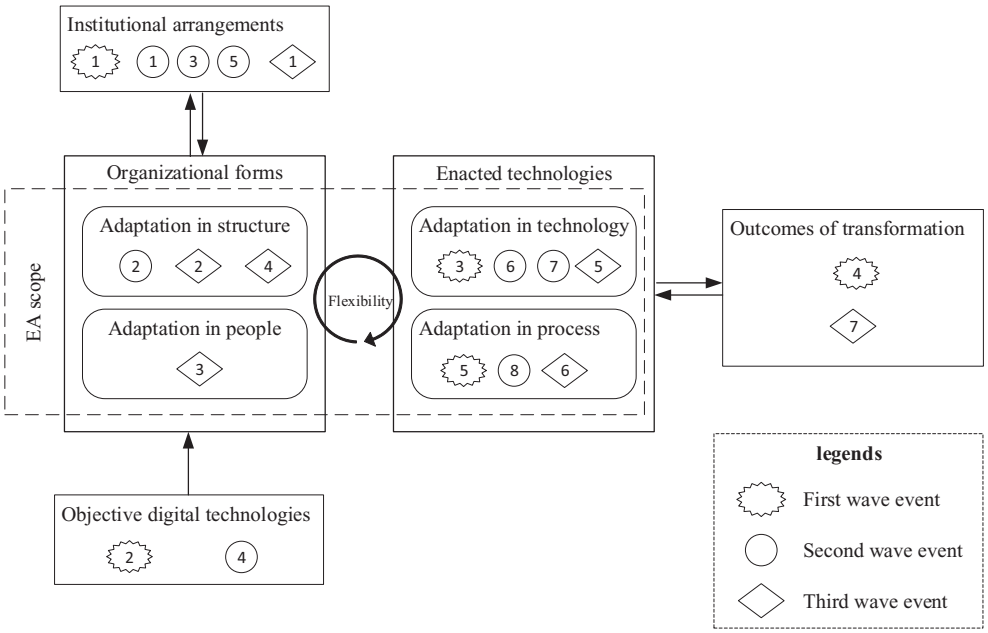

Fig. 4. Mapping the events in chronological order to the conceptual model.

services. The redesign of business processes was an essential activity in transforming public services and caused radical changes at the process level. This involved the integration of reliable data sources provided by other organizations to reshape the administrative processes from a user-centric perspective. The ZPG started service transformation from the most frequently used services at the provincial level at the end of 2017. Subsequently, several governments at the prefectural level copied this model and established their own data management departments to manage the redesign of their own service processes. The offline service delivery in the administrative service center was also improved, as a service desk was able to accept multiple types of applications rather than just handling applications for only one department.

5.3. The third wave: 2018 - the middle of 2019

The third wave of movements started with the issuance of a series of policies and regulations related to the reform of one-stop shop services and DT. Three important policy documents issued from April to December of 2018 described the break of data silos, standardization, and the implementation plan for continuous DT, respectively. These policies were based on previous practice and experiences in DT and formally legitimized or regulated the DT activities of departments or agencies at all administrative levels.

The implementation of these policies resulted in further changes in organizational forms. A separate department called the “maximum one visit service procedure” Reform Office was created to coordinate and supervise each subsidiary of the ZPG in their implementation of the policies. The creation of this office allowed the ZDMC to better focus on process design and service development at an operational level and the development of technical standards or solutions, while the reform office focused on the work at a strategic level and governance. Many public servants working at different administrative service centers were trained for one-stop shop service delivery. They were required to enhance their service capabilities to process any type of service in the one-stop shop list. This approach ultimately resulted in the reform of the administrative centers and enabled the creation of all-in-one service desks that were able to accept any kind of service application. Along with the use of online services and all-in-one service desks supported by highly flexible people, the number of public servants was reduced significantly at different levels. According to a government report, the provincial government reduced 1620 staff, and all the prefectural and county level governments together reduced 14,974 staff from May 2018 to July 2019. This decrease in staff was accompanied by a restructuring of the organizations at all levels. Six departments were closed at the provincial level, 23 at the prefectural level, and 196 at the county level.

Architectural documents in this period emphasized the construction of a big data platform based on distributed big data centers to enable the management and governance of data storage, analysis, and sharing between departments and agencies at all administrative levels. The construction of the big data platform created synchronization between the provincial big data center and many other big data centers of departments or prefectural agencies.

The benefits of the big data platform were reflected by the achievement of the one-stop shop reform. According to a self-evaluation conducted by the ZPG, up to the middle of 2019, more than 16.4 billion data records were collected in the big data platform in the cloud and shared with different departments and agencies throughout the province. Over 1.2 million public servants were actively working with the omni-channel office application, particularly its mobile channel. Notably, 95.2% of the administrative services were delivered online, including 1952 services with 9258 service building blocks, enabling the creation of flexible service procedures and customization. About 75% of cross-department procedures were transformed to one-stop shop services. On average, those one-stop shop services reduced the number of documents required for submissions by 29% and processing time by 35% compared to the previous processes.

5.4. Chronological analysis

We used serial numbers to indicate the chronological order of important events in each wave of DT movements and mapped them into the conceptual model for further analysis and discussion. Fig. 4 provides an overview of these events and the related elements. Table 2 presents a list of these events with brief descriptions and when they occurred.

This chronological analysis provides an overview regarding which events occurred simultaneously or sequentially associated with which components. Specifically, it shows the adaptations that occurred with the four organizational elements. Furthermore, it facilitates the use of the adaptation matrix for an analysis of flexibility.

Table 2
Serial numbers and descriptions of events in each wave of DT.

Number	Descriptions	(Period of) Time
The first wave (2014–2016)		
1	Announcement of the "Four Lists and One Network" policy	Nov. 2013
2	Adoption of cloud computing technology	Early 2014
3	The implementation of IaaS	Since 2014
4	Operation of the "Zhejiang Government Administration Service Network" omnichannel platform	Since mid-2014
5	Significant reductions in IT operation costs and number of approval items, and streamlining of administrative processes	2015–2016
The second wave (2016–2018)		
1	Announcement of the Implementation Plan for Promoting Big Data Development	Feb. 2016
2	Creation of the ZDMC	Early 2016
3	Announcement of the "maximum one visit service procedure" policy	Feb. 2017
4	Adoption of big-data technology	Early 2017
5	Issuing standards: Method of operation for government affairs to the "maximum one visit service procedure"	May–Dec. 2017
6	Implementation of dPaaS	Mid-2017
7	Implementation of aPaaS	Mid-2017
8	Redesign and implementation of new business processes for one-stop shop services in the ZPG as pilots	Late 2017
The third wave (2018 – the middle of 2019)		
1	Announcement of DT policies	Apr.–Dec. 2018
2	Creation of the "maximum one visit service procedure" Reform Office	End of 2018
3	Improvements in public servants' service capabilities, changes in roles, and reductions in the number of public servants	Since May 2018
4	Creation of all-in-one service desks at administrative centers and restructuring organizations at all levels	Since mid-2018
5	Implementation of the big data platform	2018–mid-2019
6	Creation of one-stop shop services at all administrative levels with standard building blocks	2018–mid-2019
7	Measuring the achievements of one-stop shop service transformation	Mid-2019

The findings show that the events are not evenly distributed on each component, and the numbers of significant events are also different in each wave. In particular, the second wave did not result in a detected outcome of transformation, and the third wave did not have an objective digital technology to be adopted. We found that at the end of the second wave, ZPG achieved success in their pilot projects for creating one-stop shop services. The efforts in this wave were mainly made by organizations at the provincial level, with the exception of a few prefectural governments. Furthermore, there were more institutional arrangement events in the second wave than in other waves. In contrast, the outcomes of the first and third waves are presented as new channels for service delivery or measurable improvement of services. The main difference is that the adaptation in these two waves influences all the levels in the hierarchical bureaucracy.

6. Findings and discussion

Hierarchical bureaucracies are common in governments, and flexibility is needed to approach their DT. This research has attempted to provide a comprehensive understanding of DT in government with multi-level bureaucracies. The case study presented above describes how the ZPG created various types of flexibility to progress their DT initiatives.

6.1. Changes in digital transformation

Understanding and predicting the scale and scope of the changes associated with the use of digital technologies is a challenge for DT decision makers (Bharadwaj et al., 2013). Discussions regarding the types of changes that emerge in DT have persisted for years (e.g., Nograšek & Vintar, 2014; Vial, 2019). Meijer and Bekkers (2015) criticize the focus of a majority of e-government research on the transformational effect of technologies, while only incremental changes are investigated. Recent research in the private sector has argued that DT does not have to be radical, but it often requires incremental steps to better deliver the core value proposition (Furr & Shipilov, 2019). In public-sector research, Mergel, Edelmann, & Haug, 2019 indicate that most efforts in the early digitalization of government services are actually transitional rather than transformational: transitioning offline services into online digital services without rethinking the service itself or its underlying processes.

Our case study, however, observed all of these types of changes over a period of five years. The efforts in online service delivery in the first wave were, in essence, an incremental change to transition services from offline to online, while radical changes occurred in the IT infrastructure of the ZPG and resulted in a new omni-channel platform. The adoption of big data technology in the second wave resulted in radical changes in data provision, sharing, and usage and enabled the creation of pilot one-stop shop services. In the third wave, the extension and implementation of one-stop shop services at other levels of governments became incremental changes. Thus, radical changes often generate new results, such as the creation of the omni-channel platform or new one-stop shop services. Radical changes occur in the exploration of digital options and innovations. For example, in the second wave, all adaptations are transformational changes. In contrast, incremental changes extend the range of use of radical innovation products. The ZPG case demonstrates the need for incremental changes in the process for the delivery of massive public services to citizens and the realization of public value in the long run. In this case, the progress of DT fundamentally changed the technology, process, structure, and eventually the people element of the ZPG. Ultimately, DT reflected changes in people's working methods and the culture of the organization toward public value. Based on the adaptation matrix and the above discussion, Table 3 summarizes the types of changes associated with the organizational

Table 3
Types of changes in organizational elements at different bureaucratic levels.

Wave	Level	Structure		People		Technology		Process	
		RC	IC	RC	IC	RC	IC	RC	IC
1st	Provincial					x			x
	Prefectural								x
	County								x
2nd	Provincial	x				x		x	
	Prefectural							x	
	County								
3rd	Provincial	x		x		x			x
	Prefectural			x					x
	County			x					x

RC = radical change, IC = incremental change.

elements and bureaucratic levels. This table may reflect decision-makers' concerns about the scale and scope of the changes in DT.

Our findings suggest that DT in hierarchical bureaucracies includes both radical and incremental changes depending on the organizational elements, the bureaucratic level, and the stage of DT. We found that adaptations as radical changes often occurred at the provincial level, except for those associated with people. Changes in structure occurred less frequently, but significantly impacted the entire bureaucratic system, as they fundamentally changed the way organizations coordinated collaboration. Such changes only occurred at the provincial level, indicating the need for legitimacy to change the structure; such legitimacy is often provided by the provincial level in our case. Fundamental changes in people's working methods were only identified once in our case study at a very late stage. This indicates that people's working methods are hardly changed, but once such changes occur, they impact all levels. The adoption of digital technologies resulted in radical changes in the technology element. These changes also only occurred at the provincial level because in our case, the technical innovations mainly concerned the infrastructure provided by the provincial government and used by the governments at all levels. Changes in processes were found to be radical or incremental depending on the stage of DT. The ZPG emphasized the exploration of digital innovation in the second wave and therefore only presented radical changes in this stage.

6.2. Flexibility creation for digital transformation

Governments need flexibility to deal with changes that occur in DT. Based on the chronological analysis presented in the previous section, Fig. 5 presents an adaptation matrix that explains the identification of various types of flexibility in the case study. The various concepts of flexibility are based on a literature study, and we contextualized these concepts to facilitate a comprehensive understanding. The following flexibility was created and realized during DT in the ZPG:

- Infrastructure flexibility (IaaS): The use of IaaS enabled a flexible computing load, including access by public servants or citizens and the storage of increasing volumes of data.
- Infrastructure flexibility (PaaS): The use of dPaaS and aPaaS enabled the implementation and integration of process building blocks to construct one-stop shop services.
- Infrastructure flexibility (data): The construction of a big data platform based on distributed big data centers enabled the flexible sharing of data between departments and agencies at all administrative levels.
- Functional flexibility: The use of a platform with a clearer functional and process design enabled the delivery of standardized and streamlined public services online.
- Process flexibility by orchestration: The use of process building blocks for constructing one-stop shop services enabled the fast implementation of new business processes.
- Process volume flexibility: Public servants working on different processes enabled the easy reallocation of human-based capabilities between processes.
- Worker flexibility: Public servants were able to work on different processes related to service procedures in different departments.
- Organizational flexibility: Public servants working on different processes enabled the creation of all-in-one service desks.
- Network flexibility: The creation of separate departments adapted the inter-organizational relationships and coordinated one-stop shop service delivery.

The adaptation matrix visualizes intra-organizational adaptations in different periods to facilitate a longitudinal analysis. We found that the technology and process elements were significantly adapted in each wave. Consequently, both infrastructure flexibility and process flexibility are present in all three waves, reflecting their importance in DT.

Infrastructure flexibility was needed in all periods to support digital activities. The traditional concept of IT infrastructure is generic and includes hardware and operating systems, communication networks,

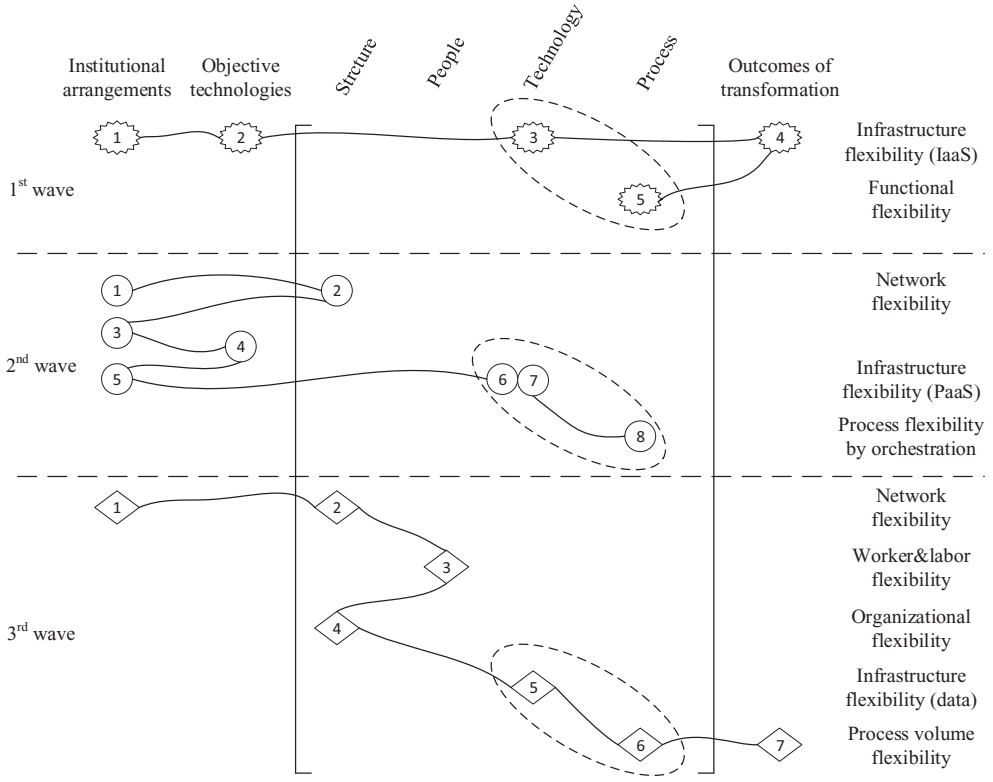

Fig. 5. Adaptation matrix for the case study.

data, and IT applications (Byrd & Turner, 2000). This results in generic concepts of infrastructure flexibility in the literature (Benitez et al., 2018). However, in our case study, the adaptations of technology infrastructure, and correspondingly, the type of infrastructure flexibility differs in each wave, in terms of their emphasis and creation methods. In the first wave, the creation of infrastructure flexibility was based on the typical IaaS model to allow flexible computing power and data storage. In the second wave, the PaaS model, including dPaaS and aPaaS, provided a flexible platform development environment. As PaaS is typical for developers, it explains why the second wave of movements did not spread out to all levels but was limited to the provincial level and a few prefectural governments. In the third wave, data infrastructure was implemented and used at all levels to enable the flexible use of data from various sources, resulting in the delivery of one-stop shop services.

Multiple types of process flexibility are highlighted in the literature, as well as different ways to achieve them. In our case study, we identified functional flexibility, process flexibility by orchestration, and process volume flexibility. Functional flexibility refers to streamlining current business processes by better design but without fundamental changes. In the first wave, the process improvement was mainly derived from the new method of service delivery. In essence, it is a transition from offline services to online delivery with slight improvements and better and user-friendly presentation. In contrast, process flexibility by orchestration enables a fundamental change in the way business processes are designed, created, and maintained. Process volume flexibility was also reflected by incremental changes, which allows for shifting the process capacity. This is not considered a fundamental change because the processes themselves remain the same, but the public servants who can work on the process can be flexibly relocated.

Two new departments were established to create network flexibility, but their responsibilities differed. In the second wave, ZDMC was created to coordinate the development of PaaS infrastructure and the creation of new business processes at the backend. In contrast, the "maximum one visit service procedure" Reform Office created in the third wave was in charge of the coordination for deploying the use of the one-stop shop services and the governance of other governmental agencies through being assigned strong legitimacy. In comparison, the Reform Office focused more on the frontend and was less technical. Its influence transferred from the provincial to the country level in the hierarchical bureaucracy, and therefore, with more significant changes.

Furthermore, the matrix shows that the creation of flexibility might not occur in isolation. Close chronological relationships of adaptations reflect the relationships between corresponding types of flexibility. As indicated by the three dotted line ellipses in Fig. 5, the adaptations related to the technology and process element present a strong connection in each wave, as they occurred close in time. The high frequency of coexistence indicates strong relevance. This relationship implies that the creation of process flexibility in different types needs the support of existing infrastructure flexibility. In addition, we found that in the third wave, the creation of process volume flexibility not only required data infrastructure flexibility but also worker and labor flexibility and organizational flexibility to allow the relocation of public servants to different processes. Workers and labor flexibility required public servants to have sufficient skills to work in different roles, and organizational flexibility was needed to allow them to work in different business units without hitting barriers. Eventually, organizational flexibility responded to network flexibility, which enabled coordination to facilitate cooperation between departments and agencies. Through this discussion, we consider that infrastructure flexibility closely supports the creation of functional flexibility and process flexibility by orchestration, while network flexibility, organizational flexibility, and worker and labor flexibility are more closely related. This finding also reveals that the types of flexibility associated with organizational elements under the same subsystem (social or technical) have stronger relevance.

Comparing the presence of flexibility in each wave shows that the creation of flexibility increased along with progress in DT. More types of flexibility are found in later stages of DT than in earlier stages. For instance, half of the identified types of flexibility were created in the third wave in our case study, reflecting the advances in DT. This confirms our basic assumption that governments create various types of flexibility to progress through their DT.

We found that flexibility creation can be technology-enabled or policy-enabled, but it shifted from the early stage to the late stage. In the first wave, the adoption of cloud computing technologies created infrastructure flexibility, and the use of an online platform created process flexibility. In the second and third waves, network flexibility was created by the establishment of two departments. As we can see from the second wave, the exploration of digital options and innovations is reflected by frequent adjustments of ZPG's policy in cooperating with the piloting projects. This shows the important role of policy in the creation of flexibility, especially for the structure. From the first to the third wave, the creation of flexibility shifted from being more technology-enabled to more policy-enabled. The presence of flexibility associated with structure and people in the later stage reflects the shift of ZPG's DT efforts from improvement in process performance to more flexible structures and user-centric organizational culture.

7. Conclusion

The case study presents a policy-driven pattern to approaching DT with the waves of movements spreading in a top-down manner. In our case, the provincial government led the DT movements by first preparing the infrastructure at the provincial level, then piloting new one-stop shop services with a few governments at the prefectural level, and finally extending the service transformation to the governments at all levels. The progress of DT involved radical or incremental changes in the technology, process, structure, and eventually the people element of the governments. In this sense, DT in government spreads like waves across different periods, organizational elements, and bureaucratic levels. In this study, we observed and analyzed efforts to create flexibility in DT relating to different periods, organizational elements, and bureaucratic levels. Given the challenge of understanding the crossing-level influence in hierarchical bureaucracy, we employed TEF to investigate the impact of intuitional arrangements on ZPG's implementation and the use of digital technologies. We aligned TEF with the diamond framework and EA scope together to further understand the adaptations in the organizational elements of structure, people, technology, and process. This combination results in a conceptual model that facilitates the chronological analysis of these adaptions. Based on the findings, an adaptation matrix was created to analyze flexibility.

The findings from our case study indicate that the creation of flexibility increases with DT progress. Flexibility creation can be technology-enabled or policy-enabled, depending on the stage and related organizational elements. Flexibility is not created in isolation. We found that infrastructure flexibility can support the creation of process flexibility, while the creation of network flexibility, organizational flexibility, and worker and labor flexibility are closely related. The creation of flexibility also depends on the bureaucratic levels, as we found that more types of flexibility are created at the provincial level than at the country level, especially those dealing with fundamental changes.

Our case study presents the DT phenomenon across three bureaucratic levels. This cross-level view has not yet received sufficient attention from the e-government research community, as existing empirical studies are predominantly focused on a single organization and often examine governments at the country level (e.g., Liu & Zheng, 2018; Tassabehji et al., 2016; Weerakkody et al., 2011). Our research contributes to enabling a multi-level scope of DT in government, indicating the potential biases caused by focusing on individual DT projects, organizations, or administrative levels. DT practitioners in

government need to move beyond focusing on new individual technologies, process performance, their own organization, or a single bureaucratic level to develop a comprehensive view on the creation of flexibility that is closely aligned with their DT agenda. Through clarifying the needed flexibility in DT, our study assists practitioners in anticipating what adaptations may arise during their DT attempts. Practitioners can enact digital technologies to create infrastructure and process flexibility to lay the foundation of massive service provision and digital innovation. Practitioners can also leverage policy adjustment to create organizational and network flexibility for the exploration of digital options and innovations that change the way of working. Ultimately, DT practitioners should aim at shaping the organizational culture toward public value.

This single case study has the limitation of a possible China-specific bias, as it only reflects the situation of a province in East China. The specific social and economic environment of Zhejiang Province in China limits the generalizability of the findings to other areas and countries. In addition, as this study focuses on flexibility, we did not treat all the components of the conceptual model with equal importance, but emphasized intra-organizational elements. Although we reflected both the views of governments and technology vendors, we have more inputs from the vendor side due to their cooperativeness and a better understanding of technologies. This approach has the risk of leading to technological determinism (Hoff & Scheele, 2014; Nograšek & Vintar, 2014) and vendor bias. Furthermore, as we relied on EA analysis to track the adaptations in the four organizational elements, the quality of collected data is partly dependent on the maturity level of EA management in the organization. However, EA maturity differs across organizations; further, it is difficult to measure and changes over time. In our study, we found that ZPG has a lower level of EA maturity in the first wave and less EA documents are retained. This risks the quality of analysis for this period. In addition, EA documents are often confidential to the public. This constrains the applicability of our analysis methods to other cases. Future studies should address these limitations by performing additional case studies and comparing the results to further examine the validity of the existing findings and the variety of factors impacting DT performance in government.

The conceptual model presented in this paper also requires further empirical examination. DT research in the literature often shows difficulty in presenting a solid theoretical foundation to reason for the selection of attributes that impact organizational changes (Mergel, Edelmann, & Haug, 2019; Nograšek & Vintar, 2014). The proposed model selected attributes by combining the widely used diamond framework and TEF. However, such a combination requires further empirical verification, since both frameworks have been criticized for ambiguity. The use of EA can add more clarity to the technical subsystem than the social subsystem for its IT-oriented nature. This imbalance also needs to be addressed in future research.

Acknowledgements

This work is supported by the National Natural Science Foundation of China (Grant No. 71501145) and the Young Scholar Support Program of Alibaba Group.

References

Afflerbach, P., Kastner, G., Krause, F., & Röglinger, M. (2014). The business value of process flexibility: An optimization model and its application in the service sector. *Business & Information Systems Engineering, 6*(4), 203–214.

Baptista, J. (2009). Institutionalisation as a process of interplay between technology and its organisational context of use. *Journal of Information Technology, 24*(4), 305–319.

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly, 11*(3), 369–386.

Benitez, J., Ray, G., & Henseler, J. (2018). Impact of information technology infrastructure flexibility on mergers and acquisitions. *MIS Quarterly, 42*(1), 25–43.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly, 37*(2), 471–482.

Bonney, M., & Jaber, M. Y. (2013). Developing an input–output activity matrix (IOAM) for environmental and economic analysis of manufacturing systems and logistics chains. *International Journal of Production Economics, 143*(2), 589–597.

Bostrom, R. P., & Heinen, J. S. (1977). MIS problems and failures: A socio-technical perspective. Part I: The causes. *MIS Quarterly, 1*(3), 17–32.

Bretschneider, S. (2003). Information technology, E-government, and institutional change. *Public Administration Review, 63*(6), 738–741.

Buschle, M., Ullberg, J., Franke, U., Lagerström, R., & Sommestad, T. (2010). *A tool for enterprise architecture analysis using the PRM formalism. Paper presented at the international conference on advanced information systems engineering.* Tunisia: Hammamet.

Byrd, T. A., & Turner, D. E. (2000). Measuring the flexibility of information technology infrastructure: Exploratory analysis of a construct. *Journal of Management Information Systems, 17*(1), 167–208.

Chanias, S., Myers, M. D., & Hess, T. (2019). Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *The Journal of Strategic Information Systems, 28*(1), 17–33.

Chen, D., Doumeingts, G., & Vernadat, F. (2008). Architectures for enterprise integration and interoperability: Past, present and future. *Computers in Industry, 59*(7), 647–659.

CIO.GOV (2012). *Digital government: Building a 21st century platform to better serve the American people.* CIO Council. Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/omb/egov/digital-government/digital-government.html#fn10.

Clark, P. A. (1972). *Action research and organizational change.* London: Harper and Row.

Cognini, R., Corradini, F., Gnesi, S., Polini, A., & Re, B. (2018). Business process flexibility - a systematic literature review with a software systems perspective. *Information Systems Frontiers, 20*(2), 343–371.

Cordella, A., & Iannacci, F. (2010). Information systems in the public sector: The e-Government enactment framework. *The Journal of Strategic Information Systems, 19*(1), 52–66.

Curtis, S. (2019). Digital transformation—The silver bullet to public service improvement? *Public Money & Management, 39*(5), 322–324.

Dubey, R., Gunasekaran, A., & Childe, S. J. (2019). Big data analytics capability in supply chain agility: The moderating effect of organizational flexibility. *Management Decision, 57*(8), 2092–2112.

EUROPA.EU (2016). *EU eGovernment action plan 2016–2020: Accelerating the digital transformation of government.* Brussels: European Commission. Retrieved from https://ec.europa.eu/digital-single-market/en/news/communication-eu-egovernment-action-plan-2016-2020-accelerating-digital-transformation.

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2014). Embracing digital technology: A new strategic imperative. *MIT Sloan Management Review, 55*(2), 1–14.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219–245.

Foorthuis, R., Hofman, F., Brinkkemper, S., & Bos, R. (2012). Compliance assessments of projects adhering to enterprise architecture. *Journal of Database Management, 23*(2), 44–71.

Fountain, J. E. (2001). *Building the virtual state: Information technology and institutional change.* Brookings Institution Press.

Furr, N., & Shipilov, A. (2019). Digital doesn't have to be disruptive. *Harvard Business Review, 97*(4), 94–103.

Gong, Y., & Janssen, M. (2012). From policy implementation to business process management: Principles for creating flexibility and agility. *Government Information Quarterly, 29*(Supplement 1), 61–71.

Gong, Y., & Janssen, M. (2017). Enterprise architectures for supporting the adoption of big data. *Paper presented at the 18th annual international conference on digital government research, Staten Island, NY, USA*.

Gong, Y., & Janssen, M. (2019). The value of and myths about enterprise architecture. *International Journal of Information Management, 46*, 1–9.

GOV.CN (2016). *Guiding opinions of the state council on further promoting the work of "internet plus government services". 55*The People's Republic of China: The State Council. Retrieved from http://english.www.gov.cn/archive/state_council_gazette/2016/10/20/content_281475470674288.htm.

Hoff, J., & Scheele, C. E. (2014). Theoretical approaches to digital services and digital democracy: The merits of the contextual new medium theory model. *Policy & Internet, 6*(3), 241–267.

Holland, J. H. (1992). *Adaptation in natural and artificial systems: An introductory analysis with applications to biology, control, and artificial intelligence.* Massachusetts, USA: The MIT Press.

Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly, 32*(3), 221–236.

Klievink, B., & Janssen, M. (2009). Realizing joined-up government — Dynamic capabilities and stage models for transformation. *Government Information Quarterly, 26*(2), 275–284.

Klievink, B., Romijn, B.-J., Cunningham, S., & de Bruijn, H. (2017). Big data in the public sector: Uncertainties and readiness. *Information Systems Frontiers, 19*(2), 267–283.

Kompf, M. (2010). Chronological order. In A. J. Mills, G. Durepos, & E. Wiebe (Eds.). *Encyclopedia of case study research*. Sage.

Leavitt, H. J. (1965). Applied organizational change in industry: Structural, technological and humanistic approaches. In J. G. March (Ed.). *Handbook of organizations* (pp. 1144–1170). Chicago, Illinois: Rand McNally & Co.

Liu, X., & Zheng, L. (2018). Cross-departmental collaboration in one-stop service center for smart governance in China: Factors, strategies and effectiveness. *Government Information Quarterly, 35*(4), S54–S60.

Luna-Reyes, L. F., & Gil-Garcia, R. (2011). Using institutional theory and dynamic simulation to understand complex e-Government phenomena. *Government Information Quarterly, 28*(3), 329–345.

Lyytinen, K., & Newman, M. (2008). Explaining information systems change: A

punctuated socio-technical change model. *European Journal of Information Systems, 17*(6), 589–613.
Manders, J. H. M., Caniëls, M. C. J., & Ghijsen, P. T. (2016). Exploring supply chain flexibility in a FMCG food supply chain. *Journal of Purchasing and Supply Management, 22*(3), 181–195.
Meijer, A., & Bekkers, V. (2015). A metatheory of e-government: Creating some order in a fragmented research field. *Government Information Quarterly, 32*(3), 237–245.
Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly, 36*(4), 101385.
Mergel, I., Gong, Y., & Bertot, J. (2018). Agile government: Systematic literature review and future research. *Government Information Quarterly, 35*(2), 291–298.
Mingers, J., Mutch, A., & Willcocks, L. (2013). Critical realism in information systems research. *MIS Quarterly, 37*(3), 795–802.
Niemi, E., & Pekkola, S. (2019). The benefits of enterprise architecture in organizational transformation. *Business & Information Systems Engineering* In press.
Nograšek, J., & Vintar, M. (2014). E-government and organisational transformation of government: Black box revisited? *Government Information Quarterly, 31*(1), 108–118.
Nurcan, S. (2008). A survey on the flexibility requirements related to business processes and modeling artifacts. *Paper presented at the 41st Hawaii international conference on system sciences*.
Pollitt, C., & Bouckaert, G. (2017). *Public management reform: A comparative analysis - into the age of austerity* (forth ed.). Oxford, UK: Oxford University Press.
Schellong, A. (2007). *Extending the technology enactment framework.* Kennedy School of Government, Harvard University.
Scholl, H. J. (2005). Organizational transformation through e-government: Myth or reality? *Paper presented at the 4th international conference on electronic government, Copenhagen, Denmark*.
Schonenberg, H., Mans, R., Russell, N., Mulyar, N., & Van der Aalst, W. (2008). Process flexibility: A survey of contemporary approaches. In J. L. G. Dietz, A. Albani, & J. Barjis (Vol. Eds.), *Advances in enterprise engineering I. 10. Advances in enterprise engineering I* (pp. 16–30). Berlin: Springer.
Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2017). How big old companies navigate digital transformation. *MIS Quarterly Executive, 16*(3), 197–213.
Singh, A., & Hess, T. (2017). How chief digital officers promote the digital transformation of their companies. *MIS Quarterly Executive, 16*(1), 1–17.
Smith, H. A., & Watson, R. T. (2015). The jewel in the crown – Enterprise architecture at Chubb. *MIS Quarterly Executive, 14*(4), 195–209.
Stevenson, M., & Spring, M. (2007). Flexibility from a supply chain perspective: Definition and review. *International Journal of Operations & Production Management, 27*(7), 685–713.
Svahn, F., Mathiassen, L., & Lindgren, R. (2017). Embracing digital innovation in incumbent firms: How Volvo cars managed competing concerns. *MIS Quarterly, 41*(1), 239–253.
Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). How does Enterprise architecture add value to organisations? *Communications of the Association for Information Systems, 28* Article 10.
Tassabehji, R., Hackney, R., & Popovič, A. (2016). Emergent digital era governance: Enacting the role of the 'institutional entrepreneur' in transformational change. *Government Information Quarterly, 33*(2), 223–236.
TOGAF (2018). *The TOGAF® standard, version 9.2.* The Open Group.
Tsang, E. W. K. (2014). Case studies and generalization in information systems research: A critical realist perspective. *The Journal of Strategic Information Systems, 23*(2), 174–186.
Twizeyimana, J. D., & Andersson, A. (2019). The public value of E-Government – A literature review. *Government Information Quarterly, 36*(2), 167–178.
Van der Raadt, B., Bonnet, M., Schouten, S., & Van Vliet, H. (2010). The relation between EA effectiveness and stakeholder satisfaction. *Journal of Systems and Software, 83*(10), 1954–1969.
Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems, 28*(2), 118–144.
Vidgen, R., Shaw, S., & Grant, D. B. (2017). Management challenges in creating value from business analytics. *European Journal of Operational Research, 261*(2), 626–639.
Weerakkody, V., Janssen, M., & Dwivedi, Y. K. (2011). Transformational change and business process reengineering (BPR): Lessons from the British and Dutch public sector. *Government Information Quarterly, 28*(3), 320–328.
Weerakkody, V., Omar, A., El-Haddadeh, R., & Al-Busaidy, M. (2016). Digitally-enabled service transformation in the public sector: The lure of institutional pressure and strategic response towards change. *Government Information Quarterly, 33*(4), 658–668.
Yin, R. K. (2009). *Case study research design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications.
Yousaf, Z., & Majid, A. (2018). Organizational network and strategic business performance. *Journal of Organizational Change Management, 31*(2), 268–285.

Yiwei Gong is an associate professor at the School of Information Management, Wuhan University. He currently serves as an editorial board member of Government Information Quarterly. His expertise and research interests include Business Process Management, Enterprise Architecture and Digital Transformation.

Jun Yang is a strategy director of Alibaba Cloud Research Center. His research includes Digital Government and Public Services, Smart City and City Brain.

Xiaojie Shi is a postgraduate student of Electronic Commerce at Wuhan University and a visiting student (master students exchange program) at NEOMA Business School in France. Her research interests include Digital Transformation and Business Process Management.