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Research Article

Blockchain as a driving force for federalism: A theory of cross-organizational task-technology fit

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ABSTRACT

Digital technologies play an important role for the delivery of many public services. However, selecting and adopting the 'right' digital technologies is often challenging, especially for federally structured governments. Universal factors for successful adoption are hard to establish, and the particularities of federalism, such as the separation of competencies, complicate technology selection. Nevertheless, blockchain technology seems to flourish in these environments. Through a single-case study on the blockchain project of Germany's Federal Office for Migration and Refugees, we unpack one essential factor for this success: the fit between (cross-) organizational task structure and technological properties. This fit earns the Federal Office's project considerable credit and traction with stakeholders and partner authorities – not least because it supports the argument that the digitalization of federal systems is possible without 'digital centralization' and redistribution of competencies. Our task-technology fit analysis contributes to a better understanding of the adoption of blockchain in the public sector. It also provides the foundation for an extended task-technology fit theory for federally structured, cross-organizational contexts.

1. Introduction

Digital innovation has come a long way in the public sector. Some small countries like Estonia – one of the world's most digitally advanced societies (Reynolds, 2016) – already offer most of their public services online. Many larger countries have yet to make similar progress, but targets are ambitious. Germany's Online Access Act (OZG), for instance, obliges its federal, state, and local governments to offer all public services digitally by the end of 2022 (Federal Ministry of the Interior, Building & Community, 2020). One essential aspect of these digitalization efforts is the selection of the 'right' digital technologies (Avgerou & Bonina, 2020; Fairclough, 2003; Goh & Arenas, 2020; Rose, Persson, Heeager, & Irani, 2015); however, selection often proves to be difficult (Avgerou & Bonina, 2020; Rose et al., 2015; Scott, DeLone, & Golden, 2016) due to complex decision-making and accountability systems (Perrons & Cosby, 2020; Rose et al., 2015; Tangi, Janssen, Benedetti, & Noci, 2021; Ziolkowski, Miscione, & Schwabe, 2020). It is particularly challenging in federally structured government systems, which are characterized by a complex separation of competencies and the equal distribution of power between various levels of government and authorities (Berman & Martin, 1983; Biela, Hennl, & Kaiser, 2012; Borriello & Crespy, 2015).

Contrary to general expectations, blockchain technology seems to flourish in this complex environment (Guggenmos, Lockl, Rieger, Wenninger, & Fridgen, 2020; Jensen, Hedman, & Henningsson, 2019; Ølnes, Ubacht, & Janssen, 2017; Rieger, Guggenmos, Lockl, Fridgen, & Urbach, 2019; Seebacher & Schüritz, 2017). This is surprising because federally structured governments typically do not exhibit the same lack of trust evident among organizations involved in many other applications of blockchain (Avgerou & Bonina, 2020; Ziolkowski et al., 2020). Quite the opposite, federally structured governments are characterized by a high-level of trustful cooperation (Amend, Fridgen, Rieger, Roth, & Stohr, 2021; Rieger et al., 2019).

It seems that other factors are at play in this environment that positively influence the adoption of blockchain. Recent research suggests that blockchain adoption is typically the result of contextual (technological, organizational, and environmental) factors and expected benefits, such as coordination and horizontal integration of data

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Table 1
Extracted organizing principles of federal organizing structures.

Organizing principles of federalism	Definition	Number of papers mentioned in (of 51)
Empowerment	Delegation of decision-making powers to lower levels of government	35
Separation of competencies	Allocation of essential functions to different levels and units of government with the guarantee of autonomy in the responsibilities they perform	28
Cooperation and coordination	Working together and exchanging information to achieve a common goal	30
Organizational flexibility	Ability to adapt to local requirements and changing requirements over time	19

Table 2
Extracted technological properties of private blockchain frameworks.

Technological properties of blockchain	Definition	Number of papers mentioned in (of 52)
Secure and distributed data storage	Cryptographically secure data storage on several nodes resistant to failure and manipulation	46
Selective transparency	Ability to grant limited rights to write and access data in accordance with the role and attributed competencies of involved parties	29
Reliable information sharing and process automation	Secure transmission of data and automated, tamper-resistant execution of predefined process logic	45
Adaptability	Technological adjustability to local requirements and changing requirements over time	35

(Toufaily, Zalan, & Dhaou, 2021). In the financial services industry, for instance, blockchain adoption appears to be driven by technological and economic viability, symbolic benefits associated with a high degree of environment-technology fit, and functional benefits resulting from task-technology fit (Liang, Kohli, Huang, & Li, 2021). Yet, viability and symbolic benefits appear to provide limited explanatory power for federally structured government systems. Viability is a fundamental antecedent rather than a context-specific adoption factor, while symbolic benefits, such as improved social image or conformity with external pressures, appear plausible but not cogent. The same applies to profit maximization considerations (Cho et al., 2021), which are irrelevant for governments. In essence, blockchain adoption appears to be more context-specific (Toufaily et al., 2021) than general frameworks for blockchain adoption suggest (Janssen, Weerakkody, Ismagilova, Sivarajah, & Irani, 2020; Liang et al., 2021; Toufaily et al., 2021). In the analysis that follows, we thus adopt a context-aware perspective on federally structured governments and explore the following research question:

RQ: Why do organizations in federally structured government systems adopt blockchain?

To answer this research question, we conduct a single-case study of a project undertaken by Germany's Federal Office for Migration and Refugees (BAMF) to develop a Federal Blockchain Infrastructure for Asylum Procedures (FLORA). The purpose of FLORA is to improve cross-organizational coordination in Germany's national asylum procedure by ensuring the efficient and secure exchange of process information between all involved authorities. We begin our analysis with a comprehensive literature review that investigates the organizing principles of federally structured government systems and the key technological properties commonly attributed to private blockchain frameworks. We then examine the links between these principles and technological properties in the context of the FLORA project. For this analysis, we draw on task-technology fit (TTF) theory (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998). In line with TTF theory, we find a close fit between the organizing principles of federalism and blockchain's technological properties to be essential for the adoption and use of FLORA. This close fit is also instrumental in securing support for the project among stakeholders and partner authorities.

By revealing how blockchain technology can be employed successfully for the delivery of public services, our study makes an important contribution to both blockchain research and practice. Specifically, our rich analysis unpacks an important driving factor of blockchain adoption in federally structured government systems while offering actionable references and guidelines for meaningful blockchain applications in public service delivery. Our analysis also provides the foundation for an extended TTF theory that is suitable for use at the cross-organizational, federal level. Specifically, we propose a broader perspective that examines tasks at a (cross-)organizational task structure level. Furthermore, we highlight how federal task structures can be shaped by federal values in the form of legal norms.

2. Literature review

In federally structured government systems, cooperation among authorities is difficult to achieve, even with the use of digital technologies (Goh & Arenas, 2020; Shevory, 2015). Different competencies (Egeberg, 2001; Jaeger, 2002; Moya Palencia, 1974), organization-specific procedures (Berman & Martin, 1983; Ebinger & Richter, 2015; Fossum & Jachtenfuchs, 2017; Keating, 2017; Watts, 1998), and established organizational identities (Jaeger, 2002; Tyworth, 2014) can hamper digital innovation efforts (Davis, 1989; Seltsikas & O'Keefe, 2010). From a purely technical perspective, there are various technologies capable of meeting the requirements of these contexts. Yet, many technological options do not progress beyond pilot projects (Carson, Romanelli, Walsh, & Zhumaev, 2018) because digital innovation in the public sector – and particularly in federally structured government systems – is driven by more complex considerations and challenges than just technological feasibility (Carter & Bélanger, 2005; Hughes et al., 2019; Scott et al., 2016). Goh and Arenas (2020) provide a valuable summary of these non-technical considerations and challenges. Many of them, such as system complexity (Avgerou & Bonina, 2020; Cordella & Willcocks, 2012; Wibbels, 2006), cooperation in a protected environment (Dawson, Denford, Williams, Preston, & Desouza, 2016; Deringer & Molnar, 1983), and organizational cultural values (Leidner & Kayworth, 2006; Seltsikas & O'Keefe, 2010), are a direct result of federal organizing structures that, in turn, have their origin in shared federal values.

To better understand these structures and values, we carefully reviewed a total of 51 political science papers on federalism, federal organization, and e-governance in federally structured organizations. Furthermore, we analyzed 52 computer science and IS papers on the use of blockchain technology. This analysis revealed four basic principles inherent to federally organized contexts (see Table 1) and four key technological properties of private blockchain frameworks (see Table 2). It also informed a summary of recent research on blockchain adoption, on which we build in arguing that blockchain adoption requires context-specific considerations. While adoption research provides various frameworks and theories for these considerations, we found Goodhue and Thompson's (1995) task-technology fit (TTF) theory to be particularly conducive to our investigation.

2.1. Federal values and organizing principles

Federalism has its roots in the Latin word *foedus* meaning 'league', 'treaty' or 'compact', and has come to represent an "[…] organization in which the activities […] are divided between [decentral] and a central government in such a way that each kind of government has some activities on which it makes final decisions" (Riker, 1964). Federalism is not simply a form of organizing but also an ideology that can be traced back to the teachings of Plato (Inman, 2007). Over time, it has been endowed with multiple fundamental values and become a veritable cultural heritage (Chemerinsky, 1995). These fundamental values encompass, for instance, shared authority and decision-making (Grant & Tan, 2013), political balance (Erk & Koning, 2009; Moya Palencia, 1974), security and protection, fairness (Smith & Fernandez, 2010), and individual as well as communal freedom (Fossum & Jachtenfuchs, 2017; Wibbels, 2006). They represent "a set of beliefs about how the social world operates" (Ingram & Simons, 2000). Federal values are typically enacted in legal norms "at all levels of government" (Jaeger, 2002). These legal norms are also the basis of federal organizing principles. These organizing principles, in turn, play an important role in the shaping of cross-organizational procedures (Goh & Arenas, 2020; Shevory, 2015). By way of a comprehensive analysis of 51 political science papers, we could characterize four such organizing principles (see Table 1; detailed results of our analysis can be found in Table A1).

The first principle is *empowerment*. It grants authorities at different hierarchical levels equal status in decision-making processes (Egeberg, 2001; Grant & Tan, 2013; Moya Palencia, 1974). Simultaneously, it helps to retain individual organizational identities and the independence of central bodies (Bormann et al., 2019; Erk & Koning, 2009; Jaeger, 2002; Mackenzie, 2010). In federal systems, authorities are given the "power to" rather than "power over" (Heeks & Stanforth, 2007). Chemerinsky (1995) describes this set-up as "the greatest beauty of federalism since multiple levels of organization share the same interests and have each the ability to act."

The second principle is the *separation of competencies* between authorities at different levels. It promotes a complex, balanced system of self-rule and shared rule (Auer, 2005; Mckay, 2005). In federal systems, each authority has specific, predefined functions (Berman & Martin, 1983; Biela et al., 2012; Borriello & Crespy, 2015), which are usually associated with the allocation of certain powers and the respective accountability for procedures related to organizational functions (Conlan, 2006; Erk & Koning, 2009). The *separation of competencies* is often complemented by an accessory principle of subsidiarity, which specifies that a given task be delegated to the level best equipped to deal with it. Only tasks that cannot be effectively processed at a lower level should be transferred to the next higher (Abels, 2019; Ebinger & Richter, 2015; Keating, 2017).

The third principle, *cooperation and coordination*, is a direct consequence of the *separation of competencies* between authorities at different hierarchical levels (Handy, 1996; Watts, 1998), as some tasks are jointly exercised or functionally organized (Benson & Jordan, 2014; Mackenzie, 2010; Springer, 1962). Authorities in federal systems often cooperate where they could act autonomously – for instance, to exchange information on legal questions or to handle joint procedures (Ebinger & Richter, 2015; Rieger et al., 2019). In general, these authorities coordinate their actions where it is deemed useful, emphasizing coordination from both a bottom-up and top-down approach (Heeks & Stanforth, 2007; Hegele & Behnke, 2017).

The fourth organizing principle is *organizational flexibility*. The fact that federal systems push essential functions to the lowest levels means that decisions can be made independently, quickly, and accurately (Biela et al., 2012; Conlan, 2006; Erk & Koning, 2009; Graham, 1980). Varying degrees of push and pull across the different levels likewise encourage diversity among authorities, providing opportunities for innovation and activism (Egeberg, 2001; Fossum & Jachtenfuchs, 2017; Nathan, 2006). This also includes the flexible design of organizational structures with different degrees of centralization or decentralization (Auer, 2005; Keating, 2017; Tiller, 2011). Such flexibility may help authorities respond to critical situations (Conlan, 2006).

2.2. Technological properties of blockchain

The four identified organizing principles make it notably more challenging to find suitable digital technologies for federally structured government systems (Benbunan-Fich, Desouza, & Andersen, 2020). Despite these challenges, blockchain technology appears to be successful in this environment (Abramowicz, 2020; Treiblmaier et al., 2021; Ziolkowski et al., 2020). Blockchains are databases that store transactions in a transparent, chronological, and tamper-resistant way in a distributed network (Carvalho, Merhout, Kadiyala, & Bentley, 2021; Upadhyay, 2020; Warkentin & Orgeron, 2020). A blockchain consists of a chronologically ordered chain of blocks. Each block contains information about valid network activities since the last addition of the previous block (Andoni et al., 2019; Sedlmeir, Buhl, Fridgen, & Keller, 2020; Upadhyay, 2020). In the past few years, blockchain technology has gained considerable traction due to its various possible applications both in the public and private sector (Benbunan-Fich et al., 2020; Mattke, Maier, Hund, & Weitzel, 2019; Upadhyay, 2020; Ziolkowski et al., 2020).

Blockchain technology is as versatile as its applications, and the same can be said of its technological characteristics. This is evident, for instance, in the list of 11 observed characteristics that Seebacher and Schüritz (2017) compiled to give a nuanced view of the nature (Weber, 2005) of blockchain technology. These characteristics include *trust*, *immutability*, *redundancy*, *versatility*, and *automation*. There is some disagreement, however, as to whether certain characteristics, such as *trust*, are characteristics in their own right or rather the by-product of other more fundamental characteristics (Amend, Kaiser, Uhlig, Urbach, & Völter, 2021; Marella, Upreti, Merikivi, & Tuunainen, 2020; Ostern, 2018). To steer clear of these debates, we decided not to focus on blockchain's general nature but instead describe the behavior of private blockchain frameworks, as typically used in federally organized contexts. To this end, we analyzed the aforementioned 52 IS and computer science papers for 'properties' of private blockchain frameworks that are not only relevant to cooperation in federally organized contexts but also uncontested. The four key properties we identified can be found in Table 2, and the detailed results of our analysis in Table A2.

The first of the four properties is *secure and distributed data storage* (Ahl et al., 2020; Andoni et al., 2019; Chapron, 2017; Kranz, Nagel, & Yoo, 2019). Transactions, such as the steps of a public procedure, can be grouped into "blocks" and cryptographically added to a data "chain" with copies stored on all participating "nodes" (Khaqqi, Sikorski, Hadinoto, & Kraft, 2018; Morstyn, Farrell, Darby, & McCulloch, 2018; Pedersen, Risius, & Beck, 2019; Thomas, Zhou, Long, Wu, & Jenkins, 2019). This minimizes vulnerability to failure and attacks and creates a highly tamper-resistant data structure wherein manipulations are easily identified (Hughes et al., 2019; Kranz, Nagel, & Yoo, 2019; Sedlmeir et al., 2020; Sousa et al., 2019).

Second, private blockchain frameworks enable *selective transparency*. This means that authorities can be granted limited rights to input and access data, dependent on their role in the respective procedures (Noor, Yang, Guo, van Dam, & Wang, 2018; Ølnes et al., 2017; Perrons & Cosby, 2020; Rieger et al., 2019). This reduces complexity by maintaining the common shared truth and necessary transparency without disclosing information that either should not or may not be accessed (Hawlitschek, Notheisen, & Teubner, 2018; Mattke et al., 2019; Rieger et al., 2019). *Selective transparency* depends on *secure and distributed data storage.* While the latter property enables cross-organizational cooperation and considers frequently changing procedural setups, desired levels of transparency may also change dependent on the responsibilities of involved organizations (Iansiti & Lakhani, 2017; Risius & Spohrer, 2017).

Third, private blockchain frameworks support *reliable information sharing and process automation* (Rossi, Mueller-Bloch, Thatcher, & Beck, 2019; Sikorski, Haughton, & Kraft, 2017; Sousa et al., 2019; Ziolkowski et al., 2020). *Reliable information sharing* builds on the previous two properties: While *secure and distributed data storage* guarantees the

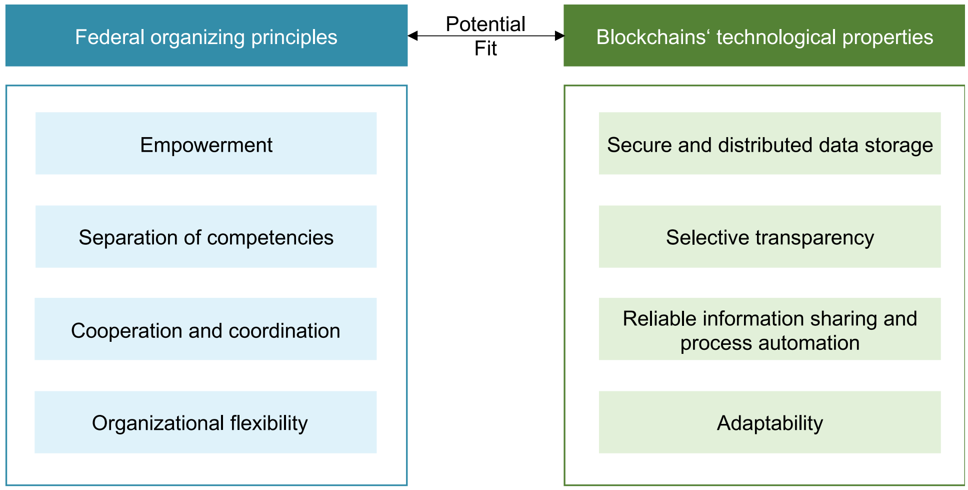

Fig. 1. Apparent commonalties between the technological and organizational dimensions.

authenticity of shared information (Mattila & Seppälä, 2018; Perrons & Cosby, 2020; Sedlmeir et al., 2020), private blockchain frameworks can – depending on the allocated competencies – reliably disseminate important information in near real-time with *selective transparency*. That is, all actors involved in a particular procedure receive timely updates (Iansiti & Lakhani, 2017; Rieger et al., 2019; Risius & Spohrer, 2017). The use of smart contracts additionally permits *process automation* via the creation of automated triggers for certain steps of the process and extensive monitoring capabilities (Kranz et al., 2019; Lauslahti, Mattila, Hukkinen, & Seppälä, 2018; Rieger et al., 2019).

Fourthly, private blockchain frameworks ensure a certain degree of *adaptability* as the design of the network and the rules for information processing can differ locally and be adjusted over time to meet local particularities and changing requirements (Andersen & Ingram Bogusz, 2019). This *adaptability* is crucial in cross-organizational contexts, where one technological solution needs to suit various cooperation scenarios (Jensen et al., 2019; Kshetri, 2018; Ziolkowski et al., 2020).

2.3. Blockchain adoption

While most early blockchain research examined technological aspects, the focus is increasingly shifting toward studying blockchain's adoption and use (Janssen et al., 2020). Blockchain adoption research has identified certain factors as strong indicators of the desirability and viability of blockchain applications. These include the need for a shared common and immutable database or the avoidance of trusted third parties (Pedersen et al., 2019). Yet, blockchain adoption typically remains a case-specific phenomenon that can require an extensive experimentation phase to establish whether the technology is fit for purpose (Du, Pan, Leidner, & Ying, 2019).

In general, blockchain adoption is influenced by various interacting and mutually dependent contextual factors. These factors can be technological (e.g., technological complexity and readiness), organizational or institutional (e.g., governance, norms, and culture), and environmental or market-based (e.g., regulation and network effects) (Du et al., 2019; Janssen et al., 2020; Toufaily et al., 2021). Concerns about the maturity of blockchain technology, for instance, can significantly slow down its adoption (Jensen et al., 2019). When these concerns result in ambivalence or distrust, they can even be fatal (Bélanger and Carter, 2008). Successful blockchain adoption, in turn, requires organizations and their representatives to trust the technology (Marella et al., 2020; Ostern, 2018; Rossi et al., 2019) even though established IS trust signals may not be effective in this context (Völter, Urbach, & Padget, 2021).

Moreover, expected benefits and the (economic) viability of blockchain applications can vary substantially (Ostern, Rosemann, & Moormann, 2020; Sarker, Henningsson, Jensen, & Hedman, 2021; Toufaily et al., 2021). The expected benefits may be symbolic (e.g., image and reputation) or functional (e.g., efficiency and financial performance) (Grover, Chiang, Liang, & Zhang, 2018). Symbolic benefits may emerge from a close fit between contextual factors and blockchain technology. Functional benefits can result, for instance, from a close fit between organizational tasks and technology (Liang et al., 2021). Viability, in turn, determines whether the expected benefits can be realized (Liang et al., 2021; Ostern et al., 2020). Benefit and viability considerations can also differ between organization types. Companies typically evaluate blockchain applications based on their return on investment (Cho et al., 2021). Industry incumbents may seek this return from business process improvements and disintermediation, while start-ups may benefit from entirely new business model opportunities (Toufaily et al., 2021). Governments, on the other hand, may benefit from coordination and horizontal data integration as well as increased efficiency in delivering public services (Toufaily et al., 2021).

Contextualization is thus crucial for investigating blockchain adoption. This means that the particularities of each context – in our case, federalism - require a context-specific analysis (Toufaily et al., 2021) to identify relevant contextual factors and benefits (Guggenmos et al., 2020; Ølnes et al., 2017; Rieger et al., 2019; Toufaily et al., 2021). Insights and perspectives from other contexts may nevertheless provide a valuable starting-point. In our case, such a starting point is provided by task-technology fit.

2.4. Task-technology fit

IS research has a long tradition of studying technology adoption and, over time, many different frameworks and theories have been developed in these studies. Naturally, some of these frameworks are also used for blockchain research. Prominent examples are the technology-organization-environment (TOE) framework (Toufaily et al., 2021), diffusion of innovations (DOI) theory (Toufaily et al., 2021), and TTF (Liang et al., 2021). While the TOE framework focuses on the mutually dependent influence of technological, organizational, and environmental factors (Tornatzky & Fleischer, 1990), DOI theory emphasizes (perceived) aspects of the innovation itself, such as the speed of its diffusion, relative advantage, compatibility, and complexity (Rogers, 1995). TTF theory, in turn, builds on the idea that a technology's use or impact on performance depends on its fit or alignment with the tasks to be performed (Goodhue & Thompson, 1995). Insights from the financial services industry suggest that TTF can be an important driver for blockchain adoption (Liang et al., 2021). Our analysis of the organizing principles of federalism and the technological properties of private blockchain frameworks appears to support this notion for federally structured governments (see Fig. 1). Hence, we adopted TTF as the theoretical lens for our investigation.

Goodhue and Thompson (1995) originally introduced the concept of TTF as "the degree to which a technology assists an individual in performing his or her portfolio of tasks". Researchers have since refined and extended TTF theory in several studies (Furneaux, 2012; Howard & Rose, 2019; Zigurs & Buckland, 1998; Zigurs & Khazanchi, 2008). The fundamental premise of the theory, however, has remained constant (Furneaux, 2012). TTF theory argues that a technology's use or impact on performance depends on its fit or alignment with the task to be performed by an individual (Goodhue & Thompson, 1995) or a group (Zigurs & Buckland, 1998; Zigurs & Khazanchi, 2008). What this means is that TTF theory lends itself to multiple levels of analysis, individual or group, depending on the technology being studied (Furneaux, 2012). TTF theory is particularly useful for highlighting the interactive effects of tasks and technologies. In doing so, it accounts for the significance of the contexts in which technologies are applied (Howard & Rose, 2019).

TTF's basic constructs and links are very flexible in terms of adaptions and extensions. Trkman (2010), for instance, integrates contingency, dynamic capability, and TTF theory to postulate that continuous improvement alongside a good fit of business process tasks and information systems are critical success factors for business process management in organizations. Oliveira, Faria, Thomas, and Popovič (2014) combine TTF, the unified theory of acceptance and usage of technology (UTAUT), and the initial trust model (ITM) to better understand the facilitating conditions and behavioral intentions involved in the adoption of mobile banking. Huang, Zhang, and Liu (2017) use TTF theory to better understand how the technological characteristics of Massive Open Online Courses (MOOC) affect student revisits. Wang, Wang, Zhang, and Ma (2020) use an extended model of user-task-technology fit with two additional elements – job fit and professional fit – to discover that both elements are an integral part of the spillover mechanism between IT satisfaction and job satisfaction.

Although existing conceptualizations of TTF are rather organization-centric and lack consideration of cross-organizational aspects, we find TTF to be an interesting theoretical lens for our investigation. The apparent commonalities between federal organizing principles and blockchain's technological properties clearly indicate that TTF could help to better understand why organizations in federally structured government systems adopt blockchain. Moreover, recent research both demonstrates that TTF may be an interesting driver for blockchain adoption and explicitly calls for cross-organizational considerations (Liang et al., 2021).

When applying TTF, it is important to clearly conceptualize the 'tasks' and 'fit' in question, since both are abstract constructs with multiple potential conceptualizations (Zigurs & Buckland, 1998; Zigurs & Khazanchi, 2008). Tasks can be described and distinguished in various ways – for instance, by characteristics such as complexity, analyzability, and equivocality (Brown, Dennis, & Venkatesh, 2010; Zigurs & Buckland, 1998). Generally speaking, tasks can be conceptualized in four ways: *task qua task*, *task as behavior requirement*, *task as behavior description*, and *task as ability requirement* (Hackman, 1969). TTF theory typically draws on the first two conceptualizations (Zigurs & Buckland, 1998)*: task qua task* captures the task's specific attributes and the stimuli involved, and *task as behavior requirement* accounts for the 'what to do' and 'how to do' that are necessary to achieve particular goals (Hackman, 1969; Zigurs & Buckland, 1998). *Task as behavior description* and *task as ability requirement* are typically less relevant to TTF theory as they do not focus on the properties of the task itself but on outcomes and characteristics of the entities performing the task (Zigurs & Buckland, 1998).

Likewise, fit can assume many different forms (Venkatraman, 1989). Prior research on TTF theory has typically used three concepts of fit: *fit as moderation*, *fit as matching*, and *fit as profile deviation* (Cane & McCarthy, 2009). While *fit as moderation* refers to the interaction between certain technology, task, and individual/group characteristics, *fit as matching* conceptualizes fit as a more direct relationship between task and technology. The third of these conceptualizations, *fit as profile deviation,* treats fit as the adherence to an ideal task-technology profile and is particularly suitable for more theoretical analyses (Cane & McCarthy, 2009; Howard & Rose, 2019; Venkatraman, 1989).

3. Research design

To leverage the TTF lens in our investigation of the presumed fit between federal organizing principles and blockchain technology, we chose a qualitative-empirical research design. Such a design enables the development of an in-depth understanding of emerging phenomena (Bettis, Gambardella, Helfat, & Mitchell, 2015). More specifically, we conducted a single-case study based on the FLORA blockchain project of Germany's Federal Office for Migration and Refugees (BAMF). Thereby, we follow the recommendations of Yin (2014). According to these recommendations, a single-case study design is appropriate if the case is critical, unusual, common, longitudinal, or revelatory. A critical case is one that is key to a researcher's theory or theoretical proposition. An unusual case is one that deviates from certain theoretical norms or everyday events. A common case reflects everyday situations and aims to elicit social phenomena, whereas a longitudinal single-case study examines the same case at different points over time (Yin, 2014). We regard the BAMF's blockchain project as a revelatory case because it provides access to a phenomenon that researchers have previously been unable to study (Yin, 2014): the adoption of blockchain technology in a federally organized government context. Blockchain adoption has been studied in private sector settings, such as global shipping (Sarker et al., 2021), insurance (W. Zhang, Wei, Jiang, Peng, & Zhao, 2021), or financial services and health care (Liang et al., 2021) but using blockchain for cross-authority cooperation in the public sector is still a new phenomenon.

The BAMF and some of its partner authorities already use blockchain in day-to-day operations. This makes the project one of the most advanced of its kind. It offers detailed insights into why blockchain may be interesting to public authorities. At the same time, it reveals how these authorities can use blockchain for cross-organizational cooperation. As blockchain is an important technology both in Germany and the wider European Union (EU), the BAMF's project has also become a reference project, which creates added pressure of expectation. Accordingly, the 'phenomenon under investigation' is not only of notable interest in its own right but may also have complex ramifications for both scientific and political communities. These circumstances justify the use of a single-case study (Eisenhardt & Graebner, 2007; Eisenhardt, 1989; Yin, 2014).

3.1. Case description

The German asylum procedure involves close collaboration between various authorities at the local, state, and federal levels, with the BAMF playing a pivotal role in handling and issuing decisions regarding asylum applications. However, federal separation of competencies often prevents 'digital centralization' and redistribution of competencies to a central authority in the procedure. The BAMF thus often explores 'decentralized' technical alternatives that require neither the extension of centralized databases nor the delegation of control to a single authority. As part of these innovation exercises, the BAMF decided to also investigate blockchain technology.

The BAMF began with a proof-of-concept (PoC) in January 2018. Based on positive experiences from the PoC, the BAMF then initiated FLORA, a joint pilot project with Saxony's central immigration authority in Dresden. The objective of this project was to develop and evaluate a blockchain-based system for the coordination of asylum procedures. Upon successful completion of the pilot in the fall of 2021, the BAMF began to roll out the system to other German states. The overall goal is to ensure the efficient and secure exchange of process information between

Table 3
Coding examples from our data analysis process.

1st stage	2nd stage	Aggregate dimensions
- Getting more transparency (e.g., interviews 1, 3, 19, 24) - More substantiated decision-making (e.g., interview 9, 11, 13, 20)	Human control	Empowerment
- Respecting organizations' range of tasks (e.g., interviews 7, 8, 10, 25) - Limiting access to sensitive data (e.g., interviews 5, 6, 18, 22)	Separation of inter-organizational responsibilities	Separation of competencies
- Making processes more efficient (e.g., interviews 7, 13, 18, 25) - Reducing data disruption (e.g., interviews 1, 4, 7, 25)	Strategic coordination	Cooperation & coordination
- Supporting both micro- and macro flows (e.g., interviews 5, 7, 13, 17) - Adapting to organization's legacy systems (e.g., interviews 1, 2, 5, 7)	Changing procedures	Organizational flexibility

the relevant authorities.

To address these objectives, the BAMF developed an application with a multi-layered architecture that takes advantage of the benefits of blockchain and, at the same time, allows for the integration of existing IT applications and services (Amend, Fridgen, et al., 2021). For the blockchain part of the application, the BAMF uses Hyperledger Fabric, a private blockchain framework that emphasizes privacy as well as flexibility (Linux Foundation, 2017; Osterland & Rose, 2018). In particular, Hyperledger Fabric provides features that allow for compliance with the EU's General Data Protection Regulation (GDPR) (Guggenmos et al., 2020; Rieger et al., 2019). Besides being a private and permissioned framework wherein only authenticated and authorized participants can view, execute, and validate transactions (Beck, Müller-Bloch, & King, 2018), it enables the sharing of data with selected participants via so-called private data collections (PDCs). As a result, the BAMF's blockchain application provides relevant authorities with an efficient, secure, and GDPR-compliant means to exchange process information, which allows effective cross-organizational process coordination.

The success of the BAMF's blockchain application has attracted considerable attention on a national and international level. For instance, it won the award for best digitalization project at the federal and state level in the 2019 German eGovernment competition. Since the second half of 2020, the BAMF has also acted as the convening authority for the European Blockchain Partnership (EBP) and its working group on the use of the EBP's European Blockchain Service Infrastructure (EBSI) for cross-border asylum procedures.

3.2. Data collection and analysis

Case studies commonly draw on a combination of the following six sources of evidence: interviews, documentation, direct observations, participant-observations, archival records, and physical artifacts (Yin, 2014). To triangulate our findings, we built our case study upon three of these sources – namely interviews, documentation, and direct observations (Myers & Newman, 2007; Yin, 2014).

Our primary method of data collection was semi-structured interviews. These were conducted using an interview guide which helped to ensure comprehensive coverage of the subject area (Rubin & Rubin, 2005). Semi-structured interviews can generate rich data that provide deep, detailed, and authentic insights into the interviewees' inner worlds and their social realities (Leech, 2002; Schultze & Avital, 2011). The protocol of our semi-structured interviews involved a brief introduction followed by questions on interviewees' perceptions of cultural and organizational particularities in the public sector and the BAMF, and on the opportunities, challenges, and success factors for blockchain projects in this context. During the interviews, we adapted the questions to shift the focus depending on the respective interviewee's knowledge and actual expertise (Myers & Newman, 2007). We mirrored the interviewees' verbal posture and vocabulary and allowed the interviewees to go in directions that they found interesting (Orlikowski & Baroudi, 1991). In selecting our interviewees (Table B2), we focused on incorporating a broad variety of perspectives on the case. That is, we selected interviewees with technical expertise and in-depth knowledge of the asylum procedure. Likewise, we included the perspectives of BAMF employees as well as those of external consultants and IT service providers. Moreover, we chose interviewees from different hierarchical levels, such as higher management and case workers, and we balanced interviewees who were deeply involved in the project with interviewees with an outsider's perspective. At the end of each interview, we also asked the participants to suggest other potential interviewees. Overall, we conducted a total of 25 interviews. Our interviews lasted between 30 and 60 min, were audio-recorded and, afterward, fully transcribed. To establish consistency and comparability, all interviews were conducted by the same interviewer. In a few cases, another member of the author team, who the interviewee knew well, joined the interview to establish trust, but mainly remained in the background. In some cases, we approached the interviewee after the interview to clarify their statements and responses. To increase construct validity, we also obtained interviewees' feedback on the draft case study reports (Yin, 2014).

Some of the authors have accompanied and evaluated the BAMF's FLORA project since it began in January 2018. This meant that we could also draw from a comprehensive database of additional information to triangulate our findings (see Table B1). In particular, we analyzed over 400 pages of documentation on the collaboration software *Confluence* and over 200 pages of technical concepts and functional specifications. Moreover, we gathered field observations from bi-weekly sprint reviews, management meetings, and over 20 project workshops with different departments, authorities, and organizations.

We used qualitative analysis techniques and the analysis software MAXQDA to analyze our data (Mayring, 2014). We undertook three stages of data analysis: open, axial, and selective coding (Corbin & Strauss, 1990). First, we analyzed the data individually and assigned initial codes. During this stage, the research team met regularly to review emerging concepts and ensure the consistency of coding (Klein & Myers, 1999; Pan & Tan, 2011). In the second stage, we clustered the codes across data sources and assigned them to higher-level themes, which were either based on our theoretical lens (deductive coding) or emerged during data collection (inductive coding). In the final stage, we selected the core categories and related the established themes to these categories. This process led us to approximately 5000 codified statements, organized into four categories and seven sub-categories or themes. Table 3 provides an exemplary overview of our coding.

4. Findings

4.1. Replicability of federal organizing principles

From our analysis of the FLORA project, we identified various organizational characteristics that focus either on business requirements or on the intra- and inter-organizational specifics of the asylum procedure. These can be grouped into the same organizing principles outlined in our literature review of federalism, federal organization, and e-governance in federally structured organizations (see Fig. 2).

The interviewees and project documents repeatedly mentioned the organizing principles as crucial characteristics of organizations in federal contexts. The principles were either explicitly referenced or could be inferred from paraphrases. Most frequently mentioned by both

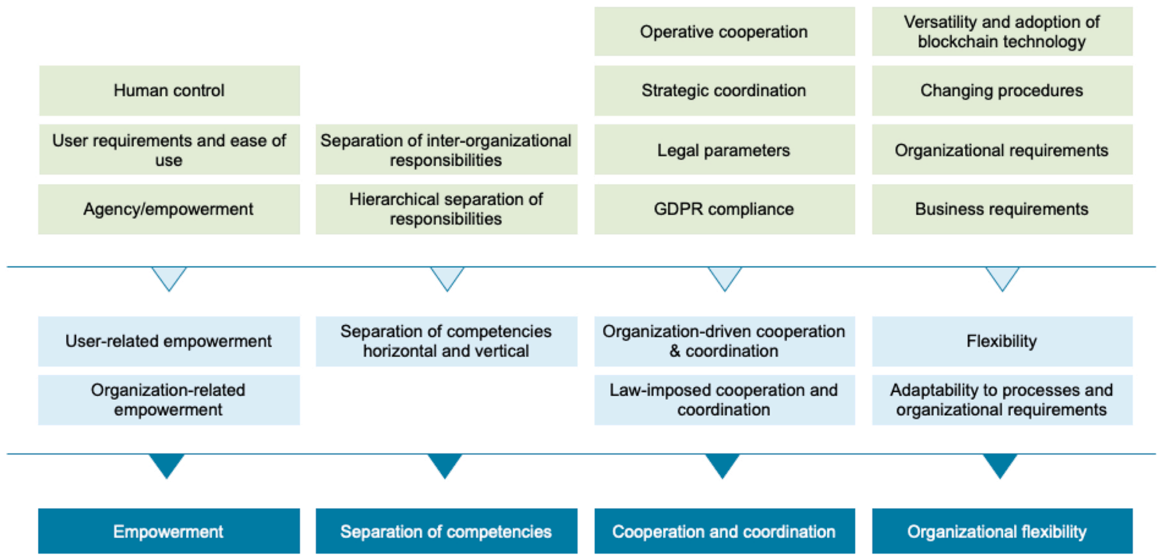

Fig. 2. Organizing principles as replicated from interviews and project materials.

Table 4
Matches between federal organizing principles and technological properties of blockchain technology as identified in interviews (overall 25) and project materials (overall 30).

		Organizing principles of federalism			
		Empowerment	**Separation of competencies**	**Cooperation and coordination**	**Organizational flexibility**
		Number of Interviews + Number of Project Documents			
Technological properties of blockchain	**Secure and distributed data storage**	19 + 24	15 + 24	0 + 0	0 + 0
	Selective transparency	10 + 17	16 + 24	0 + 0	10 + 13
	Reliable information sharing and process automation	17 + 22	15 + 13	16 + 23	13 + 15
	Adaptability	16 + 16	16 + 14	13 + 12	13 + 14

interviewees and documents were the of principles of *empowerment* and *separation of competencies* followed by *cooperation and coordination* and *organizational flexibility*.

4.2. Matching of organizing principles and technological properties

Our analysis of the FLORA project also revealed that blockchain can effectively reflect, and even drive, the four organizing principles of federally structured governments. Our initial examination of relevant literature had already suggested that the technological properties of blockchain might match to the organizing principles of federally organized structures (and thus produce a close TTF), and our case study findings corroborate and substantiate this fit (see Table 4). Moreover, the recognition and presentation of blockchain as a technical agent of federalism encouraged the BAMF's partner authorities to support the project and adopt the technology. Apart from substantiating TTF, our findings also support the notion that organizing principles are reflections of legal norms based on federal values. That is, task in federally organized structures needs to be extended by a value-law-dimension that better reflects the origin of tasks.

To determine possible matches between blockchain and organizing principles, we examined the interview transcripts and project documents at those points where we had identified statements related to one or more of the four organizing principles. Where interviewees or project documents did not merely elaborate on organizing principles but referred to a fit between a specific technological property and organizing principles, we tagged this section and labeled the match accordingly. We then counted the interviews and project documents that mentioned a match between a particular organizing principle and a technological property (see Table 4). A higher number of mentions indicates a higher potency in the match. If neither the interviews nor the project documents indicated a match between a particular organizing principle and technological property, we report it as '0 + 0'.

4.2.1. Empowerment

Empowerment at both the organizational and user level is integral to the BAMF's FLORA project. *Empowerment* is supported by all four technological properties, as indicated in Table 4. Since many different organizations are involved in the German asylum procedure, an underlying technology should *"reflect the independence and autonomy of individual authorities and also [...] address their needs"* (Interviewee 20).

Blockchain's *secure and distributed data storage* seems to meet this requirement at its most basic level. All participating authorities have access to a common ledger. This ledger contains cryptographic hashes of all status messages processed by the application for verification purposes. Moreover, the participating authorities have access to private ledgers: the *PDCs*. These *PDCs* allow data to be shared only between a subset of participants, which *"enables cooperation that facilitates data flow between organizations, while granting substantial freedom to individual organizations"* (Interviewee 15).

The distinction between common and private ledgers also highlights how blockchain's *selective transparency* can contribute to *empowerment*. Depending on their respective competencies, different authorities have access rights to different *PDCs*. As a result, the participating authorities can establish a common shared truth while emphasizing their autonomy and driving *empowerment*. In the words of Interviewee 1:

> "*Blockchain offers the possibility of mapping regional differences, leaves enough room for [individual changes], and still allows for standardization where appropriate. As a result, the technology strengthens autonomy at a local level, and federal structures are preserved and even driven.*"

Empowerment is also supported by *reliable information sharing and process automation* as well as *adaptability*. The FLORA application ensures that all competent authorities involved in a particular asylum procedure receive timely and often automated updates about important steps. These timely updates enable them to operate confidently and in a well-informed manner. As the participating authorities often have different regional structures, the *adaptability* of the Hyperledger Fabric framework also gives them the freedom to retain these structures while cooperating in various organizational scenarios. Interviewees 7 and 32 explain:

> *"Blockchain is the perfect technology to enable digital collaboration between the national and state governments. You can tell that this technology has been well received as it enables reliable and flexible collaboration not just between two agencies, or two groups, or two departments but at all different levels of organizing"*.

> *"What is usually discussed here is that blockchain technology can be used to directly and transparently execute processes between different actors in a tamper-proof manner; that individual processes can be automated, especially on the basis of smart contracts, which is expected to reduce potential errors and to increase process integrity by automatically integrating different process steps."*

4.2.2. Separation of competencies

The FLORA application supports the *separation of competencies* across the participating authorities. Particularly relevant in this regard is blockchain's *secure and distributed data storage*. Since *"[particularly] in Germany there is federalism and the separation of competencies, which – at a broader level – reflects the separation of powers"* (Interviewee 14), authorities value data control and tamper-resistance. Interviewee 19 explains that the FLORA application is:

> *"good for federal authorities because each authority has access to its data and it sees all [relevant] data, and [because FLORA] ensures that data has not been changed by somebody else. There are mathematic guarantees ensuring that data has not been changed."*

Separation of competencies also includes the individuality and rights of different authorities. FLORA addresses these expectations with *selective transparency*, as described by Interviewee 20:

> *"Authorities are very different in how they handle data that is stored on the blockchain, and which information is relevant to them. And they also want it that way. They want to be able to explicitly decide how specific connections should be made or how the data stored on the blockchain should be handled and into which system [the data] should be transferred in their own microcosm. That is, [...] primarily the independence and autonomy of the individual authorities should be considered. You simply can't be cooperating 'too closely'."*

The authorities involved in the German asylum procedure place particular emphasis on their autonomy to implement new technologies for cooperation and realize the associated possibilities for action. Yet, at a cross-authority level, it is essential to maintain an adequate degree of *reliable information sharing and process automation*. To this end, authorities exchange large amounts of information, albeit often via spreadsheets and fax messages, which is cumbersome and error-prone. *"Blockchain is supposed to improve such [still paper-based] processes, especially in cross-organizational procedures, so that everything is digitalized and traceable" (Interviewee 11)*. Specifically, Hyperledger Fabric's *PDCs* offer a technological solution that keeps relevant participants adequately informed without providing information to all authorities in the network. *PDCs* thus enable the sharing of data between a subset of authorities, but also enable the storing of data only on nodes of the authorities involved. All other authorities can only access the hash of the exchanged data as evidence of the transaction on the global ledger. In short, *PDCs* enable the reliable sharing of data and mapping of information with the specific organizations involved in handling a particular asylum procedure at a certain point in time. This, in turn, enables *reliable information sharing and process automation* while retaining the *separation of competencies.* In the words of Interviewee 11:

> *"In federal structures with decentralized coordination and asymmetric information, blockchain technology can distribute information to everyone simultaneously and automates intermediary procedural steps. That was one major selling point for decentralized coordination and automation of intermediary procedural steps. At the same time, of course, a certain transparency of available data [was mandatory]."*

Lastly, the *separation of competencies* principle is also supported by blockchain's *adaptability*. This property allows to reflect different allocations of competencies, depending on locally defined organizational procedures. Specifically, FLORA's *PDCs* have a modular and flexible design, enabling the desired plasticity and helping participating authorities adapt to locally distinct process logics using customized smart contracts. Interviewee 5 explains:

> *"We are not all in the same building. We are scattered all over the place. Information has to be shared in real-time. And, dependent on the process step, we have changing external collaborators: different state authorities, the federal police, state police, and various local authorities. That is, we often have to quickly and flexibly establish communication channels to enable immediate actions*".

4.2.3. Cooperation and coordination

To foster *cooperation and coordination* between authorities involved in the German asylum procedure, FLORA offers *reliable information sharing and automation of processes* by writing status messages to the blockchain. This provides all organizations involved in handling a specific asylum procedure with a 'shared truth' and timely updates. A statement by Interviewee 13 illustrates:

> *"It is particularly important that I can access data across different authorities, store crucial information, and accordingly improve processes. [...] Especially in cross-organizational, federal contexts, wherein authorities usually work with their own databases and have, as a result, outdated information, [it is vital] that we developed a technological solution with only one shared truth that applies to all [authorities involved] in the procedure and is also traceable and accessible for all [authorities]."*

Working with many different backend systems and having *"locally distinct organizational procedures"* (Interviewee 15) also requires a high degree of *adaptability*. The BAMF's decision to use the Hyperledger Fabric framework ensures this *adaptability* at a technological level. The distinction between the common ledger and *PDCs* allows process coordination to be modified to suit local requirements and participating authorities. *PDCs* also help with adjustments to locally distinct process logics by using customized smart contracts. This is particularly important, as Interviewee 11 explains:

> *"Since, if you consider North Rhine-Westphalia, the processes are completely different [from Dresden] and the system cannot be transferred directly; instead, adjustments have to be made which, on the one hand, may be completely new, but on the other hand, are sometimes only minor adaptations."*

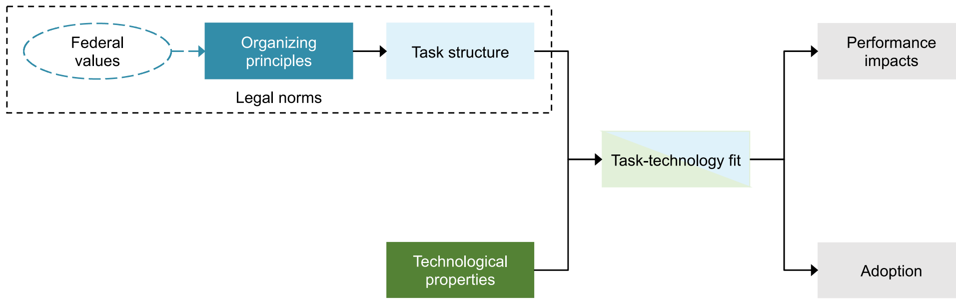

Fig. 3. An adapted and extended theory of task-technology fit in federally organized contexts.

4.2.4. Organizational flexibility

Organizational flexibility is supported by three technological properties of blockchain: *selective transparency*, *adaptability*, and *reliable information sharing and process automation*. Thanks to *selective transparency*, the exchange of information between authorities can be adapted to suit the authorities involved in a particular procedure. In federally organized contexts, various constellations of cross-organizational cooperation are encouraged, as Interviewee 32 explains:

> *"Federalism means that we have decentralized structures of organizing, that often run in parallel and need to be flexible. In such an environment, decentralized registers, decentralized databases - such as blockchain - with corresponding consensus mechanisms are an obvious choice."*

Selective transparency is also important to avoid jeopardizing the data sovereignty of participating authorities. As Interviewee 18 describes:

> *"If synchronization is not possible, although we have so many different processes between different agencies, data exchange can become very error-prone. Thus, data in different databases of agency one and agency two must somehow be reconciled and a synchronization process enabled. If you do this via a blockchain, you have the advantage that they have access to the same data but can only view certain data. Privacy is sort of guaranteed, but also that the data is the same. I find this distribution aspect very important, but also that you keep data secure and respect different responsibilities".*

FLORA's *adaptability* enables integration with various backend systems while providing a common framework for effective collaboration at the cross-organizational level. It also allows for *reliable information sharing and process automation* at various government levels while retaining authority-specific sovereignty. Interviewees 7 and 11 explain:

> *"We have many more collaborative processes than we had before. These collaborative processes mean that you are open and that you seek much more communication. This communication must be secure and assist cooperation, which is why we should not be afraid to use blockchain."*

> *"We have seen in the whole asylum procedure or mass migration, [that] this is not a problem only affecting Germany, it is a problem that affects Europe. And [it is crucial that] you can work together with a system that everyone can adapt individually but, in its entirety, is one system."*

5. Discussion

In this study, we explore the reasons why organizations in federally structured government systems adopt blockchain. As our analysis reveals, private blockchain frameworks can accommodate federal organizing principles, which results in a close task-technology fit. Certain blockchain properties, such as *secure and distributed data storage* and *adaptability* may even reinforce federal organizing principles by facilitating secure and distributed cross-organizational collaboration (Avgerou & Bonina, 2020; Fairclough, 2003; Goh & Arenas, 2020; Rose et al., 2015).

5.1. A theory of task-technology fit in federally organized contexts

In our analysis, we draw upon a task-technology fit (TTF) lens to illustrate that the successful adoption of blockchain in federally structured contexts is driven by a close TTF. In this way, we demonstrate that TTF theory is relevant and useful not only at the individual but also at the cross-organizational, federal level. Yet, we also propose adaptions and extensions for its use in these contexts (see Fig. 3). That is, we encourage the inclusion of task structure into the definition of tasks and the consideration of values and respective organizing principles as reflected in legal norms as mandatory prerequisites of tasks.

Consistent with prior research (Cane & McCarthy, 2009; Howard & Rose, 2019; Venkatraman, 1989; Zigurs & Buckland, 1998), we maintain the concept of *fit as matching*, which is to say that we are concerned with a direct relation between task and technology properties. Regarding our conceptualization of tasks in cross-organizational, federal contexts, we see them as a combination of *task qua task* and *task as behavior requirement*. More specifically, we look at all behavior relevant to achieving certain goals which are, for instance, linked to the federal organizing principles. Our results, however, suggest that the relevant unit of analysis at a cross-organizational level is less an individual task than the cross-organizational task structure. Moreover, we find that this task structure is the result of shared organizing principles, which, in turn, appear to be manifestations of shared values. In federally organized contexts, these values, and task structures are reflected in legal norms that ensure their implementation (Bozeman, 2007; Craig, 2010; Lindahl, 2000; Tobias, 1989). Thus, organizing principles are not simple antecedents of tasks and task structures but mandatory prerequisites stipulated by law (Bozeman, 2007; Lindahl, 2000). The FLORA application, for instance, is legally required to separate data from different authorities while facilitating its seamless exchange between all the authorities involved in the asylum procedure. As such, legal norms can function both as barriers to and boosters of technical innovation (Gil-Garcia, Chengalur-Smith, & Duchessi, 2007). While the function of legal norms as barriers to innovation has been examined at considerable length (Benbunan-Fich et al., 2020; Gil-Garcia et al., 2007), their role as boosters has not yet been established (Goh & Arenas, 2020). Consequently, our first proposition suggests an adaption and extension of TTF theory in federally organized contexts:

Proposition 1. In cross-organizational, federal contexts, tasks need to be conceptualized more broadly as task structure, which are the result of federal organizing principles and values as represented in legal norms.

In line with the fundamentals of TTF theory (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998), we thus argue that an appropriate task-technology fit, encompassing organizing principles as well as their related values and legal norms, is the key to adopting a particular technology and securing positive performance impacts in federally organized contexts. It can also help to select the 'right' technologies for federally structured government systems. For instance, *separation of competencies* and *cooperation and coordination* provide clear indications of the technological aspects necessary to address the underlying organizational and business needs, such as the consideration of locally distinct organizational procedures (Berman & Martin, 1983; Biela et al., 2012; Borriello & Crespy, 2015; Rieger et al., 2019). In the FLORA case, *empowerment* and *organizational flexibility* appear to be equally important motivators for the selection of blockchain. Concerns about *empowerment* are prominent in federal contexts because organizations of various influence and scale need to cooperate in democratic, albeit hierarchical, structures (Bormann et al., 2019; Erk & Koning, 2009; Heeks & Stanforth, 2007; Mackenzie, 2010). Properties of private blockchain frameworks, such as *selective transparency* and *secure and distributed data storage*, can lead to *empowerment* at a technological level by supporting selective information access – where desired or required by law – while still maintaining a common 'shared truth' for all involved organizations (Guggenmos et al., 2020; Perrons & Cosby, 2020; Rieger et al., 2019). *Organizational flexibility* is crucial because federally organized procedures typically involve the participation of several organizations in constantly changing constellations (Ebinger & Richter, 2015; Heeks & Stanforth, 2007; Hegele & Behnke, 2017; Rieger et al., 2019; Ziolkowski et al., 2020). Private blockchain frameworks are interesting when it comes to these procedures because they can offer the necessary high degree of *adaptability* and *reliable information sharing and process automation* required (Hegele & Behnke, 2017). Which brings us to our second proposition:

Proposition 2. Private blockchain frameworks offer a close task-technology fit with federally organized governmental procedures, and this close fit is an important success factor for their adoption in a cross-organizational, federal context.

A close task-technology fit is not only key to adopting a particular technology and achieving positive performance impacts in federally organized contexts. It can also reinforce federal organizing principles and values. The presentation and recognition of blockchain as a socio-technical agent of federalism gave the FLORA project considerable traction with partner authorities. Its emphasis of task-technology fit convinced other national authorities to join the project and jointly adopt blockchain. Moreover, it was instrumental in the project's selection as a pioneer for the European Blockchain Partnership. This recognition is important since the impact of blockchain applications increases with the addition of further partners (Sedlmeir et al., 2020), especially when it comes to supporting cross-organizational cooperation (Fridgen, Radszuwill, Urbach, & Utz, 2018; Jensen et al., 2019; Kshetri, 2018; Ziolkowski et al., 2020). In effect, FLORA is highly successful in promoting not just blockchain but federal organizing principles. It demonstrates that digitalization of federal systems is possible without 'digital centralization' and redistribution of competencies. Moreover, it shows that blockchain can help reinforce and enhance the principle's underlying federal and cultural values (Duffy, Jeyaraj, Sethi, & Sethi, 2021; Salcedo & Gupta, 2021; Vos & Boonstra, 2022), which is why our third proposition is as follows:

Proposition 3. Blockchain technology can function as a socio-technical agent that strengthens federal organizing principles and the underlying federal and cultural values.

5.2. Theoretical contribution

Our study makes several contributions to research on blockchain adoption, digitalization in the public sector, and TTF theory. We contribute to research on blockchain technology and its adoption in three ways. First, we illustrate that the adoption of blockchain can be desirable and lead to positive performance impacts even when trust is not an issue. In particular, our research corroborates the suggestion that TTF can be an important driver for the adoption of blockchain technology. Second, we extend the body of rich case studies on blockchain adoption by providing a focused analysis of the technology's adoption in federally structured contexts (Toufaily et al., 2021). Third, our findings suggest that research on blockchain technology would do well to take a more practical perspective by focusing more on properties (Weber, 2005) rather than on characteristics of blockchain. To be clear, this approach does not ignore the characteristics of blockchain technology. Our identified properties, such as *secure and distributed data storage* and *selective transparency*, either reinforce characteristics such as *trust* (Amend, Kaiser, et al., 2021) or integrate characteristics such as *immutability* and *redundancy* (Seebacher & Schüritz, 2017).

Aside from blockchain adoption, our study contributes to research on digitalization in the public sector. As we have demonstrated, a fit between cross-organizational organizing principles and key technological properties can unlock the full potential of digitalization efforts in the public sector, particularly in federally structured government systems. Our research thus extends the work of recent studies that have attempted to identify non-technical challenges inherent to the adoption of new technologies in federally organized contexts (e.g., Goh & Arenas, 2020). Many of these challenges, such as system complexity (Avgerou & Bonina, 2020; Cordella & Willcocks, 2012; Wibbels, 2006), cooperation in a protected environment (Dawson et al., 2016; Deringer & Molnar, 1983), and organizational cultural values (Leidner & Kayworth, 2006; Seltsikas & O'Keefe, 2010), symbolize task characteristics. When these task characteristics are brought into close alignment with certain technological properties, adoption becomes more likely, as do positive performance impacts. As illustrated in our case study, this close alignment can be achieved by blockchain technology as it exhibits properties that fit many tasks associated with cross-organizational cooperation in the public sector – particularly in federally structured government systems. That being said, blockchain is certainly not the only solution for cross-organizational cooperation in the public or the private sector (Jensen et al., 2019; Jović, Tijan, Žgaljić, & Aksentijević, 2020; Tsiulin, Kristian, Hilmola, Goryaev, & Karam, 2020). Each case requires its own evaluation of task characteristics and underlying organizing principles in relation to the proposed technology and their fit (Vos & Boonstra, 2022).

Finally, our study contributes to TTF theory by demonstrating that TTF also plays an important role in cross-organizational, federally organized contexts. While the fundamental premises of TTF theory remain applicable – namely that adoption and performance depend on an appropriate fit between task and technology (Goodhue & Thompson, 1995) – we offer a new perspective on tasks and their cross-organizational structure as the result of shared organizing principles and values. Prior research has also indicated that TTF may be applicable beyond task conceptualization at an individual level (Furneaux, 2012; Zigurs & Buckland, 1998; Zigurs & Khazanchi, 2008), but what we demonstrate here is that a good fit between technology and tasks at an organizational and cross-organizational level is at least as important. At an individual level, poor TTF would lead to reduced usability and performance (Goodhue & Thompson, 1995; Howard & Rose, 2019), whereas poor TTF at an organizational and cross-organizational level would lead to high legal barriers, error-prone processes, and a significantly lower organizational readiness to adopt the technology in question. Moreover, our study demonstrates that, in federally organized contexts, tasks have to be considered on a more abstract level. That is, task structures are the result of federal organizing principles derived from federal values, all manifested in legal norms. In consequence, federal values are an important additional factor to be considered in technology selection and adoption. This suggestion aligns closely with recent studies by Salcedo and Gupta (2021), Duffy et al. (2021), and Vos and Boonstra (2022), who establish the importance of cultural values for technology selection and adoption in companies.

5.3. Practical implications

Aside from these theoretical contributions, our study also holds several practical implications. It can help decision-makers in authorities and other public institutions to identify the contexts in which blockchain technology can thrive. More specifically, it can guide technology selection and adoption in federally organized contexts. The core organizing principles we have identified, along with the matching blockchain properties, pinpoint some of the factors that drive successful technology adoption in the complex environment of federally structured governments. Furthermore, the deeper understanding of the underlying TTF that our study provides can help decision-makers improve the likelihood of successful adoption and positive performance impacts (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998). This focus on TTF, if well communicated, can also help decision-makers encourage other organizations to participate in blockchain projects. Pointing out shared values and similar organizing principles should make the potential of TTF evident and spread the use of blockchain (Salcedo & Gupta, 2021). Since the benefit of a blockchain project increases with the size of the network, this acquisition of partners is very important (Sedlmeir et al., 2020), particularly when it comes to supporting cross-organizational cooperation (Fridgen et al., 2018; Jensen et al., 2019; Kshetri, 2018; Ziolkowski et al., 2020).

Another practical implication is the suggestion that governmental decision-makers should not focus exclusively on tasks and technology when assessing task-technology fit. Ideally, they would also look at task- and technology-related aspects. For instance, federal values and their manifestation as federal organizing principles can have a much higher priority than the potential benefits of applying a certain technology (Gil-Garcia et al., 2007; Jaeger, 2002; Salcedo & Gupta, 2021). Federally organized contexts may also require special frameworks for technology governance that are aligned both with technological properties and federalism's organizing principles. Centralized workflow-management systems are a case in point. Their 'centralized' governance frameworks often complicate adoption even though they are much easier to implement and maintain than blockchain applications (Rieger et al., 2019; Ziolkowski et al., 2020). With this in mind, governmental decision-makers should consider task- and technology-related aspects with the same rigorous attention to detail with which they consider a technical fit.

A third practical implication for decision-makers refers to the work of Trkman (2010), Zigurs and Buckland (1998), and Zigurs and Khazanchi (2008). TTF is typically dynamic, so organizations must continuously evaluate TTF and, if necessary, coordinate organizational or technological changes. Even if there is a good initial fit between task and technology, it is important to ensure organizational readiness for later changes. These may, for instance, be required due to the introduction of new procedures or partners in cross-organizational cooperation. Therefore, both the technology in use and the organization itself should be able to adapt to new circumstances and so retain TTF (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998; Zigurs & Khazanchi, 2008).

Besides governmental decision-makers, this study also has practical implications for IT service providers and the technological, open-source community. For instance, IT service providers might want to define modularity or local adaptability as an important requirement for blockchain applications (Lockl, Schlatt, Schweizer, Urbach, & Harth, 2020; P. Zhang, White, Schmidt, Lenz, & Rosenbloom, 2018). In federal contexts, the degree of centralization and decentralization largely depends on the task at hand and the structure of the respective organization (Auer, 2005; Keating, 2017; Tiller, 2011). Blockchain applications should be able to accommodate these different degrees to ensure relevance beyond the German asylum procedure. The same is true of system complexity. The more organizations that join the blockchain network, the more value the network can create. Yet more organizations also mean more complex network management (Sedlmeir et al., 2020). Therefore, IT service providers might want to focus on reducing the complexities that come with an increasing number of participants, federal organizing structures, and legal requirements.

Closer collaboration between IT service providers, the open-source community, and governments could also drive the adoption of blockchain in the public sector. Insights from different pilot projects and the resulting adjustments to the blockchain frameworks would be readily available for other governmental and non-governmental organizations. This, then, would be a win-win scenario for all concerned, as IT service providers, open-source developers, and governmental decision-makers could avoid previous errors, and other organizations could profit from the current framework while also making valuable contributions to it (Mu, Bian, & Zhao, 2019).

5.4. *Limitations and future research directions*

While this study offers interesting insights into the adoption of blockchain technology in federally organized contexts, it is also subject to some limitations. First, the generalizability of single-case studies is often questioned (Walsham, 2006). Although we deem our single-case study design to be appropriate, our research could no doubt benefit from validation using other cases in a federal context, for instance, at the European level. A particularly interesting case could be the European Blockchain Service Infrastructure. At Germany's proposal, the European Blockchain Partnership has established a working group that will investigate options for using EBSI to support the management of cross-border asylum procedures. Although this application is still in an early phase, the organizing principles and respective technological properties identified in our study seem also to be relevant also at this cross-border, supranational level. For instance, the founding declaration of the EBP and documentation in the EBSI Confluence indicate that the EBP also considers features such as *separation of competencies* and *organizational flexibility* to be essential (Declaration: Cooperation on a European Blockchain Partnership, 2018; European Commission, 2021). As well as additional case studies, future research could also use quantitative methods to validate the identified TTF or to elaborate on how federal values affect organizing principles (Leidner & Kayworth, 2006).

Second, our study could benefit from cross-validation in other contexts. Specifically, equivalents of federal organizing principles may also be discovered in certain private sector cases. An interesting case in point could be the container shipping industry, where cooperation is similarly decentralized and separated according to competencies. We expect particularly valuable insights to emerge from an investigation of the TradeLens project. TradeLens is a blockchain application jointly developed by IBM and Maersk, the world's largest container shipping company, to track process data and documents across supply chains (Jensen et al., 2019). It would also be interesting to investigate the financial services industry where TTF also seems to be an important factor for the adoption of blockchain (Liang et al., 2021). Lastly, it could be worthwhile examining industries where centralized organizational structures dominate, such as the energy sector. In electric power systems, blockchain applications appear to be less successful (Mengelkamp et al., 2018; Ølnes et al., 2017; Sousa et al., 2019). This is particularly so for applications that involve the replacement of established market roles and, as such, face substantial regulatory challenges (Andoni et al., 2019; Li, Yang, He, Chen, & Wang, 2019; Thomas et al., 2019).

Third, it remains to be seen how TTF will impact performance in day-to-day operations and how it will combine with other success factors such as viability and symbolic benefits (Liang et al., 2021). The roll-out of the FLORA project to several of Germany's states and its selection as a trailblazer for the EBP have shown some propitious early signs that support our propositions and demonstrate viability. However, replicating our results with, for instance, EBSI will provide further feedback and a clearer indication of the importance of each factor as well as the relevance of symbolic benefits for federally structured governments.

6. Conclusion

In this study, we examine why organizations in federally structured government systems adopt blockchain. We draw on TTF theory to argue that adoption in these contexts is driven by a high degree of fit between cross-organizational task structure and blockchain's technological properties. In particular, we highlight four technological properties exhibited by private blockchain frameworks, each of which aligns closely with several of the four organizing principles of federalism. Accordingly, these blockchain frameworks can be powerful tools for facilitating cross-organizational cooperation between independent and heterogenous authorities. Our study contributes to a deeper understanding of the adoption of blockchain technology and of task-technology fit at the cross-organizational, federal level. Moreover, our insights can help researchers and practitioners – especially decision-makers in federally structured government systems – understand the circumstances in which blockchain technology can be a good fit.

CRediT authorship contribution statement

Tamara Roth: Conceptualization, Data curation, Formal analysis, Writing – original draft. **Alexander Stohr:** Investigation, Methodology, Validation, Writing – original draft. **Julia Amend:** Data curation, Formal analysis. **Gilbert Fridgen**: Supervision, Writing – review & editing. **Alexander Rieger**: Conceptualization, Project administration, Supervision, Writing – review & editing.

Declaration of interest

Since January 2018, Gilbert Fridgen and Alexander Rieger have been part of the scientific advisory team that supports and accompanies the FLORA blockchain project of Germany's Federal Office for Migration and Refugees (BAMF). Alexander Stohr has joined the team in August 2019 and Julia Amend in March 2020.

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Appendix A. Details of the literature review

see Appendix Table A1, Table A2.

Table A1
Results of the literature review on federalism.

#	Paper	Empowerment	Separation of competencies	Cooperation and coordniation	Organizational flexibility	Total of organizing principles mentioned
1	Auer (2005)	x		x	x	3
2	Avgerou and Bonina (2020)	x		x		2
3	Berman and Martin (1983)		x	x		2
4	Biela et al. (2012)	x	x		x	3
5	Borriello and Crespy (2015)	x	x		x	3
6	Bormann et al. (2019)	x	x		x	3
7	Carter and Bélanger (2005)	x		x		2
8	Christiaanse and Huigen (1997)			x		1
9	Conlan (2006)	x		x	x	3
10	Constantinides, Henfridsson, and Parker (2018)	x	x			2
11	Cordella and Willcocks (2012)	x		x		2
12	Davis (1989)	x				1
13	Dawson et al. (2016)	x		x		2
14	Deringer and Molnar (1983)			x		1
15	Dinan and Heckelman (2020)	x	x		x	3
16	Ebinger and Richter (2015)	x	x	x	x	4
17	Egeberg (2001)	x	x			2
18	Erk and Koning (2009)	x	x		x	3
19	Fossum and Jachtenfuchs (2017)	x	x	x	x	4
20	Gil-Garcia et al. (2007)			x		1
21	Goh and Arenas (2020)	x		x		2
22	Graham (1980)	x	x			2
23	Grant and Tan (2013)	x	x	x		3
24	Heeks and Stanforth (2007)	x	x			2
25	Hsueh and Prakash (2012)		x		x	2
26	Igira (2008)	x				1
27	Ingram and Simons (2000)		x	x		2
28	Irani, Love, Elliman, Jones, and Themistocleous (2005)			x		1
29	Jaeger (2002)	x	x	x	x	4
30	Keating (2017)	x	x		x	3
31	Leidner and Kayworth (2006)	x		x		2
32	Mackenzie (2010)		x	x	x	3
33	Mckay (2005)	x	x			2
34	Moya Palencia (1974)	x	x	x	x	4
35	Nathan (2006)	x	x			2
36	Pang, Lee, and DeLone (2014)			x	x	2
37	Parsons (2002)		x	x	x	3
38	Pencek (2008)		x	x		2
39	Rai and Tang (2010)				x	1
40	Ravishankar (2013)			x		1
41	Rodden and Wibbels (2002)	x	x			2
42	Scott et al. (2016)			x		1
43	Seltsikas and O'Keefe (2010)	x				1
44	Smith and Fernandez (2010)	x		x		2
45	Soss, Fording, and Schram (2008)	x				1
46	Springer (1962)			x		1
47	Trechsel (2005)	x	x	x		3
48	Tyworth (2014)	x			x	2
49	Watts (1998)	x	x	x	x	4
50	Wibbels (2006)	x	x	x		3
51	Ziblatt (2004)		x			1
		35	28 12	30	19	

Table A2
Results of the literature review on blockchain technology.

#	Paper	Secure and distributed data storage	Selective transparency	Reliable information sharing and process automation	Adaptability	Total of technological properties mentioned
1	Abramowicz (2020)	x	x		x	3
2	Ahl et al. (2020)	x	x	x	x	4
3	Andersen and Ingram Bogusz (2019)	x	x	x	x	4
4	Andoni et al. (2019)	x	x	x	x	4
6	Beck, Avital, Rossi, and Thatcher (2017)	x		x		2
7	Benbunan-Fich et al. (2020)	x			x	2
8	Chanson, Bogner, Bilgeri, Fleisch, and Wortmann (2019)	x	x	x	x	4
9	Chapron (2017)	x	x	x		3
10	Chong, Lim, Hua, Zheng, and Tan (2019)	x		x	x	3
11	Davidson, de Filippi, and Potts (2018)	x	x	x	x	4
12	di Silvestre et al. (2019)	x	x	x	x	4
13	Drummer and Neumann (2020)	x		x		2
14	Foti and Vavalis (2019)	x	x	x		3
15	Gomber, Kauffman, Parker, and Weber (2018)			x	x	2
16	Hawlitschek et al. (2018)	x	x	x		3
17	Howson (2019)	x	x	x		3
18	Iansiti and Lakhani (2017)	x	x	x	x	4
19	Jensen et al. (2019)	x	x	x	x	4
20	Khaqqi et al. (2018)		x			1
21	Kshetri (2018)	x	x	x	x	4
22	Lacity (2018)	x		x		2
23	Lauslahti et al. (2018)	x		x	x	3
24	van Leeuwen, AlSkaif, Gibescu, and van Sark (2020)	x	x	x	x	4
25	Li et al. (2019)	x		x	x	3
26	Lin, Pipattanasomporn, and Rahman (2019)	x				1
27	Lowitzsch, Hoicka, and van Tulder (2020)	x		x		2
28	Luo, Dong, Liang, Murata, and Xu (2019)	x			x	2
29	Lüth, Zepter, Crespo del Granado, and Egging (2018)	x		x		2
30	Mattila and Seppälä (2018)	x		x	x	3
31	Mattke et al. (2019)	x	x	x	x	4
32	Mendling, Pentland, and Recker (2020)			x		1
33	Mengelkamp et al. (2018)	x	x	x		3
34	Morstyn et al. (2018)	x			x	2
35	Noor et al. (2018)	x	x	x	x	4
36	Ølnes et al. (2017)	x	x	x	x	4
36	Pedersen et al. (2019)	x	x	x		3
38	Perrons and Cosby (2020)	x	x	x		3
39	Renwick and Gleasure (2021)		x	x	x	3
40	Riasanow, Burckhardt, Soto Setzke, Böhm, and Krcmar (2018)	x		x	x	3
41	Rieger et al. (2019)	x	x	x	x	4
42	Risius and Spohrer (2017)	x		x	x	3
43	Rossi et al. (2019)	x	x	x		3
44	Sedlmeir et al. (2020)	x	x	x	x	4
45	Shafiei Gol, Stein, and Avital (2019)	x		x	x	3
46	Sikorski et al. (2017)	x		x	x	3
47	Sousa et al. (2019)	x	x	x	x	4
48	Thomas et al. (2019)	x		x	x	3
49	Treiblmaier etal. (2021)	x		x	x	3
50	Ying, Jia, and Du (2018)			x	x	2
51	T. Zhang, Pota, Chu, and Gadh (2018)	x	x	x	x	4
52	Ziolkowski et al. (2020)			x	x	2
		46	29	45	35	

Appendix. B Case study evidence

see Appendix Table B1, Table B2.

Table B1
Overview of our case study evidence.

Type	Details
(1) Interviews	See Table B2
(2) Documentation	(1) 441 pages of documentation in Atlassian Confluence (2) Technical concepts on data privacy (89 pages) and IT security (81 pages) (3) 121 pages of functional specifications (4) Project presentations (5) Publicly available reports (Digitalization agenda, press clippings, blockchain strategy of Germany's federal government, reports of other organizations)
(3) Direct observations (with multiple observers)	(1) Bi-weekly sprint reviews and project management meetings (2) 20 + workshops with different directorates, authorities, and organizations

Table B2
Overview of the conducted interviews.

Interviewee	Role	Duration (min)
1	Head of division	50
2	Employee IT	50
3	Head of division	60
4	Employee IT	30
5	Head of group	40
6	Head of division	30
7	Head of group	50
8	Decision-maker	40
9	Case handler	30
10	Case handler	33
11	Researcher	42
12	Researcher	52
13	Researcher	56
14	Researcher	43
15	Researcher	43
16	Consultant	50
17	Consultant	60
18	Developer	30
19	Developer	50
20	Developer	60
21	Enterprise architect	60
22	External stakeholder	45
23	External stakeholder	32
24	External stakeholder	60
25	External stakeholder	51

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