

# Need for Change: Business Functions Affected by the Use of Decentralized Information Systems

*Short Paper*

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## **Abstract**

*Driven by economic advantages and the idea of disintermediation of business processes, the decentralization of technical and economic systems has become a highly discussed topic in recent years. Extant research primarily investigated the technical implementations of decentralized information systems (IS) and their use by firms in business networks. It became clear that interorganizational relationships and business functions must be transformed to enable the use of decentralized IS (e.g., those related to how firms can be involved in the design, instantiation, operation, and governance of decentralized IS). However, the impact of transforming business functions of individual firms remains largely unclear, obfuscating a comprehensive understanding of the implication of decentralized IS use on internal organizational structures of firms. In this work, we focus on the identification of challenges for firms in using distributed ledger technology (DLT as a representative for decentralized IS) and their effects on the business functions of firms.*

**Keywords:** Decentralized Information Systems, Internal Business Functions, Distributed Ledger Technology

## Introduction

Today, firms heavily rely on centralized information systems (IS) to support their business processes (Eurostat 2020). A centralized IS is usually managed and operated by a single party, such as a firm or its external IT provider (Schuff and St. Louis 2001). Today's increasingly interwoven business processes, which span across large networks of firms, call for improved information flow to better manage inter-firm collaborations. However, using centralized IS to support inter-firm information flows creates barriers, for example, non-verifiability of actions due to limited access to centralized IS for external stakeholders. Extensive reliance on, for instance, one external service provider can lead to unreliable, non-transparent business processes and information asymmetries that diminish trust between collaborators (Kwon and Suh 2004).

Decentralized IS can address drawbacks of centralized ones by enabling firms to jointly manage, operate, and use a shared IS (Beck et al. 2018; Mendling et al. 2018). Decentralized IS usually comprise a network of separate computing devices that interact with each other without mediation. Moreover, the management and operation of decentralized IS generally involves no central party, because these tasks are distributed across all participating firms. A leading technology to instantiate decentralized IS is distributed ledger technology (DLT). DLT enables the operation of append-only distributed databases (i.e., distributed ledgers) that are organized in a decentralized way (Kannengießer et al. 2020). Based on DLT, decentralized IS can use distributed ledgers to store records of transactions between actors (e.g., firms) and reliably execute business logic formalized in software programs (i.e., smart contracts). DLT systems can host multiple software applications that can be used by any member of the system.

However, using DLT has various implications on firms, such as shared innovation through increased collaboration and mutual access to trusted data using a decentralized data storage (Zavolokina et al. 2020). These implications require firms to transform business services and business functions for the effective provision of business capabilities (Markus 2006; Mendling et al. 2018). These transformations can even extend to the structural reorganization of firms, where, for example, diminishing information asymmetries support the development of a flat organization instead of hierarchical structures. Business functions specify how firms provide business capabilities, including the involved business services, people with their associated roles, procedures with subordinate processes, and technologies (Dietz 2006). To anticipate the implications of using DLT on business functions, thorough knowledge about potential challenges of using DLT systems and their impacts on business services is required. Nonetheless, it is still unclear which business services and associated business functions may become subject to transformations.

Existing research on the use of DLT by firms takes two principal perspectives: *inter-organizational* and *intra-organizational*. The *inter-organizational perspective* refers to using DLT systems to improve inter-firm collaborations, for example, increasing transparency in supply chains or accelerating the transfer of funds in finance (Hofmann et al. 2019; Jensen and Ross 2020). Within the inter-organizational perspective, the joint governance of DLT systems emerged as a major topic (Beck et al. 2018; Zachariadis et al. 2019; Zavolokina et al. 2020). The *intra-organizational perspective* refers to the investigation of relationships between operational abilities, processes, and settings internal to the firm (e.g., investment decision making, organizational mindset, and trusted relations) and the successful adoption of DLT systems (Austin and Williams 2021; Kannengießer et al. 2020; Knauer and Mann 2020; Seebacher et al. 2021). Especially, research on the integration of DLT systems into business processes highlights the need to develop and enhance capability areas within business process management (e.g., Cen et al. 2017; Mendling et al. 2018). Moreover, other internal capabilities are impacted by the usage of DLT (e.g., knowledge sharing, formation of research teams, leadership; Pan et al. 2020). Despite other valuable contributions on decentralization that indicate transformation within firms (e.g., Hempel et al. 2012; Rangus and Slavec 2017), insights about implications of using DLT on firms' business services is still scarce (Frizzo-Barker et al. 2020; Wamba and Queiroz 2020) and potentially required transformations of business functions to support the use of DLT remain unclear. To understand which firms' business functions may be transformed by using DLT systems as a representative for decentralized IS, we pose the following research question: *What are internal business functions to be transformed when using DLT systems?*

To answer our research question, we conducted 14 semi-structured interviews with DLT experts from different industries (i.e., finance, professional services, and IT-services). We transcribed the interviews and applied thematic analysis (Braun and Clarke 2012) to extract challenges that firms are facing when using DLT systems. Next, we mapped the identified challenges to business services, which are included in the

BIAN Service Landscape V8.0 (Banking Industry Architecture Network 2019). In total, we identified 20 challenges for firms in using DLT systems that can affect 36 business services. From the interviews, we finally derived exemplary transformations of business functions executed to deliver the business services affected by the identified challenges.

By presenting an overview of challenges for firms when using DLT systems and indicating transformations of business functions, we support decision-makers in anticipating organizational changes. By mapping identified challenges to established business services included in the BIAN landscape (Banking Industry Architecture Network 2019), effects of using DLT systems on firms' business services and business function providing these services become better understandable. In this way, we support the identification of transformative mechanisms for business functions that can help firms when using DLT systems. Our results can serve as a basis for the development of transformative mechanisms to change firms' business functions to better use DLT systems.

## Method

To identify challenges of using DLT systems for firms, we chose an explorative, qualitative research approach and conducted semi-structured expert interviews. Potential interviewees were approached through existing contacts from ongoing research projects and by contacting practitioners with DLT project experience on LinkedIn. Following methodological recommendations from prior research (Ayres 2008; Gorden 1975), thirteen interviews were held with a total of fourteen experts regarding the design and organizational integration of DLT system (see Table 1). These experts from fourteen different companies, situated in four different service sectors (i.e., financial services, IT services, and professional services), had an average experience with DLT projects of 4.9 years. The interview guide was sent to the interviewees one week in advance, asking them to prepare an exemplary use case of their own choosing that they were familiar with (e.g., from prior consulting projects). During the interviews, the use cases were discussed with the respective experts. In particular, we asked for perceived benefits and challenges of using DLT in these cases and the perceived implications of using DLT systems on internal business functions of the respective firms. The interviews took between 21 and 88 minutes, with an average of 47 minutes. We recorded and afterwards transcribed each interview. Additionally, we took notes during the interview. After each interview, we discussed our notes, impressions, and the transcript to assess the extent of novel insights contributed to our sample. After finding no new insights in three consecutive interviews, we deemed that we had reached a sufficient theoretical saturation to proceed with the actual data analysis after the fourteenth interview.

We analyzed the interviews using thematic analysis (Braun and Clarke 2012) that comprises six phases: (1) *familiarize yourself with the data*, (2) *generate initial codes*, (3) *search for themes*, (4) *review themes*, (5) *define and name themes*, and (6) *produce the report*. After familiarizing ourselves with our transcripts and notes (1), we coded the transcripts to extract preliminary challenges for using DLT systems (2). The coding procedure comprised two rounds of analysis and refinements of the codes. First, we discussed the identified challenges and assigned them to preliminary codes. Second, we refined the initial codes by merging differently labeled but overlapping codes together to achieve exclusiveness of the codes. For example, we merged the codes *partner management* and *collaboration* to the code *stakeholder coordination*. During the subsequent search for themes (3), we collated the identified twenty codes into six preliminary themes (e.g., governance, IT system engineering, and user-centered application design). If a code did not suite an existing theme, we created a new theme. For example, we assigned *in-house IT* to the theme *IS sourcing*, while we assigned the code *understanding* to the theme *leadership and organizational culture*. For the review of the

Use Case Domain	Company Type	Job Position	Avg. DLT Experience
Decentralized Finance	3 retail banks, 3 IT service provider, 2 management consulting firms, 2 IT consultancies, 1 service provider	2 product managers, 2 managing consultant, 2 IT-consulting managers, 1 sales manager, 1 business development, 1 founder, 1 enterprise architect, 1 innovation manager	5 years
Cryptocurrency Mining	1 IT service provider	1 business developer,	4 years
Legal Document Exchange	1 law firm	1 chief executive officer	8 years
Product Lifecycle Management	1 management consulting firm	1 managing consultant	5 years

**Table 1. Overview of interviewees**

developed themes (4), we discussed the identified six preliminary themes and associated 23 codes with three DLT experts (i.e., two researchers and one project manager). The discussion revealed minor inconsistencies in the descriptions of the identified codes. We refined the descriptions of the codes to offer a set of distinct challenges. The changes did not affect the preliminary themes. Next, we structured our themes according to the TOE framework (Tornatzky and Fleischer 1990), on which basis we distinguished three major sources of challenges: technology, organization, and environment. In the sixth phase, we accumulated our knowledge and developed descriptions of each theme. Next, we developed an intuitive name for each theme and code and a precise description (5). Finally, we summarized the themes in a report that we used to identify business services affected by the revealed challenges in the next step.

To identify business functions affected by the identified challenges, we used the classification of business services presented in the BIAN Service Landscape V8.0 (Banking Industry Architecture Network 2019). The classification comprises two hierarchical levels: *business domain* and *business service*. Business domains represent coherent sets of responsibilities and tasks constituted of multiple business services. Business services execute parts or even complete business functions required to deliver a business capability. In this sense, the sum of business services required to execute a business function for the delivery of a business capability specifies the resources (i.e., people and their roles, procedures and processes, and applied technologies) affected by the challenges identified in the thematic analysis. For the mapping of challenges identified in the thematic analysis to affected business functions, we first mapped the challenges to the BIAN business services. If an interviewee explicitly named a business service affected by a challenge, we assigned the corresponding business service to the corresponding challenge. If the business service was not explicitly named, we inferred the mapping and asked the interviewees for feedback on the assignments of business services to the identified challenges. Since the feedback from the interviewees revealed minor inconsistencies within our mapping, additional refinements were made. Finally, we mapped the identified challenges caused by using DLT systems to affected business services.

## Results

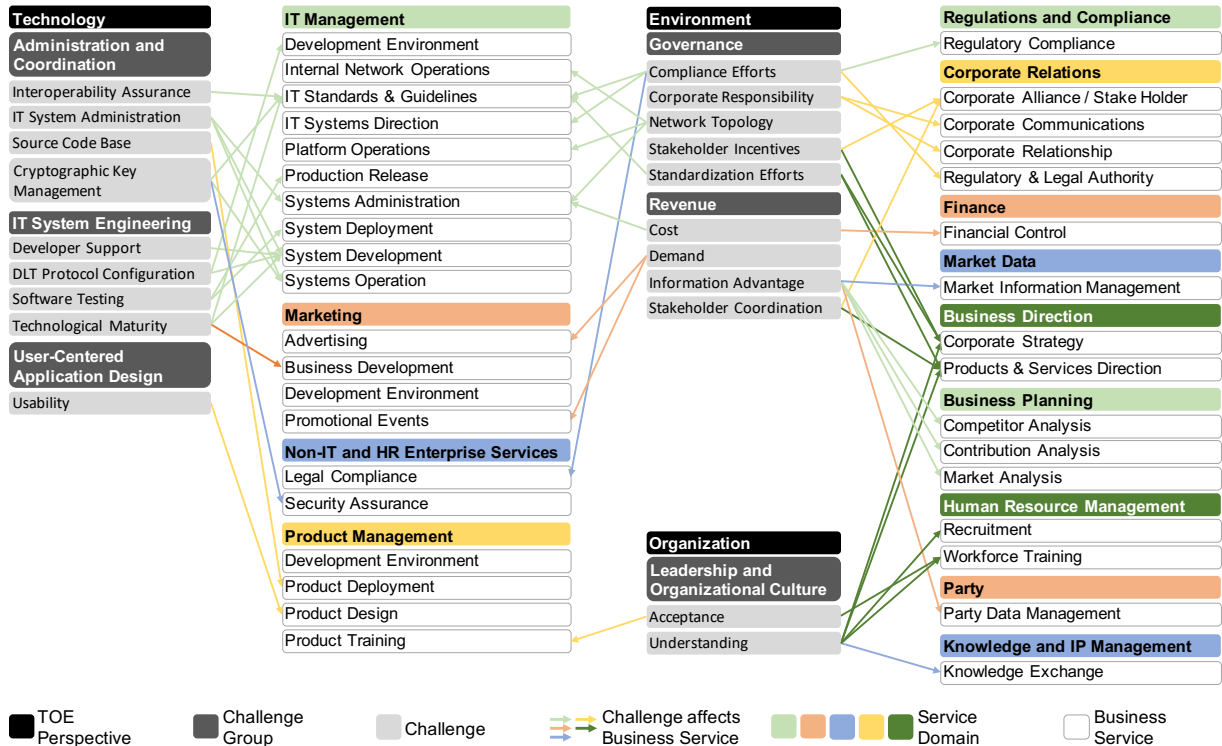
In this section, we present challenges caused by using DLT that can negatively affect firms' business functions. For each perspective of the TOE framework, we describe one selected challenge per theme and highlight the impact of the challenge on specific business services. Moreover, we point out potential solutions to improve associated activities as means for organizational transformation of firms towards the successful use of DLT systems. While it is not possible to give a detailed account of all our results in this research-in-progress paper (due to the space limitation), a high-level overview of all identified challenges and affected business services is given in Figure 1. We identified 20 challenges for firms regarding the use of DLT. We mapped these challenges and solutions to 36 business services associated with 13 business domains that can become subjects to transformations due to the identified challenges.

### ***Technological challenges and affected business services***

The technological context considers all aspects of DLT systems that stem from technical constraints and affordances that are relevant when introducing DLT systems to a firm (e.g., technical characteristics; Tornatzky and Fleischer 1990). We identified nine challenges associated with three themes that can affect business services of firms: *Administration and coordination*, *IT system engineering*, and *user-centered application design*. In the following, we present a selection of challenges and affected business services grouped by their respective themes. The technological context considers aspects of DLT systems that stem from technical constraints and affordances that are relevant when introducing DLT systems to a firm (e.g., technical characteristics; Tornatzky and Fleischer 1990).

***IT system engineering.*** The theme *IT system engineering* refers to challenges related to designing, implementing, and operating decentralized IT systems.

*Developer support* challenges are caused by increased hurdles in developing applications on DLT systems. Compared to conventional software development, for example, currently offered tools for smart contract development seldomly support the local execution of developed software under realistic conditions. The low developer support hinders the effective design and development of DLT systems. According to our interviewees, low developer friendliness strongly affects the business service *system development*: “[...] there are still two main problems: Usability, which many people, including us, are working on and the way



**Figure 1: Overview of identified challenges caused by using DLT systems and respectively affected business services**

blockchain transactions were implemented in the past, respectively smart contracts. That will not work anymore.” (IT-consulting manager). To improve developer friendliness and increase flexibility in providing business capabilities enabled by DLT systems (e.g., cryptocurrency trading when using DLT), new capabilities for developing and maintaining source code are required.

**Administration and coordination.** The theme *administration and coordination* refers to challenges associated with the processes related to system component administration, source code maintenance, and the management of software systems.

*Management of cryptographic keys* refers to the efforts related to managing and organizing the creation, custody, and use of cryptographic keys that are required to sign transactions to successfully store these transactions in a distributed ledger. In contrast to traditional IS that rely on centralized public key infrastructures (PKIs), most DLT systems allow for the individual creation of cryptographic keys independent of centralized services. Any owner of cryptographic keys is responsible for their generation and custody and cryptographic key cannot be recovered when lost. Therefore, firms that use DLT must implement processes for managing the keys of their employees or customers. The additional efforts for key management affect the business services *IT standards & guidelines*, *systems operation*, and *security assurance*. Key management requires the adaption of security assurance checks to ensure that security countermeasures are in place involving tests with multiple threat categories to increase protection against different scenarios: “[...] someone in the organization must have the keys or there must be a procedure, a two-man rule, to ensure that the right transactions are executed or not. Keys may be passed or recovered. That is not quite simple.” (Product manager). An innovation manager adds that “[...] custody is currently outsourced.” To reduce efforts associated with safekeeping, administration, and protection of cryptographic keys several firms follow outsourcing practices and transfer responsibilities toward external service provider.

**User-centered application design.** The theme *user-centered application design* refers to challenges perceived by end users of DLT systems in terms of application design that prevent them from efficiently achieving their goals.

*Usability challenges* relate to the difficulties that end-users face when using products or services provided by DLT systems, such as decentralized finance applications (i.e., DeFi applications). For example, the use

of usernames and passwords are common to authenticate end-users in centralized IS. In DLT systems, authentication is largely based on unhandy digital signatures generated from a cryptographic key (i.e., private key). Using cryptographic keys and digital signatures can pose a usability challenge for end-users. New design principles are necessary to address the requirements for using DLT systems (e.g., capabilities to sign transaction). Consequently, this challenge affects the business service *product design*, which addresses how products are created designed, created, and maintained: “[...] you have the risk that employees are overwhelmed because I often see that DApps are horribly complicated in terms of usability or user experience. And the main unique selling point has always been that is driven by blockchain. And that is not an argument for using such a technology in a company.” (Chief executive officer).

### **Organizational challenges and affected business services**

The organizational context refers to the characteristics and resources of firms (e.g., scope, size, and managerial structure of the firm; Tornatzky and Fleischer 1990) that define the response to external or internal opportunities in the use of DLT systems.

**Leadership and organizational culture.** The theme *leadership and organizational culture* refers to challenges related to cultural transformations associated with the norms, attitudes, and behaviors of employees to support the transformation toward the usage of DLT systems.

*Understanding* refers to insufficient knowledge of employees about DLT. A lack of understanding causes ineffective communication, mismanagement, and inefficient execution of business tasks. Especially, it hinders business services associated with *corporate strategy* to meet, refine, and improve the corporate goals and related business function: “[...] I see the management level as an enabler that must initiate a culture change. They must propagate and clarify the vision that we will have to operate more and more across industries in the future. If they have envisioned it, then it should work.” (Product manager). Moreover, the business services *Product & Services* and *Knowledge Exchange* are affected: “[...] It is really the buildup of competencies about blockchain. [...] That's almost focused on one person in our company right now. If he drops out, we have a problem. [...] Who creates a wallet for the customer and so on? It is no longer the project manager; it has to be transferred to operations somewhere. And who does that in operations? If the person has no know-how and is not familiar with the terms, it is extremely difficult. That brings us back full circle to knowledge transfer.” (Innovation manager). Moreover, the business services *Recruitment* and *Workforce Training* are affected. One enabler to improve associated activities relates to *Human Resource Management*: “[...] That is the thing about human resources. That is the hiring process, recruiting as well as training. Whether they are internal to the company or not.” (Business developer).

### **Challenges Caused by the Environment and affected Business Services**

The environmental context refers to the usage of DLT systems under external uncertainty with regards to regulatory requirements, legal issues, market demand, industry specificities, cooperation and competition between firms. We identified two themes including nine challenges that can affect firms' business services: *Costs*, *demand*, *stakeholder incentives*, *information advantage*, *stakeholder coordination*, *corporate responsibility*, *compliance efforts*, *network topology*, and *standardization efforts*.

**Revenue.** The theme *revenue* refers to challenges associated with strategic decisions regarding the participation in a network of firms that require shared resources of the firms in their DLT system.

*Stakeholder incentives* cause challenges for designing decentralized ecosystems because it requires the consideration of potentially contradicting or diverging goals of the firms involved in the business ecosystem. DLT systems comprise multiple nodes that are managed by different stakeholder to achieve a high degree of decentralization (Kannengiesser et al. 2020). The need to incentivize all stakeholders to contribute to the shared DLT system affects the business services *corporate strategy* and *corporate alliance*. One IT-consulting manager stated the benefits once an ecosystem is established: “[...] The ecosystem draws solutions out of the DApps store and, after the standardization has been solved, they are automatically networked with each other. That is how the interaction is supposed to work. The operating company just provides the underlying technology, actually the marketplace, and the integration and compensation begin.”

**Governance.** The theme *governance* refers to challenges in establishing and maintaining mechanisms, rules, and processes that ensure accountability, decision-making, participation in designing, implementing, and operating a network of firms that jointly use a DLT system.

*Network Topology* regards decisions on responsibilities for the operation of nodes in a DLT system with unknown consequences for firms using the DLT system. Since the consequences of decisions are unknown, there are uncertainties in operating the DLT system (e.g., administration of access rights). Challenges related to *Network Topology* exacerbates monitoring of transactions. We have identified the business services internal *network operations*, *platform operations*, and *system administration* that are impacted by *Network Topology* challenges: “[...] Yes, I think it depends on the use case. And it also depends on the extent to which the blockchain can exploit its advantages [...] not everyone has to host a node [...] I would say that 15 nodes are enough in this context [...] You can also say that rotates. First 15 people have a node, then in 2 years the others have to take over.” (Management consultant). To improve associated activities, several companies consider an outsourcing approach: “[...] In the bank, you have a few process adjustments. But in the end, it is outsourcing, and you don't do it yourself.” (Product manager)

## Discussion and Future Research

In this study, we found that the challenges for using DLT systems require organizational transformations across several service domains and respective business services. Although IT management is the foremost affected service domain, several non-technical areas (e.g., Marketing, Regulation & Compliance) also encounter difficulties meeting the necessary organizational requirements for a successful use of DLT systems. The identified challenges affect firms as a whole, including people and their roles, procedures and processes, and applied technologies ranging from the strategic to the operational level (e.g., corporate strategy and systems operation). Our interviewees stated strong concerns regarding the current acceptance and understanding of decentralization by employees. To increase acceptances and understanding of decentralization and DLT systems in firms, some interviewees assumed that the internal organizational structure of firms is an important factor. They mentioned that firms building on loosely coupled networks of organizational units may experience fewer challenges and an easier integration of DLT systems compared to strictly hierarchically organized firms. Moreover, some interviewees reported that firms with an increased workforce agility tend to react and adapt to changes in their working environment caused by decentralization.

Leveraging synergies between business units of different firms requires the compliance of involved firms with procedural and technical standards. The interviewees mentioned that the standardization of business processes and software interfaces can favor the use of DLT systems in conjunction with existing IS. Moreover, standardization of DLT protocols has been mentioned to be essential for interoperability. However, the standardization of IS may decrease heterogeneity among firms regarding their used IT and, thus, reduce firms' competitive advantages. The more standardized companies' IT becomes, the more difficult it can be for companies to adapt business processes to create new competitive advantages. While the interviewees pointed out the importance of standardization, they also suspect decentralized intra-organizational structure of firms (e.g., division by function) may facilitate the identification of synergies with other firms. Imagining a comprehensive standardization of firms' functional units, these functions can become redundant between firms. To reduce redundancies, firms may merge their functional units, which however causes centralization in business ecosystems. Thus, the degree of standardization of decentralized IS appears to be a corner stone for balancing the degree of political decentralization and the degree of technical decentralization of DLT systems (Sunyaev et al. 2021).

This work contributes to practice by identifying 20 challenges for firms when using DLT systems and presents first- and second-order themes that complement the understanding beyond technical difficulties. By revealing services and business functions affected by challenges in using DLT systems, we facilitate the identification of transformative mechanisms to facilitate the use of decentralized IS. Our work contributes to research in two ways. First, we extend the view on decentralization by the intra-organizational perspective, which interdepends with inter-organizational interactions and relations between firms. Second, the insights of discrepancies between the current state and a possible target state in organizational structures

serves as a cornerstone for the development of transformative mechanisms for the organizational transformation of enterprises for the successful use of decentralized IS.

Our study has some limitations caused by the qualitative study design. First, our data only reflects perceptions of a few employees per firm. Our research highlights that using DLT systems is a multi-perspective challenge. Thus, the number of employees per firm may be too low to explicate the entirety of challenges faced by firms. Second, most interviewees were from the finance or the professional service industries. The selection of interviewees also required us to adjust the analysis approach, which accordingly incorporates the BIAN Service Landscape that was designed to primarily describe business services in the financial industry. Hence, there might be a contextual bias in our data that limits the generalizability of our results. We plan to address both limitations by extending our interview sample by including a wider range of industries and multiple employees with different responsibilities per firm. Third, the analysis of our data was to some extent subject to our own interpretations. Nonetheless, we are confident that we reduced potential interpretation biases by discussing incremental advances of our results with other researchers in the field.

With our research, we try to better understand the coexistence of technical and political decentralization in business ecosystems using DLT systems. To this end, the findings presented in this work form a starting point for further research on transformative mechanisms that support firms in successfully using DLT systems. With the resulting insights it will be possible to investigate transformative mechanisms that support firms in integrating and using DLT systems, for example, to create new revenue streams (e.g., fractional ownership of digital assets). Based on these insights, we also believe that leadership and organizational culture could play a decisive role in enabling transformations. We plan to conduct focus groups to explore solutions to overcome the identified challenges. In the focus groups, we will prioritize distinct activities and explain the steps toward transformation. Moreover, we will investigate how firms can find pareto optima between standardizing business services and increasing their competitive advantage through individuality.

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