# Digital trust in business ecosystem collaboration: Leveraging digital technologies to develop a framework

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**Abstract:**

Inter-organizational trust has been considered as a panacea in order to conduct a successful business transaction in the B2B context. When different firms with different organizational objectives interact and collaborate to achieve common goals, mutual trust plays a central role, particularly in the dynamic collaboration in the business ecosystem. Therefore, developing inter-organizational trust in a business ecosystem through leveraging digital technologies has become imperative. Advanced digital technologies and platforms (e.g., IoT, automation, AI, blockchain etc.) have a clear role in it, therefore, it is interesting to examine how firms can interact and successfully collaborate in an ecosystem where the relationship is not limited to only one actor. Thus, this research explores how digital technologies and digital transformation can be leveraged to develop digital trust among business ecosystem actors. We develop a conceptual framework based on integrating relevant literature as well as by collecting empirical evidence from Business Finland's program 'Digital Trust Finland' which helps Finnish businesses to build a global business on digital trust and security and facilitate business ecosystem actors to enhance collaboration. The findings of this research aim to contribute to the theoretical and empirical discussion by integrating and connecting literature on inter-organizational trust and digitalization with a logical argument of a cross-cutting role of digital technologies. From the managerial perspective, the propositions of this study aim to emphasize the need to develop digital trust among collaborating partners. The proposed framework will drive decision-makers in organizations to revolutionize the traditional ways of collaborations which is inevitable to survive in the fast-paced digital age.

**Keywords:** Digital trust, business ecosystem collaboration, digital technologies, conceptual framework

## Introduction

Inter-firm collaboration in a business ecosystem is the most important aspect of the operative lifecycle of firms where several levels of interactions with several industrial organizations are held. The core purpose of such collaborations usually is to effectively conduct economic transactions to create a 'win-win' environment for everyone involved. However, business ecosystem interactions and collaborations are beyond economic benefits and involve inter-organizational relationships (Shahzad, 2021). When different organizations with different objectives and interests interact with each other and collaborate to achieve common goals, relational aspects of mutual trust and commitment significantly affect the outcomes of such collaboration (Shahzad, 2018; Shahzad et al., 2018; Shahzad et al., 2020). In particular, mutual trust in the business ecosystem plays an important role as firms collaborate with some actors they never interacted with earlier. Digitalization and industry 4.0 technologies are therefore facilitating and supporting several industries to conduct trustworthy collaborations (herein digital trust) in ecosystems (Mubarak & Petraite, 2019;). These disruptive technologies include IoT, automation, AI, blockchain etc. that provide trustworthy platforms among firms to integrate throughout the whole supply chain. Digital trust developed by such disruptive technologies does not only facilitate ecosystem collaboration but also enhance the innovative capabilities of the firms (Mubarak & Petraite, 2020).

Recent research on inter-organizational trust has mainly focused on developing long-term relationships and commitment, minimizing transaction costs and conflicts (e.g., Shahzad et al., 2020; Shahzad et al., 2018; Ali et al., 2021), and the impact of Covid-19 on inter-firm trust (Shahzad & Imran, 2021). While some recent studies on digital trust have mainly focused on its impact on open innovation collaboration (e.g., Mubarak & Petraite, 2020), driving intra-organizational cultural change and cross-departmental trust (e.g., Abraham et al., 2019), institutionalized organizational trust (Sankowska & Paliszkiewicz, 2016), IoT related trust and digital infrastructure (e.g., Nord et al., 2019; Koohang et al., 2019), e-commerce platform (e.g., Levine, 2019; Yuan et al., 2021), peer-to-peer collaborative consumption platforms (Möhlmann, 2016), and user's trust on technologies such as blockchain (e.g., Shin, 2019). However, regardless of the plethora of research on inter-organizational trust and digital trust, a rigorous discussion around digital trust in business ecosystem collaboration remained unaddressed in the literature.

Therefore, the purpose of this research is to explore the role of security and privacy in building trust on digital infrastructure and how digital technologies and digital transformation can be leveraged

to develop digital trust among business ecosystem actors. We focus on cyber security including encryption methods, data privacy, and information communication technologies (ICT) as well as their critical role in building trust on digital infrastructure. Further, we emphasize the significant role of digital technologies (e.g., IoT, Blockchain, AI) in developing collaborative trust among business ecosystem actors (e.g., universities, research institutes, public sector organizations, and industry). We develop a conceptual framework based on integrating relevant literature as well as by collecting empirical evidence from Business Finland's program 'Digital Trust Finland' which helps Finnish businesses to build a global business on digital trust and security and facilitate business ecosystem actors to enhance collaboration. This research contributes to the seminal literature on digital trust and business ecosystem by integrating the discussion on digital infrastructure and ecosystem collaboration with a logical argument of a cross-cutting role of digital technologies.

## Relevant literature

### Trust in ecosystem collaboration

Factor trust holds a key position in the literature on social capital (Francois & Zabojnik, 2005; Knack & Keefer, 1997) and inter-firm governance mechanisms (Shahzad, 2021; Shahzad et al., 2018). A plethora of studies ( Koohang et al., 2019; Paliszkiewicz, 2019; Sankowska & Paliszkiewicz, 2016; Shahzad et al., 2018, 2020) suggests the trust has been utilized in various contexts, as so it has been conceptualized on a contextual basis. Trust in the inter-firm network context can be conceptualized as a non-contractual mechanism in which one firm is willing to believe and accept vulnerability in exchange for a positive outcome from their partner firm. Trust between firms is affected by various factors such as communication, partner reputations, transparency in partnerships and duration of relationship (Chai et al, 2020). In terms of implications, trust plays a major role in inter-firm contexts, for example in their research Shahzad et al. (2018) argue trust has an important role in the success of buyer's suppliers' relations. Similarly, having trust in partners increase the commitment of partners in inter-firm relationships (Pandit et al., 2021), and enhance inter-organizational collaborations (Lee et al., 2021).

The idea of interactions and collaborations among different actors can be traced back to philosophies of early economics where traditional market systems stand upon the interdependencies between buyers and suppliers (Wurth et al., 2021). The nature of collaborations and inter-dependencies changes in the context of ecosystem-based collaborations, in such collaborations actors and elements not only exhibit traded independencies but also untraded inter-

dependencies (Dosi, 1988). Collaborations and knowledge sharing mechanisms are essential for the success of a given business ecosystem. The importance of these collaborations has also been well recognised in the literature and various relevant models such as triple helix (Chinta & Sussan, 2018), industrial innovation systems (Hsu, 2005a), regional innovation systems (Hsu, 2005b; Pekkarinen et al., 2011) and industrial districts (Asheim, 1996; Becattini, 1991) has been discussed. Each model in the abovementioned frameworks evaluate a specific type of interaction among different actors, for example in their research Hsu, (2005a) posits collaborations among government and research organizations has greater implications for technologies development and industrial growth at a macro level. Similarly, the ubiquitous phenomenon in ecosystem-based collaborations includes heterogeneous actors, which on one side offer a multitude of opportunities to its actors, but also pose challenges on managing such relationships (Karhiniemi, 2009). To successfully manage such networks, require a different type of sociological and economic governance mechanisms (Lee et al., 2021). The economic mechanism includes contractual agreements and symmetric dependences among the businesses when forming business relations (Liu et al., 2017), while trust and communication (sociological) among the business partners are integral elements in building successful B2B networks (Shahzad et al., 2018).

**Digital trust in the business ecosystem**

The trust in online environments has been conceptualized differently as compared to offline modes since the nature of transaction and interaction is different in online modes (Alpcan et al., 2011). Trust in online transactions has different meanings and scholars have operationalized it in different contexts. Digital trust in online platforms and collaborations have different meanings and perspectives for collaborating parties, for example, meanings of trust for a customer in an online transaction is different than businesses selling their products over the platform. Digital trust in online purchases from customers perspective is conceptualized as the expectation of online shoppers from an online seller that they will deliver products or services as promised, despite buyer vulnerability to bear the possible risk of loss (Lim et al., 2006; Mack & Mayer, 2015). Trust in digital technologies infrastructure has been studied mainly from the perspective of security and the ability of the technology to meet its objectives without being compromised by malicious attacks (Koohang et al., 2019; Nord et al., 2019; Sung, 2018). Furthermore, recent studies such as ( Mubarak et al., 2019; Mubarak & Petraite, 2020) presents a human-technology centric approach towards digital trust, arguing implementing digital technologies can leverage the level of trust among collaborating firms which in turn facilitate their open innovation performance. In this regard, Mubarak & Petraite,

(2020) conceptualize “the digital trust in the context of business networks is the confidence of one firm in competencies of collaborating firms and technologies processes to form secure and reliable business networks. In this research, we analyse digital trust in both contexts, i.e. trust in digital technologies infrastructure and trust developed through technologies-based collaborations.

The introduction of digital and emerging technologies in the industry 4.0 era has caused major technological disruptions which compel contemporary businesses to redesign their business models, change the nature of business processes and operations and expanded their geographical boundaries for doing businesses and alter the nature of collaborations and interactions among the different actors of a business ecosystem (Sung, 2018). New technologies such as the internet of things (IoT), blockchains, artificial intelligence (AI), and other digital technologies have offered current businesses the opportunity to develop and operate cyber-physical systems (CPS) which can monitor, communicate, process, store and analyse a large amount of data to help them make informed business decisions (Hafeez, 2021). Similarly, advancements in web-based technologies have given emergence to digital platforms where businesses and users come along to co-create and innovate at a much faster pace than a company alone can do (Hein et al., 2020). Given the importance of collaborations and digital technologies role in current businesses, traditional firms have also realised the significance of forming inter-firm and ecosystem base collaborations for digital transformation, open innovation, and attain sustainable competitive advantage (Shahzad, 2021; Imran et al., 2021). Business firms are forced to form new types of collaborations and partnerships to sustain and compete in their respective market and such collaborations, information and knowledge exchange is the key pillar (Pekkarinen et al., 2011). For successful collaborations and knowledge exchange, trust is a key facilitating factor (Shahzad, 2021) and when firms with different objectives and organizational structures are collaborating on shared purpose through digital technologies, managing trust in this context is crucial. Digital technologies such as IoT and blockchain technologies offer a novel paradigm for secure and reliable information-sharing mechanisms between the partners and collaborators (Mubarak & Petraite, 2020) thus inter-organizational trust can be enhanced by utilizing modern information communication technologies. Business firms by utilizing digital technologies in their inter-organizational relationships can enhance mutual trust and enhance their cooperation to mutually benefit from such cooperation’s.

## Methodology

### Research strategy

In the current research, we evaluate "Digital Trust Finland" to decode how utilizing digital technologies in ecosystem-based collaborations can enhance inter-organizational trust (digital trust). Evaluating digital trust in the context of ecosystem-based collaborations requires a real practical case for identification of relevant themes and strategies and previous research such as Ratnasingam, (2005) shows case study research design is the most appropriate method to evaluate inter-organizational trust in B2B e-commerce context. Also, trust in multidimensional relations is difficult to measure (Hosmer, 1995) and case study research design allows researchers to dive deep into the phenomenon to make an empirical understanding of the topic. Therefore, the case is analysed through qualitative document content analysis. Researchers argue qualitative document analysed is considered cost-effective, time-efficient, stable and provide exact information on the topic through textual analysis (Bowen, 2009). This strategy is particularly relevant to research which aim to analyse and understand the certain phenomenon and interpret meanings through textual analysis (Landrum & Ohsowski, 2018). Therefore, in this research, we utilize a case study design analysed through qualitative content analysis.

**Case introduction**

The case analysed in the current research is the "Digital Trust Finland" initiated and managed by Business Finland (Business Finland, Accessed on 01.10.2021). The program consists of several projects both run by higher education institutes and businesses aiming to build digital infrastructure and a digital trust-based business model through ecosystem-based collaborations. The program has a 100 million euros budget to support the development of solutions and services based on digital trust, help Finnish businesses in internationalization, networking and strengthen ecosystem-based collaborations. The program has enhanced collaborations and digital competencies of the businesses by arranging workshops, webinars and events for different actors of the business ecosystem both at the national and international level. The program has many projects and initiatives, however, in current research, we only focus on events, projects and initiatives aiming to increase digital trust among the businesses through ecosystem-based collaborations and digital technologies.

**Data collection and analysis**

For this research, we utilized secondary data publicly available on the website of the 'Digital Trust Finland' (Business Finland, Accessed on 01.10.2021). Our notion to utilize web-based data for analysing digital trust is inspired by Pandit, (1996), in his research argue web base data contain rich information utilizing such data systematically is suitable for studies researchers aims to comprehend

a certain phenomenon in depth through qualitative case analysis. A similar kind of method has also been used by Turner, (1983) for grounded theory research in the domain of organizational behaviour. Thus, the main source of data for this research is published reports of the program available publicly on the website database, however, for data triangulation researchers of the study also carefully reviewed data available in other forms such as events memos, webinar recordings, news and updates available online.

The research follows a systematic procedure as recommended by Bowen, (2009) to conduct qualitative document analysis. After accessing the archive of reports, researchers initiated a superficial examination of the reports to identify the relevant reports. Upon identifying and selecting relevant reports, a thorough examination of the reports was conducted to get familiarize with the data and determine the purpose and audience of the reports (Bowen, 2009). To grab much information from the reports, at first generalize information relevant to the research framework has been extracted, and the same process has been repeated to ensure to avoid missing key data relevant to the research framework. We also examined reports to determine whether the reports are contain primary data or using secondary data and the majority of the reports were compiled based on the primary data sources, providing key facts as well as detailed information on digital trust and other concepts relevant to research framework. We performed a content analysis on the data and based on the analysis found out “Digital Trust Finland” focus on two main types of trust i.e. (1) creating trust in digital infrastructures and (2) developing trust among businesses through digital technologies.

## Results and conclusions

### Creating trust in digital infrastructures

In this research, we explored the role of security and privacy in building trust in digital infrastructure as well as the role of digital technologies and digital transformation in developing digital trust among business ecosystem actors. We found that security and privacy are an essential part of developing trust in digital infrastructure (cyber-physical systems, architecture and applications, platforms etc.) (Nord et al., 2019). The rapid increase in technological advancements has spurred the number of cyber-attacks and protecting digital infrastructures against cyber-attacks and other malware attacks is indispensable. We also found that a special emphasis has been placed on quantum cryptography as such on building encryption methods and secure algorithms to protect digital infrastructure from cyber-attacks by other quantum computers. Cryptography is becoming a popular technique to

tackle cyber security issues and prevent cyber-attacks launched through a quantum computer (Arnold, 2020). The other techniques mentioned to ensure the security of the digital infrastructures are setting up security operation centres and educating and training employees to raise awareness about digital and cyber security.

Furthermore, analysis indicates digital identity management, GDPR compliance and strong authentication support security and privacy, which resultantly increase trust in digital technologies. Digital identity management involves allowing role base access to individuals and organizations built upon strong authentication procedures to access the data and digital assets. In this way, secure and reliable access to relevant digital entities is ensured. The third main pillar to build digital trust is dealing with General Data Protection Regulations (GDPR) also known as the consent of the users. Emplacing GDPR makes it easy for organizations to comply with data collection, protection and regulations, therefore placing GDPR and updating users about their data rights and how their data is protected is essential to build their trust in digital technologies (Haque et al., 2021). Assigning digital identities to all entities and putting strong authentication procedures along with the consent of users for data utilization leads to individual and organizational level trust in digital infrastructure. This helps firms to build confidence in the operative environment of digital infrastructure which in turn minimize the hesitation of the firms in adopting digital technologies (Sicari et al., 2015). Based on our discussion, we propose:

P1. Ensuring security and privacy through critical communication technologies enhance trust in digital infrastructure

**Creating digital trust among businesses through digital technologies**

The analysed program also focuses on enhancing ecosystem-based collaborations, networking and internationalization of Finnish businesses, particularly companies operating in digital trust-based services and solutions. Regarding the role of digital technologies in developing digital trust among business ecosystem actors, we found that platform-based interaction enhances the firms' confidence in their peers in the ecosystem. Results show that among program participating companies few platform-based organizations offer blockchain-based solutions for secured and reliable data sharing and collaborations among the business firms. During the analysis, we found blockchain is the most influential technology in terms of building business to business digital trust. The data shared through blockchain is secured by emplacing encryption methods and is immutable which can be tracked by relevant entities at any given time. The immutability, encryption and

trackability of the transactions in blockchain technologies raise the level of trust in technologies as well as promote trust among the collaborating parties (Shahzad, 2020). For example, one of the program participant organization utilizes blockchain for creating inter-organizational trust by emphasising on secure and smart contracting, which allow organizations to collaborate with other organizations without explicitly revealing their identity.

Further, we also find evidence on IoT utilization in trust-building mechanisms among the businesses based by analyzing the Digital Finland Trust participant firm. We found participant firms offer IoT technologies based solutions for firms to monitor, track progress, control and make an informed decision about their business processes and operations based on the real time data provided by such technologies (Sicari et al., 2015). IoT technologies ability to enable real time monitoring of business processes and operations to increase transparency in inter-firms' transactions, which in turn increase the level of trust among interacting firms (Chai et al, 2020; Hafeez, 2021).

Furthermore, results also indicate that role of 5G/ 6G communication technologies and AI will grow exponentially as the former technologies support information communication systems in fast and reliable data communication, whereas, later has greater implications and applications for firms to make an informed decision based on computations on a large set of data (Akerkar, 2019). Therefore, we propose that:

P2. Utilizing digital technologies enhances digital trust among business ecosystem actors and facilitate trustworthy collaboration

Based on this discussion, we propose the following conceptual framework which elaborates the varying roles of digital technologies, digital infrastructure and critical communication technologies in building digital trust among business ecosystem actors.

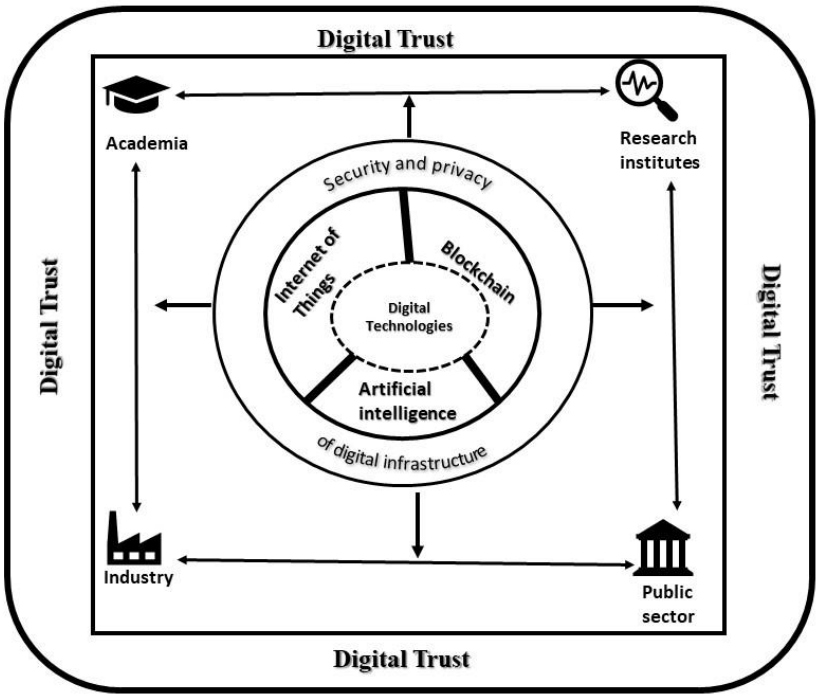


*Figure 1. The conceptual framework for creating digital trust in infrastructure and ecosystem collaboration*

**Managerial implications**

Our conceptual framework and research propositions have several managerial implications. Firstly, companies should actively participate in the discussions around digitalization and digital transformation related initiatives to enhance their awareness of the industry's best practices, digital infrastructure and its potential application in their business setting. Secondly, managers must interact with platform-based companies in order to understand their business needs in terms of technological applications. Such kind of managerial interactions and participation will help them to build trust in digital technologies. Thirdly, managers who aim to adopt a disruptive technology need to understand their business needs first hand and develop a business case around them. Fourthly, firms that are involved in ecosystem collaborations should integrate digital technologies for example blockchain which ensures trust, immutability, security, privacy and traceability. Such disruptive technologies help different organizations in an ecosystem to create mutual trust which in turn facilitate collaboration.

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