Investigating the influence of organizational factors on blockchain adoption

An innovation theory perspective

Trevor Clohessy
Department of Enterprise and Technology, Galway-Mayo Institute of Technology, Galway, Ireland, and
Thomas Acton
School of Business and Economics, National University of Ireland Galway, Galway, Ireland

Received 28 August 2018
Revised 8 April 2019
Accepted 23 May 2019

Abstract

Purpose – Blockchain possesses the potential to disrupt and reshape a plethora of industries in the next decade. However, blockchain adoption rates in technology developed countries, such as Ireland, are relatively low. Motivated by blockchain's potential to transform sociotechnical systems, the lack of systematic inquiry pertaining to blockchain studies from an information system perspective, the authors propose the following research question: "How do organizational factors influence blockchain adoption in organizations based in a developed country?" Specifically, the purpose of this paper is to elucidate the impact of organizational factors on the adoption of blockchain and the adoption of blockchain in companies based in Ireland.

Design/methodology/approach – A comprehensive literature review was conducted, and the methods of qualitative content analysis were used to identify the most important technology–organization–environment (TOE) blockchain adoption factors. Organizational factors are often viewed as the most significant determinants of IT innovation adoption in organizations. Consequently, using a multiple-case study of 20 companies based in Ireland, the authors investigate how the top three organizational factors identified from the blockchain literature affected these companies decision to adopt or not adopt blockchain.

Findings – The literature review on blockchain adoption identified specific technological, organizational and environmental factors. Furthermore, the case study findings identified three patterns: top management support and organizational readiness are enablers for blockchain adoption, and large companies are more likely to adopt blockchain than small to medium-sized enterprises (SMEs). The authors explain these patterns by examining the nature of blockchain and the characteristics of Ireland as a developed country. Practical and scientific contributions are also presented.

Research limitations/implications – This study makes several important scientific contributions. First, the findings revealed that top management support and organizational readiness are significant enablers of blockchain adoption. Ireland is recognized as a technology developed country; however, the findings in relation to top management support contradict existing IT adoption literature pertaining to developed countries. Second, previous IT innovation adoption literature suggests that organizations size has a positive influence on a company's IT innovation adoption process. This study demonstrates that large organizations are more likely to not only adopt blockchain but are also more likely to conduct increased levels of blockchain research and development activities. Finally, and most significantly, the authors identified several patterns, which relate specifically to Ireland as a developed country that influenced the findings. These findings could hold particular relevance to governments and organizations of other developed countries in terms of accelerating blockchain adoption.

Practical implications – The findings about the low level of blockchain awareness and the lack of information pertaining to viable business use cases indicate that the Irish government could play a more significant role in promoting the benefits of blockchain technologies. Further, the findings could also encourage IT providers to formulate enhanced strategies aimed at disseminating information pertaining to blockchain technologies. Second, the positive influence of top management support and organizational readiness, particularly about core competencies, on blockchain adoption suggests that equipping managers with the requisite knowledge and skills will be crucial in adopting these IT innovations. Finally, organizations who adopted blockchain used cloud-based blockchain platforms and tools to overcome the constraints of their initial low levels of organizational readiness.

Industrial Management & Data Systems
Vol. 119 No. 7, 2019
pp. 1457-1491

0263-5577
DOI 10.1108/IMDS-08-2018-0365

Originality/value – This is one of the first studies to identify specific TOE blockchain adoption factors. Further, the authors examine how the three most identified organizational adoption factors impact organizations decisions to adopt blockchain. Finally, the authors discuss how the resulting three patterns identified by examining the nature of blockchain and the characteristics of Ireland as a technology developed country.

Keywords IT adoption, Blockchain, IT Innovation,
Technological–Environmental–Organizational (TOE) Framework

Paper type Research paper

1. Introduction

> Blockchain enables you to do something that you have not done before. Therefore, the fundamental question for your business prior to adoption should be: what problem are you trying to solve which can only be solved by blockchain? (A16)

The emergence of blockchain as a trend in the information technology (IT) sector has attracted considerable attention from practitioners, academics, researchers and national development authorities. Blockchain, as it is used today, "is a tamper-resistant database of transactions consistent across a large number of nodes and is cryptographically secured against retrospective manipulations, and it uses a consensus mechanism to keep the database consistent whenever new transactions need to be validated" (Beck, 2018). Blockchain was introduced in October 2008 as part of a proposal for bitcoin by Satoshi Nakamato, a virtual currency system, that "eschewed a central authority for issuing currency, transferring ownership, and confirming transactions" (Lansiti and Lakhani, 2017). Bitcoin is viewed as the first application of blockchain technology. Blockchain is not a disruptive technology; it is a foundational technology, which possesses "the capacity to create new foundations for our economic and social systems" (Lansiti and Lakhani, 2017). Modern applications of blockchain range from low novelty and complexity initiatives (e.g. bitcoin payments) to high novelty and complex initiatives (e.g. self-executing contracts). There are also nuanced mature blockchain supply chain tracking initiatives. For instance, in the diamond industry off-the-shelf blockchain technologies can be acquired to trace gems along the supply chain from origin to the customer. Furthermore, blockchain is being used in the music industry where databases containing information pertaining to music rights ownership are being stored in public ledgers. Future transformational applications will encompass large-scale public identification systems (e.g. passport control) and machine learning-based decision making (e.g. money laundering). Large global financial institutions such as NasDaq, Bank of America, JP Morgan, the New York Stock Exchange, Fidelity Investments are currently conducting private blockchain research and development initiatives. These initiatives encompass the trialing of digital currencies (e.g. interbank transfers), and the replacement of manual and paper-based transactions (e.g. foreign exchanges). Blockchain technology can provide its adopters with strategic and operational advantages which include enhanced security, cost savings, immutability, faster transactions, transparency and pseudonymity (Lansiti and Lakhani, 2017; Tapscott and Tapscott, 2016).

Several reports have predicted that these advantages may be especially promising for developed countries (Espinel, 2015; Cuomo *et al.*, 2016; Pisa and Juden, 2017). For the purposes of this study, a developed country represents a sovereign state categorized as having a highly developed economy and advanced IT infrastructure relative to other less industrialized countries. In 2018 the global blockchain technology market is predicted to reach $548m in size and is forecast to grow to $2.3bn dollars by 2021 (Mehta and Striapunia, 2017). However, although the global blockchain adoption rate is increasing gradually, as reported by IT analysts such as McKinsey (2017) and Accenture (Treat *et al.*, 2017) and multinational technology company IBM (Bear *et al.*, 2016), in developed countries such as

Ireland, the UK and the USA, the adoption rates appear to be rather low. Reasons which are used to explain the low rate of adoption of blockchain in Ireland are, among others, organizational and technology readiness (Beck, Becker, Lindman and Rossi, 2017) and lack of blockchain awareness (Fitzpatrick *et al.*, 2017). For example, a study conducted by PWC of 1,300 Irish business leaders reports that 14 percent of Irish survey respondents claimed that they are either very or extremely familiar with blockchain, compared to 24 percent globally. Further, the survey highlights how 45 percent of Irish business leaders say blockchain is not part of their strategic plans and 23 percent of respondents are either in the early stages of evaluating the technology or experimenting with it compared to 30 percent globally (Fitzpatrick *et al.*, 2017).

To investigate the low rate of adoption of blockchain in Ireland, we operationalized innovation theory, which has been extensively used to examine technology innovation adoption in organizational studies (Rogers, 1995; Yu and Hang, 2010; Van de Weerd *et al.*, 2016). IT innovation can be defined as the application of a new IT by an organization, individual or unit (Swanson, 2004). According to Wang (2009), one question that is central to research on IT innovation is "Why do some information technologies come to be applied widely among organizations, while others do not?" Information systems (IS) researchers have studied IT as organizational innovations and have identified various, organizational, technological and environmental factors which contribute to an organization's decision to adopt or not adopt an IT innovation. A framework that is often used to investigate the intention of an organization to adopt an IT innovation is the technology–organization–environment (TOE) framework (Tornatzky and Fleischer, 1990).

The adoption of a IT innovation can result in significant transformation to an organization's internal and external operations (Wang, 2009; Kaganer *et al.*, 2010). Consequently, organizations should thread carefully when deciding to adopt such innovations. As a result, a large body of research has focused on specific organizational factors that impact company's decisions concerning IT innovation adoption (Wang, 2009). Organizational factors that are considered significant determinants of IT innovation adoption include organizational readiness, top management support, innovativeness, organizational size, culture, prior IT experience and business model readiness (Damanpour, 1991; Law and Ngai, 2007; Jang, 2010; Yang *et al.*, 2015).

Blockchain is frequently referred to as one of the primary IT innovations that possesses the potential to disrupt and reshape a plethora of industries (e.g. insurance, financial, legal, sharing economy etc.) in the next decade (Tapscott and Tapscott, 2016; Puschmann and Alt, 2016). Motivated by blockchain's potential to transform sociotechnical systems, the lack of systematic inquiry pertaining to blockchain studies from an IS perspective and the theories presented earlier, we propose the following research question:

RQ1. How do organizational factors influence blockchain adoption in organizations based in a developed country?

Specifically, this study elucidates the impact of organizational factors on the adoption of blockchain and the adoption of blockchain in companies based in Ireland.

The paper proceeds as follows. The next section discusses the determinants of blockchain adoption. The research method is presented next, followed by the data analysis and results. Next, we discuss our research findings. The study concludes with discussion of contributions of the study from the research and practice perspectives.

2. Blockchain adoption

2.1 Blockchain definition and characteristics

IT innovations are now part of the popular business lexicon. Given the significant impact of IT innovations on organizations, IT innovation adoption has regularly been put under the

spotlight over the past decades. There is a wealth of research demonstrating how IT innovations can influence every facet of a company and can lead to enhanced innovation, growth, performance, profitability efficiency and productivity (Barrett *et al.*, 2015; Plewa *et al.*, 2012; Christensen *et al.*, 2015).

For this study, we define blockchain as an open-source data set, distributed across millions of computers, utilizing avant-garde cryptography (Tapscott and Tapscott 2016). Each block in the chain is an acknowledgment by network participants that the transaction took place and was not fraudulent. Each block contains information from the previous block, thus ordering chronologically, creating a chain of blocks (Nakamoto, 2008). Blockchain is anticipated to disrupt a multitude of industries in the next decade (Ito *et al.*, 2017; Li *et al.*, 2018). Blockchain provides adopters with advantages such as anonymity (Zyskind and Nathan, 2015); immutability (Pilkington, 2016); transparency (Kosba *et al.*, 2016); security (Mendling *et al.*, 2017) and fast transactions (Kiayias and Panagiotakos, 2016).

Case study research investigating blockchain technology should also consider and reflect on the unique characteristics of blockchain (Beck, Avital, Rossi, Thatcher, 2017). Table I provides an overview of the six unique characteristics that encapsulate blockchain technologies. These characteristics may not apply equally to all categories of blockchain applications. For instance, according to Treiblmaier (2019) private permissioned blockchains run by a private consortia of organizations encapsulates a type of closed ecosystem encompassing pre-defined membership with clearly defined governance structures that in some instances could be described as being centralized. In contrast, public permissioned blockchains such as Bitcoin and Ethereum encapsulate open-ecosystems that can be accessed

Characteristic	Definition	Positive	Negative
Access privileges: permissioned and permissionless	Both instances describe the level of public access to data. In public permissioned blockchains, there are no restrictions on reading data. Private permissionless blockchains restrict access to pre-defined users	Public: accessibility, and decentralized cooperation. Private: transaction performance, defined governance structures, innovation speed, data privacy, security and anonymity	Public: transaction performance, governance issues, data privacy, security and anonymity. Private: cost, censorship, regulation and trust
Immutability	Transactions cannot be altered/deleted once added to the blockchain	Traceability and business value	Inflexibility pertaining to the deletion/altering of data
Transparency	Blockchain facilitates read-only access to transactions and the inspection of smart contracts contents	Efficient and accurate record keeping	Data privacy
Programmability	Programmable blockchains such as Bitcoin and Ethereum use scripting languages to write digital smart contracts	The deterministic execution of smart contracts	Non-programmable blockchains and the complexity of coding real world contracts into blockchain smart contracts
Decentralized consensus	The elimination of a central authority/broker with innovative consensus protocols	Disintermediation and the creation of new power structures	Energy consumption, governance issues and security vulnerabilities
Distributed trust	Blockchain does not necessitate high confidence levels in single authorities	Trust-free systems	Elimination of personal relationships

Table I.
Blockchain characteristics

Sources: Treiblmaier (2019) and Clohessy *et al.* (2018)

by anybody. These aforementioned access privileges have consequences pertaining how the characteristics outlined in Table I manifest for blockchain applications. In addition, some of these characteristics are still being contested in the academic and practitioner literature (Ito *et al.*, 2017). There are also characteristics that we have not included such as the chronological time stamping of data and cryptography mechanics "since those are usually a means to an end" Treiblmaier (2019).

2.2 Determinants of blockchain adoption

According to Rogers (1995), an innovation is "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (p. 11). Whereas innovation can allude to something abstract, like an idea, it can also manifest through new technology. An organization's decision to adopt a IT innovation can be conceptualized as "a decision to make full use of an innovative IT as the best course of action available" (Rogers, 1995, p. 21).

Many theories in the IS field have been used to identify specific factors that significantly or insignificantly influence the adoption of IT innovations in enterprises. Examples include the TOE framework (Tornatzky and Fleischer, 1990), the perceived e-readiness model (Molla and Licker, 2005), the technology acceptance model (Venkatesh and Davis, 2000), assimilation theory (Armstrong and Sambamurthy, 1999) and theory of reasoned action (Karahanna *et al.*, 1999).

The main objective of the TOE framework (Tornatzky and Fleischer, 1990) is to identify technological, organizational and environmental views that influence the adoption of IT innovations in organizations. These views can provide barriers and incentives to IT adoption. The technological view encompasses technological factors such as complexity, relative advantage, privacy, security and compatibility that can affect existing IT systems in use or the new IT being considered for adoption (Rogers, 1995). The organizational view refers to the internal factors within an organization such as prior IT experience, innovativeness, top management support, organizational size, information intensity and organizational readiness (Weiner, 2009; Wang *et al.*, 2010). The environmental view encompasses factors which impact an organization's day-to-day business operations such as competitive and industry dynamics, government interactions, and regulation (Lippert and Govindarajulu,2006).

Table II delineates blockchain studies, which outline significant technological, organizational and environmental factors that influence blockchain adoption. Table II was created based on a comprehensive literature review (Kitchenham and Brereton, 2013). An effective literature review not only makes a significant contribution to cumulative culture but also "creates a firm foundation for advancing knowledge. It closes areas where a plethora of research exists and uncovers areas where research is needed" (Webster and Watson, 2002). Our motivation was to produce a well-rounded understanding of blockchain adoption, which is currently lacking in the IS field by carefully describing and then contrasting and comparing an array of sources on the topic (Heyvaert *et al.*, 2013). The first step in the analysis of the literature encompassed the sourcing of relevant research resources via scholarly databases and manual searches. To ensure the consistency and reliability of the search and data collection process, a three-stage literature mapping protocol was used as prescribed by Kitchenham and Brereton (2013) to search, select, appraise and validate the literature. This mapping protocol ensured that no relevant literature was overlooked which may have been categorized under different headings. This protocol also helped the researchers to define the boundaries in which the review was conducted (e.g. inclusion and exclusion criteria). For the initial Stage 1, a rigorous search of seven prominent databases was conducted to produce a research resource set which was representative of the status of blockchain adoption research: EBSCOhost, JSTOR, ProQuest, Google Scholar, PubMed, Scopus and Web of Knowledge. We selected these specific

No.	Author	Technological factors	Organizational factors	Environmental factors
1	Wang *et al.* (2016)	Perceived benefits*, data security*, data integrity, complexity*, compatibility*, technology maturity*, uncertainty	Organizational size*, top management support*, organizational readiness*, responding capability	Regulatory environment*, industry pressure*, market dynamics*
2	Lansiti and Lakhani (2017)	Relative advantage*, cost savings, complexity*, accessibility, trialability, compatibility*	Technology readiness*, organizational size*, top management support*, value chain readiness	Competitive pressure*, relationship with partners, government policy, business use cases*
3	Guo and Liang (2016)	Cost, data security*, privacy, relative advantage*, business concerns*, compatibility*, complexity*, disintermediation*	Organizational readiness*, top management support*, blockchain knowledge, information intensity	Market dynamics*, government support*, regulatory environment*, industry standards*
4	Crosby *et al.* (2016)	Perceived benefits*, complexity*, relative advantage*, privacy, data security	Customer relationship, top management support*, organizational readiness*, organizational size*	Government support*, regulatory environment*, competitive pressure*, trading partner pressure*
5	Swan (2015)	Complexity*, relative advantage*, data security*, privacy, disintermediation*	Technology readiness*, organizational readiness*, business model readiness*, relative advantage	Regulatory environment*, public perception of the industry standards*, market dynamics, government support*
6	Shrier *et al.* (2016)	Complexity*, relative advantage*, perceived benefits*, legacy infrastructure, compatibility*	Organizational readiness*, organizational size*, top management support*, employee disruption	Regulatory environment*, governmental support*
7	O'Dair *et al.* (2016)	Relative advantage*, perceived benefits*, complexity*, compatibility*, data governance, disintermediation*	Blockchain knowledge, organizational size*, organizational readiness*, business model readiness	Emergence of use case examples, government regulation*, market dynamics, critical user mass*
8	Folkinshteyn and Lennon (2016)	Data security*, privacy, perceived benefits*, disintermediation*, cost savings, continuity of service	Organizational readiness*, customer relationship, size, top management support*	Market dynamics*, trading partner support*, regulatory environment*
9	Tapscott and Tapscott (2016)	Perceived benefits*, data security*, privacy, technology maturity*	Organizational readiness*, organizational size*, business model readiness*, blockchain knowledge*	Government support*, market standards, regulatory environment*
10	Mendling *et al.* (2017)	Data security*, latency, throughput, usability, hard forks, wasted resources	Organizational readiness*, organizational size*, governance, business models, top management support*	Regulatory environment*, market dynamics, competitive pressure*
11	Pilkington (2016)	Perceived benefits*, complexity*, technology maturity*, compatibility*,	Organizational size*, top management support, participation incentives*,	Competitive pressure*

Table II.
Significant blockchain TOE adoption factors

(*continued*)

No.	Author	Technological factors	Organizational factors	Environmental factors
		permissions (public vs private blockchains)*	innovativeness*, technological readiness*	
12	Morabito (2017)	Complexity, perceived benefits, compatibility*, maturity*, cost	Technological readiness, innovativeness*, value chain readiness*, top management support and involvement*, size	Regulatory environment*, government support, business use cases*, trading partner support*
14	Seebacher and Schüritz (2017)	Perceived benefits*, smart contract coding*, complexity	Technology responding capability, information intensity, organizational readiness*, value chain readiness*	Industry pressure*, business use cases*
15	Lindman *et al.*, (2017)	Complexity*, perceived benefits*, technology maturity*, compatibility, technology architecture*	Technology readiness*, Value chain readiness, business models, organizational readiness*	Regulatory environment*, market dynamics*
16	Chen *et al.*, (2018)	Perceived benefits*, complexity*, smart contract coding*, energy consumption	Top management support*, organizational readiness*	Market dynamics, governmental projects, Industry pressure*
17	Beck, Becker, Lindman and Rossi (2017)	Smart contract coding*, permissions*, security, architecture (centralized vs decentralized)*, privacy	Incentive structures, governance mechanisms, accountability decision rights (management vs control), business models*	Market dynamics*, regulatory environment*
18	Zamani and Giaglis (2018)	Security, perceived benefits*, smart contract coding*, complexity*	Value chain readiness, business models*, organizational readiness*, organizational size*, top management support*, innovativeness	Business use cases*, market standards, regulatory environment*
19	Woodside *et al.*, (2017)	Perceived benefits*, security, complexity*, privacy, compatibility, cost	Business models*, innovativeness*	Regulatory environment*, market dynamics*
20	Kokina *et al.* (2017)	Data security, smart contract coding*, perceived benefits*, scalability, permissions*	Incentive structures*, business models, quality assurance	Regulatory environment*, market standards

Note: *Factors found to be significant

Table II.

databases because of the multidisciplinary nature of blockchain research. Furthermore, these databases have been used by IS researchers as sources for other systematic literature reviews (Vom Brocke *et al.*, 2015). We used the search strings "blockchain" "adoption" "TOE" and "bitcoin" "adoption" "TOE." We included both theoretical and empirical studies and extracted significant factors that influenced blockchain adoption. Given the existing dearth of academic research pertaining to blockchain adoption, gray literature research resources (e.g. conference proceedings, research reports, issue papers, white papers) were also included. All research resources were imported directly into an EndNote database. Using EndNote's "find duplication" feature 70 duplicates were removed. The remaining research sources were further filtered. The selection processes encompassed a decision-making process to include or exclude relevant research papers from the data extraction process. For instance, in terms of exclusion criteria, Stages 2 and 3 resulted in the removal of research articles that were extraneous to the research question, further duplicates not

initially picked up by EndNote (e.g. surnames and first names misplaced), materials no longer accessible, questionable sources (e.g. credibility of resource could not be verified) and research sources where blockchain was only briefly mentioned and was not the main theme of the content. The final selection decision took place when the research sources were read in parallel with data extraction and quality assessment. Stage 3 search and selection took place in parallel with data and quality extraction from the research sources identified in Stages 1 and 2 and comprised three main tasks: search process validation, backwards snowballing and researcher consultation (Kitchenham and Brereton, 2013).

Next, the final 20 research articles were systematically full text reviewed and coded (Strauss and Corbin, 1998) to create Table III, which present an overview of salient blockchain adoption considerations. Following the recommendations of Ritchie *et al.* (2003), a multistage hierarchical data analysis approach was used comprising four analytical cycles that incorporated open and axial coding techniques based on the recommendations of Strauss and Corbin (1998). The hierarchical data analysis procedure used was an iterative process whereby as "categories are refined, dimensions clarified, and explanations are developed, there is a constant need to revisit the original or synthesized data to search for new clues, to check assumptions or to identify underlying factors" (Ritchie *et al.*, 2003, p. 213). The primary analytical cycle comprised a process of open coding which was used to identify codes from the research resource title, keywords, abstract and content. Open coding "involves analyzing the text (e.g. a sentence or paragraph) and summarizing this text by the use of a succinct code" (Myers, 2013, p. 107) and requires scrupulous familiarization and interrogation of the data. Due to the tentative nature of the codes and concepts that emerged during the initial stages of the open coding process, the researchers constantly compared the qualitative data for similarities and variations (Myers, 2013). As the analysis advanced, the codes and concepts became more conclusive and definitive. In the secondary analytical cycle, axial coding was used to reassemble the data that were fractured during the open coding phase by identifying causal conditions and relationships between the concepts and categories (Strauss and Corbin 1998). Axial categories and subcategories were developed through a coding paradigm of causal conditions, strategies, context or intervening conditions. This stage of the analysis also focused on intended and unintended consequences. The coding process continued until the categories were theoretically saturated (Strauss and Corbin, 1998). The tertiary analytical cycle encompassed a process of triangulation and peer debriefing. To confirm representativeness, once the coding was completed, the resulting themes (e.g. business model readiness, organizational readiness, technological readiness) were juxtaposed and triangulated in order to elucidate similarities and differences. Peer debriefing enabled us to use external groups as a soundboard for further validating the final set of themes which emerged

Technological factors		Organizational factors		Environmental factors	
Perceived benefits	13	Organizational readiness[a]	13	Regulatory environment[b]	15
Complexity	12	Top management support	9	Market dynamics[c]	11
Compatibility	8	Organizational size	9	Industry pressure[d]	5
Data security	6	Business model readiness	7	Government support	5
Smart contract coding	6	Technology readiness	3	Business use cases	4
Maturity	5	Innovativeness	3	Trading partner support	3
Relative advantage	4	Participation incentives	3	Critical user mass	1
Disintermediation	4	Blockchain knowledge	1		
Permissions (public vs private)	3				
Architecture	2				

Table III.
Summary of significant blockchain adoption factors

Notes: [a]Includes value chain readiness; [b]includes government regulation; [c]includes competitive pressure; [d]includes industry standards

from the analysis (Schwandt *et al.*, 2007). For instance, one of the outcomes of the peer debriefing was to place similar considerations under a common themed consideration (see Table III). Table II enabled us to extract specific variables that were found to be significant in at least one of the studies, denoted by*. This process enabled us to then create Table III, which provides a summary of the variables according to the number of times that were found to be significant.

As can be seen in Table III, three organizational factors emerged as being significant from the blockchain literature: organizational readiness ($N = 13$), top management support ($N = 9$), and organizational size ($N = 9$). Our findings support extant IT innovation adoption literature, which have identified how organizational factors such as top management support, firm size, prior IT experience, innovativeness and organizational readiness are often viewed as the most significant determinants of IT innovation adoption in enterprises (Kimberly and Evanisko, 1981; Tornatzky and Fleischer, 1990; Damanpour, 1991). These organizational factors have also been widely examined to ascertain the degree to which they constrain or act as a catalyst for the adoption of IT (Grandon and Pearson, 2004; Van de Weerd *et al.*, 2016). Given the dearth of empirical research into the organizational factors in a blockchain IT innovation adoption context, we have intentionally narrowed the scope of the study whereby we have focused only on the top three organizational factors, which emerged from the literature (Table III). We now provide further information in the following section on these three specific factors. For each factor, we discuss the existing literature from general innovation adoption and blockchain perspectives and provide a definition that we used in our research.

2.2.1 Top management support. Top management support has been identified as a key recurrent factor critical to the adoption of IT innovations (Sabherwal *et al.*, 2006; Bajaj, 2000; Dong *et al.*, 2009; Kulkarni *et al.*, 2017). According to Jarvenpaa and Ives (1990), "few nostrums have been prescribed so religiously and ignored as regularly as top management support in the development and implementation of IT." For this study, we define top management support as "managerial beliefs about technological initiatives, participation in those initiatives, and the extent to which top management advocates technological advancement" (Kulkarni *et al.*, 2017). High levels of top management support for a specific IT innovation ensure the long-term vision, commitment and optimal management of resources, creation of a favorable organizational climate, support in overcoming barriers and resistance to change (Wang *et al.*, 2010; Gangwar *et al.*, 2015). In the context of blockchain adoption, top management support plays an important role because blockchain adoption may involve new regulatory requirements, a high degree of complexity, the acquisition of new resources, the integration of resources, the re-engineering of business-to-consumer and business-to-business transactions and information exchanges and the development of new skills and competencies (Swan, 2015; Pilkington, 2016; Lansiti and Lakhani, 2017).

2.2.2 Organizational readiness. Organizational readiness is conceptualized as the availability of specific organizational resources to adopt new IT innovations (Lacovou *et al.*, 1995; Weiner, 2009; Wang *et al.*, 2010). This conceptualization is frequently categorized under several headings, including human resources, financial and infrastructure facets. Human resources facets refer to the presence of employees with the requisite knowledge, skill and experience to adopt new IT innovations (Wang *et al.*, 2010). Next, financial facets refer to the allocated financial resources an organization commits to new IT innovations (Weiner, 2009). While certain research has focused on the financial resources from the perspective of a specific IT innovation (e.g. Lacovou *et al.*, 1995), in general, many studies have focused on financial resources from the perspective of any new IT innovation. Finally, infrastructure facets refer to existing IT platforms on which new IT innovations can be developed (Lacovou *et al.*, 1995). When organizational readiness for a new IT innovation is high, an organization's management and staff are more likely to initiate change, exhibit

greater effort and persistence, and engage in enhanced cooperative behavior (Weiner, 2009; Wang *et al.*, 2010). Consequently, this results in a more effective adoption of the new IT innovation. The exact influence of organizational readiness on the adoption of blockchain is currently unclear. While existing theoretical research suggests that organizational readiness has a significant influence on the adoption of blockchain (Swan, 2015; Wang *et al.*, 2016), there is currently a dearth of empirical studies that have confirmed that this is the case.

In line with Weiner (2009) and Wang *et al.* (2010), we define organizational readiness as the availability of employees with the requisite IT knowledge and skills; financial resources for adopting IT innovations (e.g. IT budget); and infrastructure on which blockchain applications can be built.

2.2.3 Organizational size. To categorize the size of each case company in our study, we enlisted the use of a quantitative measurement approach in line with the organizational size definition provided by the World Bank (Kushnir *et al.*, 2011). The number of employees in the organization determines this approach. For instance, micro enterprises are classified has being organizations with 1–9 employees; small enterprises, with 10–49 employees; medium enterprises; 50–249 employees and large organizations with ≥250 employees. For this study, we simplified the classifications as medium-sized enterprises (SMEs), with 1–249 employees (micro, small and medium enterprises) and large enterprises, with ≥ 250 employees. Many past studies suggest that an enterprises' willingness to adopt a new innovative IT is positively influenced by organizational size (Damanpour, 1992). The reasoning behind this is that large organizations possess more complex and diverse facilities which positively contribute to adoption (Lee and Xia, 2006). Micro enterprises and SMEs, on the other hand, are susceptible to many barriers which constrain their ability to adopt IT innovations such as resource poverty (e.g. lack of IS personnel and expertise) and small IT budgets (Thong and Yap, 1995). However, our research indicates that in the case of specific IT innovations, because of the characteristics of the technology and the flexibility and adaptability of micro enterprises and SMEs, the opposite has been found. For example, empirical studies have shown that SMEs were more suitable and more inclined to adopt cloud computing technologies (Carcary *et al.*, 2014; Van de Weerd *et al.*, 2016). While organizational size is considered an important predictor of blockchain adoption (Tapscott and Tapscott, 2016; Mendling *et al.*, 2017) further empirical research is necessary to establish a consistent relationship between organizational size and blockchain adoption.

2.3 Blockchain adoption in Ireland

The Bloomberg innovation index for 2018 ranked Ireland in 13th place. The index scores countries using seven criteria, including research and development spending, concentration of high-tech public companies and patent activity (Jamrisko and Liu, 2018). A report by the IDA (2017) has identified Blockchain as a strategic priority and commenced a number of initiatives to establish Ireland as a European center for financial technology (FinTech) and Blockchain development. Currently, much of the blockchain adoption is taking place in the FinTech services sector. For instance, Deloitte selected Dublin as a base for their EMEA blockchain lab. Additionally, the Blockchain Association of Ireland has pioneered a "Crypto Coast" program, which has established a network of blockchain and cryptocurrency companies along the east coast of Ireland. Furthermore, a report by the blockchain association of Ireland (Moeller and Schwerin, 2017) highlighted how Irish organizations are investigating the potential use of blockchain technology as a means of compliance with the general data protection regulation (GDPR). In 2017, there was a 41 percent increase in blockchain-related roles when compared to 2016 (Moran, 2018). These roles encompassed various employment opportunities including accounting, software development, data science, management consulting, business analysis and project management.

However, the majority of blockchain developments are taking place within a small network of organizations (IDA, 2017). Moreover, we have also highlighted the low levels of blockchain awareness in Ireland and how blockchain adoption in Ireland is stagnant (Fitzpatrick *et al.*, 2017).

3. Method

In this study, we followed a multiple-case study approach to investigate how organizational factors influence the adoption of blockchain in Irish organizations. Our research adopted an organizational perspective; that is, we focused our research on three organizational perspectives that were defined *a priori* (Eisenhardt, 1989), based on extant studies: top management support, organizational size and organizational readiness. As part of our case study protocol, we consistently compared our findings with existing theory. We then used this analysis to enhance our understanding of the adoption process and to elucidate why Irish companies adopt blockchain or not. Furthermore, this multiple-case design enabled direct replication across cases with contrasting situations that allowed us to draw more powerful analytical conclusions (Yin, 2014).

With our research method, our intention was to understand why the adoption of blockchain in Ireland is relatively low and to ascertain how the several organizational factors influenced company's adoption decision. Therefore, we used an exploratory case study to determine how or why a certain condition (the adoption or non-adoption of blockchain) came to be.

In the remainder of this section, we discuss our case selection process. We then present how we collected, processed and analyzed the data.

3.1 Case selection

All the cases in our research were located in Ireland. The country is of particular interest for the following reasons. First, Ireland has the typical characteristics of a developed country and particularly a developed country in the European Union region (Jamrisko and Liu, 2018). Consequently, the findings of this study may be relevant for similar developed countries.

We used our own networks to identify case companies. Cases were selected using literal and theoretical replication (Benbasat *et al.*, 1987; Yin, 2014). We used literal replication to corroborate cases with similar characteristics, thus enhancing the reliability and strength of our study (Yin, 2014). Theoretical replication predicts contrasting results for predictable reasons. For example, we were interested in organizations with sufficient organizational readiness and those with insufficient readiness or how SMEs and large organizations differ in their adoption of blockchain.

We used three variables organizational size, organizational readiness and top management support as well as an outcome variable (adopt or not adopt) as conditions to determine the types covered by our theoretical replication. We identified the types based on the size condition (SME and large organizations) at the start of the study. The remaining types (organizations which adopted blockchain vs those that did not, organizations with sufficient top management support vs insufficient management support and, organizations with sufficient vs insufficient organizational readiness) were delineated after the interview process and the initial data analysis stage. Cases were added to the study following the initial analyses in stances where there were not at least two individual cases in each subgroup that complemented the theoretical contributions across the groups with literal replication within each group.

We sent a letter of permission to a total of 50 companies, of which 20 agreed to be participants in our study. Four interviewees were interviewed twice, namely A2, A4, A15 and A19. Of these 20 companies, 8 had adopted blockchain and 12 had not or did not intend

to adopt blockchain in the next two years. Information relating to our case study companies is presented in Table IV. The cases are divided over different sectors (e.g. financial, IT, education, fishing, gaming, legal, marketing and mobile app development).

3.2 Data collection and interview process

Data collection took place between May and November 2017. Most of the interviews ($n = 15$) were conducted in the case organization's offices and lasted between 60 and 120 min. The five remaining interviews were conducted via Skype. We selected interviewees who had a main role to play in IT adoption decisions within each organization. As can be seen from Table IV, the interviewees came from different management functions and included IT managers, company owners, researchers and directors. Thus, our study reflects a broad range of expertise and knowledge in blockchain. Prior to the interviews, each interviewee was emailed a research information sheet that provided a background to the study.

No.	Industry	Existing blockchain applications	Employees	IT staff	Locations	Total assets	Position	Blockchain awareness
A1	IT	None	10	8	1	< €100,000	Owner	Basic
A2	Education	Identity authentication	16,000	30	1	€100,000 < $3m	IT manager	Medium
A3	IT	Supply chain monitoring	6,000*	276	348	< €20m	IT manager	High
A4	IT	Supply chain	244	26	2	€100,000 < $3m	IT Manager	Medium
A5	Education	None	2,439	20	1	€100,000 < $3m	IT manager	Basic
A6	IT	Supply chain	2,600*	1,240	425	< €20m	IT manager	High
A7	Gaming	None	750	10	165	< €20m	IT manager	High
A8	Mobile app development	Crypto payment applications	20	16	1	€100,000 < $3m	CEO	High
A9	IT	Identity management	8	3	1	< €100,000	Owner	High
A10	Legal	None	600	17	4	< €20m	FinTech researcher	Medium
A11	Financial	None	2,500*	55	7	< €20m	IT director	Medium
A12	Financial	None	210	8	3	€100,000 < $3m	IT manager	Basic
A13	IT	None	12	7	1	€100,000 < $3m	CEO	Basic
A14	Marketing	None	15	2	1	< €100,000	Owner	Basic
A15	IT	Multiple	3,000*	2,130	3	< €20m	IT manager	High
A16	Fishing	None	7	2	1	€100,000 < $3m	CEO	Medium
A17	IT	None	6	4	1	< €100,000	Owner	Medium
A18	IT	None	344	23	3	< €20m	CIO	High
A19	Financial	Multiple	9,546	367	220	< €20m	CIO	High
A20	Financial	None	1,423	210	1	< €20m	FinTech researcher	High

Table IV.
Summary of case organizations

To ensure that we obtained all the required information from our interviewees we used semi-structured interviews as our primary data collection method (Pare, 2004; Yin, 2014). We used an interview guide, which evolved during the interviewing process. The initial research questions contained within the interview guide were refined following a number of pilot tests involving a similar cohort to the interviewees selected for the main study. We also used senior researchers and academics as a soundboard to identify flaws, limitations and other weaknesses contained within our interview guide.

We complemented our interviews with field notes and documentation (e.g. annual reports, corporate websites, white papers etc.) which we obtained online. Prior to commencing the interviewing sessions, we introduced ourselves and provided an additional backdrop to the study explaining the purpose of our research. Questions were then administered via the study interview guide. The interview topics included the case organizations background, the interviewee's awareness of blockchain and the impact of the three organizational factors on blockchain. For example, the following examples illustrate a sample set of questions that were asked concerning top management support:

> What are your and senior management's perceptions of blockchain?
>
> Have you or do you plan to adopt blockchain. If yes, can you discuss why and how you adopted the technology?
>
> Have you encountered any blockchain negativity from senior management within your organization?
>
> Can you provide examples of various resources that you or senior management have made available with respect to blockchain adoption?

Additionally, in order to clarify the interviewee's awareness of blockchain, the interviewer asked if the interviewee had ever heard of blockchain and, if so, could they explain what blockchain was. The interviewer then provided our definition of blockchain (see Section 2) and provided several examples of blockchain in business and personal settings. Once there was an agreed understanding of blockchain for the interview, the interviewer proceeded with the remaining questions.

In line with the study's confidentiality policy, all interviewees were ensured that they and their case organizations would be referred to pseudonymously in the study. Consequently, the identifiers A1–A20 represent the interviewees. All interviews were audio recorded with the express consent of the interviewees. The interviews were then transcribed and sent to the interviewees for feedback and approval.

3.3 Data processing and analysis

To assist with the data analysis, we developed six codes to organize the data: blockchain awareness, organizational readiness, organizational size, top management support, developed country and blockchain adoption and use. We used NVivo 11 to code our interviews across these six themes. Table V highlights our coding scheme and provides a detailed description and an example of each code.

We analyzed the data in four iterations. To make sense of and structure, the initial data we commenced with a within-case analysis of each of the individual cases. Each case was analyzed separately in terms of the three organizational variables and outcome variable by using the interview transcripts, field notes and online documentation. Additionally, we analyzed the data for evidence related to blockchain awareness level, blockchain adoption and use and matters that are typical for developed countries.

Using an informal qualitative comparative analysis (QCA) technique, the results of the within case analysis were processed, and cross-case comparisons made. QCA, a method which originated in management research, was primarily developed "to solve a fundamental

Code	Description	Example
Blockchain awareness level	Contains a definition and collection of interviewee responses regarding their awareness level	"Yes, I have been aware of blockchain for the past four years […] It is a database which allows different identities to share information in a secure manner." (A8)
Top management support	Contains a collection of interviewee responses pertaining to how top management make decisions on the adoption or rejection of blockchain	"Unfortunately, management are unable to see the value that blockchain can bring to the company and as a result we do not have plans to adopt any specific implementations soon. The core issue is the lack of business use cases." (A10)
Organizational readiness	Contains a collection of interviewee responses relating to the impact of the availability of the required organizational resources (financial, IT expertise, and IT infrastructure) in triggering the adoption or rejection of blockchain	"We are currently implementing instances of blockchain along our supply chain […] however we are finding it difficult to get our SME supply chain partners to implement our flagship blockchain authentication service […] they are struggling to see how blockchain sits with within their IT innovation strategies." (A3)
Organizational size	Contains a collection of interviewee responses pertaining to the size of the organization or its IT unit and how this influences its adoption decision	"Our IT department is quite large. We have created a new department which is focused entirely on blockchain research and development." (A6)
Blockchain adoption and use	Contains a collection of responses relating to the (non-) adoption or use of blockchain applications	"We created a blockchain product on IBM's hyperledger platform." (A9)
Developed country	Contains a collection of interviewee responses regarding matters that are typical for developed countries (in relation to blockchain adoption)	"The Irish government have yet to offer their voice on blockchain technologies. Until they do, smaller companies like ourselves will be reluctant to enter the playing field." (A1)

Table V.
Coding scheme

problem presented by cross-case analyses: preserving the integrity of cases as complex permutations of causal factors while concurrently allowing for the systematic examination of similarities and differences in causal factors across many cases" (Greckhamer *et al.*, 2008). These permutations are a specific set of factors (in this study, organizational variables) that produce a given outcome of interest (in this study, the adoption of blockchain). In the field of IS, QCA has been used for exploring permutations of factors that explain service innovations (Ordanini *et al.*, 2014) and has, for example, been used to explain IT innovation outcomes (Fichman, 2004). Next, we carried out a cross-case analysis using the QCA results as a basis for identifying varying permutations that led to either the adoption of non-adoption of blockchain. The goal of this phase of data analysis was to find similarities across our 20 cases, which would allow us to draw conclusions based on the impact of our three organizational variables (Yin, 2014).

3.4 Validity

The quality of empirical case study research designs can be judged according to four logical tests: construct validity, external validity, internal validity and reliability. To ensure construct validity we, first, used multiple sources of evidence (online documentation, field notes and interview transcripts, second, summarized the interview reports for each case and elicited feedback and approval from the interviewees and, third, established a chain of evidence. External validity establishes the domain to which a study's findings can be generalized. The steps we took to ensure this category of validity were that we used a multiple-case study design in which we used a replication logic to ensure the generalizability

of our findings. An explanation-building analytic technique was used to ensure internal validity. Internal validity establishes a causal relationship. Finally, we ensured the reliability of our research by using a case study protocol and a case study database which ensures that the main operations of the study such as the data collection procedures can be repeated (Miles *et al.*, 2013; Yin, 2014).

4. Results

We present our findings in three sections. First, we elucidate on the results of our within-case analysis. Next, we elaborate on our QCA to demonstrate how the various cases scored on the three organizational variables in relation to the outcome variable, blockchain adoption. Finally, we present our across-case analysis, where we discuss the patterns we identified. These are patterns are supported by interview quotes to reveal additional information about the respondents' perceptions regarding these variables.

4.1 Within-case analysis

The within-case analysis necessitated a thorough analysis of each individual case based on the outcome variable (adoption or non-adoption of blockchain) and the three organizational variables. We also analyzed other case details, such as awareness of blockchain and any other characteristics which manifested. The analysis of the three organizational variables consisted of two segments: first, we investigated various methods that allowed us to allocate a value to each of the variables. For organizational size, this was straightforward: This specific variable was sourced from the respondents' interviews or from the case organizations websites or annual reports. Similarly, the assessment of the outcome variable (adoption or non-adoption of blockchain) was also determined based on the data elicited from the respondents. However, organizational readiness and top management support were more challenging to determine. Concerning top management support, this variable was determined based on how each of the interviewees viewed the perception of this variable within their organization. For example, the interviewee in A6 described how the development of brand new research and development facility dedicated solely for the blockchain projects was clear evidence of the company's top-level management support. For organizational readiness, we investigated three specific concepts: human resources, financial resources and IT infrastructure. Our analysis of the interviews and the supplementary documentation enabled us to determine if these conditions were present or not. For instance, the interviewee in A1 elaborated how they had insufficient financial resources, no employees with the necessary skills and experience and insufficient IT infrastructure to develop blockchain technologies:

> Being a start-up organization, my budget is quite restrictive in term of IT expenditure. I have one senior IT manager and three interns who work on a part-time basis who do not possess the requisite blockchain competencies. We have carried out an inventory of the infrastructure that we would need for blockchain development and unfortunately I cannot justify a budget for researching the potential of blockchain for our company. (A1)

4.2 Qualitative comparative analysis

Using a QCA approach, which in line with Rihoux and Ragin (2009), we present Table VI and Table VII that provide overviews of how the case organizations were categorized according to top management support, organizational readiness, organizational size and the outcome variable, blockchain adoption. First, we categorized each variable with either a 1 which indicated that a given condition was present or a 0 indicating that a given condition was absent. We coded large organizations with a 1 and SMEs with a 0 given large organizations are more likely to adopt an IT innovation (Joo and Kim, 2004; Anderson *et al.*, 2014).

Case	Organizational size	Organizational readiness	Top management support	Blockchain adoption
A1	0	0	0	0
A2	1	1	1	1
A3	1	1	1	1
A4	0	1	1	1
A5	1	0	0	0
A6	1	1	1	1
A7	1	0	0	0
A8	0	1	1	1
A9	0	1	1	1
A10	1	0	0	0
A11	1	0	0	0
A12	0	0	0	0
A13	0	0	0	0
A14	0	0	0	0
A15	1	1	1	1
A16	0	0	0	0
A17	0	0	0	0
A18	1	0	0	0
A19	1	1	1	1
A20	1	0	0	0

Table VI.
Case organization data set

Permutation	Organizational size	Organizational readiness	Top management support	Blockchain adopted	Blockchain not adopted
A: 000	0	0	0		6
B: 001	0	0	1		
C: 010	0	1	0		
D: 011	0	1	1	3	
E: 100	1	0	0		6
F: 101	1	0	1		
G: 110	1	1	0		
H: 111	1	1	1	5	

Table VII.
Case permutation data set summary

We adopted the same procedure for the other two variables top management support and organizational readiness. The data from the within-case analysis were used to assign values to the three variables, as illustrated in Table VI.

Table VI provides a summary of our case organization data set. This data set enabled us to create Table VII which illustrates eight possible permutations of the three organizational variables which influenced an organization's decision adoption of blockchain. Four of these permutations were found in our data set, specifically A, D, E and H. Interestingly, the permutations that lead to blockchain adoption was permutation D, containing SMEs with sufficient organizational readiness and top management support, and permutation H, comprising large organizations with sufficient organizational readiness and top management support. Permutations A and E did not lead to blockchain adoption. Four permutations were not identified in our study, namely permutation B (SMEs with sufficient management support that have adopted blockchain), permutation C (SMEs with sufficient organizational readiness that have adopted blockchain), F (large organizations with sufficient top management support that have adopted blockchain) and permutation G (large organizations with sufficient organization readiness but lacking top management support that have adopted blockchain).

In addition to Table VII, we created Figure 1 that illustrates a set-theoretical representation of our case organization data set. Case organizations that adopted blockchain are marked in gray. SMEs who did not have sufficient organizational readiness, top management support and who did not adopt blockchain are situated outside of the three circles. As can be seen from this representation, five large organizations and three SMEs with sufficient top management support and organizational readiness adopted blockchain. Consequently, our data suggest that sufficient top management support and organizational readiness represent the strongest predictors for the adoption of blockchain. Additionally, most large organizations except for A2, A3, A6, A15 and A19, did not adopt blockchain.

4.3 Across-case analysis

Table VIII provides a summary of our findings with regards to how the selected three organizational factors cumulatively determined the rationale for both large organization's and SME's decisions to adopt blockchain or not to adopt blockchain. This table also outlines the type of blockchain applications deployed. Consequently, in this section, we present our findings in relation to the interviews and discuss the common indicators that help us explain the impact of organizational variables on the adoption of blockchain. First, we present an overview of the blockchain awareness of the study's interviewees. Next, we delineate our findings in relation to the three variables: organizational readiness, organizational size and top management support. We conclude with an overview of our findings in relation to Ireland as a developed country.

4.3.1 Blockchain awareness level. The main themes emanating from the blockchain definitions provided by the interviewees revolved around immutable and distributed ledgers, trust, reduced costs, increased speed, reduced fraud and risk, and increased security and traceability. We created the following three categories of groups to classify the blockchain awareness of our interviewees: first, basic level – the interviewee has heard about blockchain technology but is unable to adequately describe the concept; second, medium level – the interviewee has heard about blockchain technology and is able to give an accurate description of blockchain; and third, high level – the interviewee is able to give a correct description of blockchain technology and can provide real world examples of blockchain applications.

We identified that 5 out of the 20 interviewees had only a basic level of blockchain awareness. Six of the interviewees had a medium level awareness of blockchain. Only nine

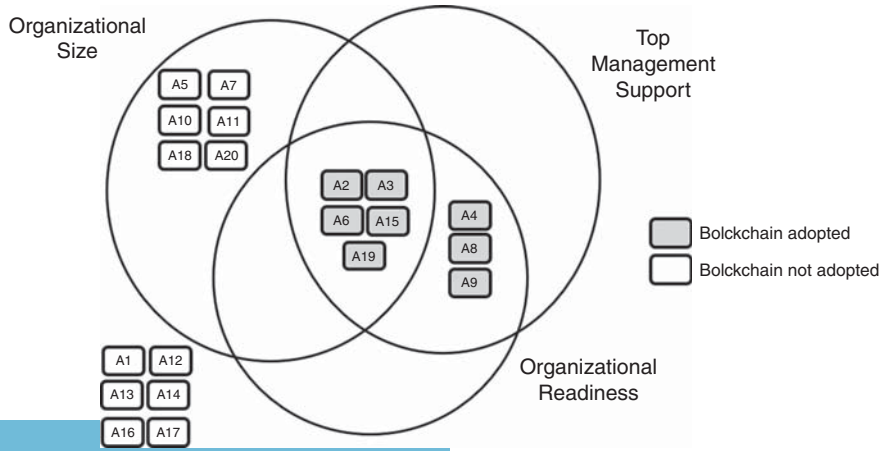

Figure 1.
Set-theoretical representation of case organizations

Organization	Adopted – deployment and rationale	Non-adopting rationale
Large	Multiple instances of fully deployed and functional blockchain applications Private permissioned blockchains Initial blockchain prototyping to create business use cases Availability of cloud-based blockchain development tools Supply chain transaction innovation cost reduction enhanced security enhanced transparency enhanced efficiency	Lack of internal IT adoption coordination Blockchain technological complexity Lack of specific industry business cases and standards Lack of government incentives Lack of blockchain top management awareness Lack of internal staff with requisite blockchain skills and competencies Lack of supply chain organizational buy in
SMEs	Single instance of a fully deployed and functional blockchain application Public permissioned blockchains Provision of new innovative services Availability of cloud-based blockchain development tools Availability of publicly available business use cases	Lack of blockchain awareness Lack of specific industry business cases Challenges sourcing employees with requisite blockchain skills and competencies Challenges sourcing blockchain educational resources

Table VIII. Summary of main blockchain organizational adoption considerations

interviewees were able to demonstrate that they had a high level of blockchain awareness. In other words, most of our interviewees had heard of blockchain technology but were unable to provide a correct description and provide actual examples of real world blockchain applications. Most interviewees who were classified as having a basic to medium level of blockchain awareness ($n = 11$) described blockchain as being applicable only to the FinTech industry which is not entirely in line with the definition of blockchain used in this study. Below is a sample of the interviewee's responses:

> The word that comes to mind with blockchain is security which is associated with identity and the management of financial activities along the supply chain. (A1)

> Blockchain are distributed digital transaction ledgers where you can record and verify transactions in a secure peer to peer environment. (A3)

> Blockchain enables financial organizations to comply with financial regulatory requirements in real time. (A14)

4.3.2 Top Management support. For the purposes of this study, top management support refers to a person or a group of people who make decisions or play a key role in influencing decisions, which result in an organization being able to adopt or not adopt blockchain. Take for example a CEO of a company who has made the decision that blockchain will underpin their new payments loyalty system. This CEO then makes the necessary organizational resources available to support the blockchain adoption process. Eight of the case organizations demonstrated satisfactory top management support for blockchain. Furthermore, these eight cases had adopted blockchain. It was evident that top management were able to recognize the benefits of blockchain technologies, as is evidenced in the following:

> We have been operationalising a number of blockchain strategic initiatives for the past two years. These initiatives were created by our CEO and board of directors who envision that blockchain is going to be vital for securing our enterprise cloud and supply chain services. All of future services will be underpinned by blockchain technology. (A3)

In other cases, top management support for blockchain grew gradually and was influenced by employees who were able to demonstrate real world value as is illustrated in the following:

> Management were initially reluctant to adopt blockchain despite the obvious benefits. This was until our senior engineers created an innovative blockchain prototype that could fundamentally restructure our supply chain. Consequently, management created a new department which was managed by a newly recruited CIO to spearhead the internal development of our private blockchain projects. (A4)

> Interest in blockchain technologies was first initiated by our software engineers who had an interest in cryptocurrencies. They developed multiple innovative proof of concept blockchain prototypes which were showcased to lower, middle and then upper management […] in that order […] gaining top management support was crucial but it was an evolutionary process […] these prototypes got them excited. (A6)

It was interesting to note that in the case of four organizations while there was interest among decision maker influencers for their organizations to pursue blockchain strategies, their enthusiasm was not reciprocated by top management:

> It is so important to get management awareness and buy-in even at a blockchain proof of concept stage. However, there is zero uptake of anything blockchain here now. Our senior managers and IT staff have little or no understanding of what blockchain is. It is such a pity as many of our American competitor are rolling out a number of loyalty programmes and grey/black market supply chain monitoring and authentication applications which are underpinned by blockchain technologies. (A7)

> If I'm to be blunt, most of our top managers here would have a very basic awareness of what blockchain is. It is still very early days for a lot of people in terms of understanding what it is and how they are going to use it […] there needs to be more practical use cases before our managers give the green light for adopting blockchain. (A11)

> There is no point having the only telephone in the world if no one else has one. Most of the blockchain innovation in Ireland is occurring in the Fintech industry that encompasses larger companies. Where is all of this going in terms of SMEs? A lot will become clearer in 3–5 years' time once business and market use cases become available. (A18)

Cumulatively, our findings indicate that top management support had a positive influence on the adoption of blockchain. It was interesting to note that several of the case interviewees were researching and developing possible blockchain applications/use cases, ether in their allocated innovation time slots or in their spare time, to influence senior management decisions.

4.3.3 Organizational size. In this section, we discuss how organizational size influences an organization's decision to adopt or not adopt blockchain. We categorized these organizations as SMEs or large. As illustrated in Table IV, 11 large organizations and 9 SMEs took part in our study. In total, 5 out of the 11 large organizations and 3 out of the 9 SMEs adopted blockchain. If we delve into the primary reasons that the five large organizations adopted blockchain, the intention to adopt was related to reduced costs, enhanced security, efficiency and transparency of transactions:

> We have been implementing instances of blockchain (e.g. bitcoin rewards, distributed ledgers) along our supply chain for the past two years. We have reaped numerous logistic advantages in terms of improved transaction flows, enhanced integral traceability and security. (A3)

> Blockchain enables the company to do to financial regulatory compliance in real time. This has manifested in significant cost savings for the company. We no longer need expensive consultants to retrospectively review our transactions. (A19)

The data revealed that these organizations have earmarked blockchain technologies as one of their top strategic IT budget priorities for the next three to five years. Interestingly, all the adopting large companies were using privately permissioned blockchain applications.

In contrast, all of the SME's were using public permissioned blockchains. The interviewees identified that the primary advantage of these private permissioned blockchains was tighter control and security mechanisms. For instance, interviewees A19 and A15 indicated that access privileges to modify or read the blockchain state of their applications is restricted to only a few authorized users:

> Our fully private blockchain technologies underpin various database and auditing functions within the company. The write permissions to these blockchain applications are centralized within the organization. (A15)

> There are public and private permission blockchains. We currently have blockchain applications to optimise back and middle office systems that can be categorised as the latter. Only a hand full of people have authorised access to these blockchains including the financial regulator, which serves to augment our security, reporting and regulatory, and compliance profile. Unfortunately, there is a myriad of issues (e.g. trust, cost, privacy) with public permission blockchains. Consequently, I do not envisage that we as a company will be using these public instances anytime soon. (A19)

All of the three SMEs indicated that the primary advantage of the public permissioned blockchains was the ease of accessibility, setup and access to information resources. In terms of two of the SMEs, the interviewees indicated that they were not aware of private permissioned blockchains and were eager to investigate further. The interviewee from the other SME had investigated the possibility of private permissioned blockchain but ruled it out as an option due to the complexity, cost and lack of business use cases for their industry.

For the non-adopting large organizations, issues relating to lack of top management support, lack of business use cases, lack of government incentives and blockchain's association with cryptocurrencies/initial coin offerings (ICOs) were cited by the interviewees as reasons for why their companies had not pursued blockchain technologies. These reasons will be visited in subsequent sections. One interviewee mentioned their inability to develop sustainable business models and one of the reasons for not adopting blockchain:

> Unfortunately, management are unable to see the value that blockchain can bring to the company and as a result we do not have plans to adopt any specific implementations soon. The core issue is that we have been unable to simulate sustainable revenue and business models for potential blockchain products and services. Yes, they can see the bottom line benefit of smart contracts but until there is real money to be made, we are not going to dedicate much time to investigating it any further. (A10)

Of the nine SMEs, our study identified that three adopted blockchain, but the other six did not. In comparison to the larger organizations who had adopted multiple instances of blockchain and who were actively trialing other applications, these SMEs had adopted single instances of blockchain applications. While the interviewees in these SMEs identified various reasons for adopting blockchain, there was a consensus that their organizations had primarily made the decision to adopt for the new innovative functionality that blockchain technology could provide, as evidenced by the following:

> For me blockchain is all about identity management and protection. Our blockchain product enables citizens to transform their physical identities into virtual ones that are wrapped around smart contracts. Blockchain will enable citizens to forge self-sovereign identities. (A9)

> […] we also created a secure cryptocurrency payment wallet, underpinned by blockchain technology, to enable our customers to pay us in bitcoin. We are only one of a handful of companies here in Ireland to do so. (A8)

Specific technological and business use case issues were outlined by interviewees from two non-adopting SMEs:

> We are looking at blockchain as a means of adding a further layer of security for protecting transactional data within our SaaS CRM. However, the only use cases for businesses our size are

> only to be found in large corporations. Our clients are still trying to get their heads around cloud computing. Blockchain is adding to the confusion and therefore we are resistant to make the move now. (A13)

> We have created a cloud-based data market platform where fish farmers can manage their farms and share data. We are interested in underpinning this platform with blockchain technologies to digitize farming stock such as oysters. The farmers will then have a transparent method of stock management. However, we will not adopt blockchain until (i) specific technological issues (e.g. scaling, tokenization, securitization) are resolved and (ii) smart contracts which are specific to the fishing industry have reached maturity. (A16)

Based on the findings presented here, we can conclude that organizational size is generally positively related to blockchain adoption. Considering the number of blockchain instances adopted and the prevalence of ongoing blockchain research and development activities, our data suggest that large enterprises are more likely to adopt blockchain than SMEs.

4.3.4 Organizational readiness. For the purposes of this study, organizational readiness with regards to adopting new IT innovations was examined in terms of three categories of organizational resources which encompassed the availability of employees with the requisite IT knowledge and skills; financial resources for adopting IT innovations (e.g. IT budget) and infrastructure on which blockchain applications can be built. According to existing research (Lacovou *et al.*, 1995; Wang *et al.*, 2010), the absence of one or more of these resources is likely to constrain an organization's ability to adopt an IT innovation. Examining the results of our QCA in conjunction to Figure 1, it can be observed that all organizations which adopted blockchain had sufficient organizational readiness.

In terms of financial and IT infrastructure resources, we noted that the availability and functionality of cloud-based blockchain development platforms were pivotal in triggering an organization's decision to adopt blockchain, as confirmed by the following interviewees, whose companies had adopted blockchain:

> As with any software development project, the cost depends on the use case and the inherent complexity. Furthermore, blockchain development and cloud computing go hand in hand. We currently use the IBM Bluemix platform for developing blockchain applications. Our motivation here is to keep our development cost base as low as possible. (A15)

> The emergence of cloud-based products such as Ethereum and Microsoft's Blockchain-as-a-service (BaaS) has meant that organizations can use a rapid and fail-fast platform for developing, testing and deploying blockchain applications on a free or pay-as-you-go basis. (A2)

> We are currently using IBM's cloud-based development platform Hyperledger to create my blockchain enabled identity management application. These cloud-based blockchain development platforms and tools have enabled SMEs such as mine to leverage blockchain in a cost-effective and innovative manner. (A9)

One interviewee mentioned the presence of hidden costs embedded within one specific cloud-based blockchain development platform that were beginning to frustrate his supervisors:

> From a business and development point of view blockchain is relatively inexpensive. However, there are hidden costs associated with blockchain. For instance, if you want to run an application against the blockchain there are processing costs. On the Ethereum platform you must pay a 'gas' rate to verify every transaction. (A4)

From our analysis of the organizations that adopted, it emerged that the core competencies required for blockchain are broader than the core technology and encompassed skill sets that fall under the following categories: first, foundational technology (e.g. cryptography, public key architecture); second, distributed ledger technology (e.g. mining, consensus algorithms); third, forensics and law enforcement (e.g. money laundering, darknet); fourth,

markets, economics and finance (e.g. game theory, business modeling); fifth, industrial design (e.g. supply chain, IoT) and, sixth, regulations and standards (e.g. smart contracts and frameworks). A2 and A15 were examples of two organizations that were familiar with the skills and knowledge required for blockchain:

> We have engineers who are experts in creating secure (e.g. cryptography, encryption) distributed network infrastructures. They are currently creating instances of private blockchains on a peer-to-peer network. Some organizations do not have this expertise and this type of development would prove onerous particularly for tricky aspects of private blockchain such as automatic peer discovery. (A2)

> From our experience, the upskilling involved for an expert software or database engineer is quite minimal. For instance, an individual with strong coding skills (e.g. C, Java, Python) and a good understanding of distributed storage (e.g. NoSQL, RDBMS) would need to acquaint themselves with the intricacies of smart contract and blockchain frameworks. Next, they would have to familiarize themselves with ledger and decentralised technologies. (A15)

However, in contrast to the responses above, we also found that non-adopting SMEs were struggling in terms of employee blockchain competencies:

> From my experience of seeking external competencies, there is a dearth of people here in Ireland who have an in-depth-knowledge and actual hands-on experience developing blockchain applications. Additionally, not everything is applicable for the blockchain. Therefore, it doesn't make sense for us from a commercial value standpoint to explore it further. (A14)

Finally, we observed that the presence of organizational readiness for the lead provision company in a supply chain does not always guarantee that other partners along their supply chain will also have equivalent levels of organizational readiness to adopt blockchain as evidenced by the following:

> We have all the requisite resources in place to develop and host our own proprietary blockchain services […] however we are struggling to get our SME supply chain partners to implement our flagship blockchain authentication service which can result in performance management, supply chain traceability, counterfeit, cyber and customer engagement benefits […] they are struggling to see how blockchain sits with within their IT innovation strategies (e.g. we are not a virtual currency business). (A3)

> We have been developing blockchain applications for the past 5 years. While we can see the value add, our business partners are struggling to also see it for their business. We are encountering a lot of resistance because of various misinformation regarding blockchain. It could be a few years more until we see widespread adoption. (A15)

Based on the arguments presented in this section, we conclude that the presence of sufficient organizational readiness in terms of the availability of financial and employee resources and access to IT infrastructure have a positive influence on a company's decision to adopt blockchain.

4.3.5 Adopting blockchain in a developed country. In the previous subsections, we presented our findings in relation to our *a priori* variables. However, during our analysis we found additional determinants of blockchain adoption that related to Ireland as a developed country.

There was consensus among the interviewees that Ireland as a country is quite proactive in terms of the current initiatives that are taking place nationwide which are aimed at enhancing blockchain awareness. Examples of such initiatives include regular blockchain meetups, the establishment of metagroups such as the Blockchain Association of Ireland and the IDA Blockchain Expert Group that is tasked with positioning Ireland as a leading European center for blockchain development. Technology providers such as Hewlett Packard, IBM, and Dell in conjunction with multinational professional service providers

such as Deloitte, EY and Accenture have established research and development hubs that focus primarily on blockchain research activities. Furthermore, these companies have developed specific internal blockchain applications, which they are currently piloting. However, we point out that most of the interviewees noted that the Irish government and the central bank must do more to promote the adoption of blockchain technologies. Indeed, the Irish government could make a global statement by adopting and rolling out blockchain technologies via specific governmental e-Services:

> In similar fashion to how the UK's cloud first policy was pivotal in accelerating the adoption of cloud technologies in the private and public sectors, the Irish government could signal their intent on a global scale by implementing a new form of public procurement infrastructure which is underpinned by blockchain. (A3)

> In order to put Ireland on the global blockchain map, we need a high profile, government backed national use case which is underpinned by blockchain technology in a similar vein to Dubai, Delaware and Hong Kong. For instance, the Irish government could roll out a universal national digital identity scheme using blockchain. However, most governmental officials are not even aware of blockchain and that is disappointing. (A19)

Six of the interviewees pointed out that the newly enacted GDPR triggered their organizations to adopt or consider blockchain technology to ensure compliance with the new data protection laws:

> In the past six years, we have undergone a significant digital transformation to provisioning cloud-based technologies. Security is of paramount importance for our customers. With the emergence of the general data protection regulations we have prioritized the underpinning of all of our cloud-based services with blockchain technology. (A6)

> Despite the repeated lack of support by management for blockchain technologies […] I was at a meeting recently where they indicated that they were now considering adopting blockchain because of the strict sanctions in place for non-compliance with the GDPR. Identity and data protection is becoming more and more of a concern. (A5)

Further issues, which emerged from our analysis, related to a low blockchain awareness level. While most of our interviewees had heard of blockchain, as discussed earlier most them had heard of blockchain technology but were unable to provide a correct description and provide actual examples of real world blockchain applications. There was also a consensus among the interviewees that there was a low awareness level with the other companies they were dealing with on a day-to-day basis. One interviewee mentioned that he had been several blockchain seminars that he felt were more about the promotion of cryptocurrency products (e.g. ICOs) rather than educating blockchain laymen. Another interviewee indicated that blockchain was being misleadingly pitched as the panacea to a plethora of organizational issues at open seminars:

> There is still a lot of hype around blockchain. Providers have underpinned their marketing campaigns with the notion that blockchain is the remedy for all company problems. That is not the case. For instance, from our experience, blockchain is not suitable for internal process improvement such as improving asset utilization. (A6)

Most of our interviewees pointed out that the number of blockchain business use cases across various industries has yet to reach full maturity:

> Since 2013, the company have committed substantial financial investment. For instance, we have installed backend filing systems which are hashing compliant so that they are interoperable with a multitude of blockchain applications. However, this functionality has yet to be used to its fullest potential. The business use cases demonstrating the value that can be derived for adopting blockchain have not yet matured here in Ireland. (A8)

> We like most companies are driven by the bottom line. The existing business cases have yet to convince our senior executives that a move is justified. They believe there is a herd mentality concerning blockchain. Until we as a company can see the benefits in terms of cost, faster transaction times and improved security and most significantly see our competitors using it, we will continue to observe blockchain with interest from a distance. (A11)

However, our study revealed that all of the large organizations who had adopted blockchain had developed private permissioned blockchains. All of the interviewees from these organizations acknowledged that their blockchain deployments were exciting and innovative developments for their companies however due to strict NDAs their organizations were prevented from providing their business use case details to a wider external audience. It would be interesting to investigate if this is the case in other developed countries and if these NDAs play a significant contribution to blockchain awareness and adoption of blockchain technologies.

Finally, 16 of our interviewees pointed out that blockchain is still largely associated with terms such as "cryptocurrencies" or "virtual currencies" which give the technology a negative connotation (e.g. ponzi schemes, unregulated ecosystem, illicit transactions and fraud):

> Once senior managers could decouple the concept of blockchain from its Bitcoin alter-ego, they were able to see the benefits that the company could derive in terms enhancing supply chain operations while also providing the same safety, higher speeds and lower costs. (C7)

> There is currently a guilty by association phenomenon currently occurring with blockchain and cryptocurrencies. Yes, bitcoin would not have been possible without blockchain, however, cryptocurrencies are just one blockchain use case example. Recent scandals with regards to initial coin offerings, the unregulated nature of virtual currencies and a lack of custodial frameworks have unfairly tainted people's perceptions of blockchain. (A11)

5. Discussion

This section will first discuss the influence of organizational factors on the adoption of blockchain by organizations based in Ireland and then outline the limitations of the study.

5.1 Patterns of blockchain adoption in Ireland

Our across-case analysis revealed three patterns pertaining to the adoption of blockchain in Ireland: top management support positively influences blockchain adoption; large organizations are more likely to adopt blockchain than SMEs; and organizational readiness is an enabler got blockchain adoption. We now discuss each of these patterns and elucidate on the context in which the results were identified, namely, Ireland as a developed country.

5.1.1 Pattern 1: top management support is an enabler for blockchain adoption. In terms of top management support, we identified that sufficient top management support was present for all companies who adopted blockchain. Thus, we conclude that key decision makers play a significant role in deciding whether an organization adopts or does not adopt blockchain. This finding has been consistently found in the literature that has demonstrated that the presence of sufficient management support acts as a compelling enabler for the adoption of IT innovations (Sabherwal *et al.*, 2006; Bajaj, 2000; Kulkarni *et al.*, 2017). Top management support has also proposed as a significant factor for blockchain adoption (Swan, 2015; Tapscott and Tapscott, 2016).

It was also interesting to note, first, the positive influence of top management's commitment toward technological innovativeness, second, the connection that emerged concerning top management support and the levels of blockchain awareness and, third, the ability for top management to adjust their behaviors throughout a blockchain adoption process. In terms of this first finding, we identified that the level of research and

development intensity occurring within an organization had a significant impact on the adoption of blockchain. Top management's commitment toward research and development initiatives has also been found to be a strong enabler for the adoption of IT innovations (Jarvenpaa and Ives, 1991; Rogers, 1995).

All of the interviewees from the adopting case organizations were directly involved and/or responsible for decisions about the IT budget allocations for research and development initiatives. These interviewees indicated that prior to the adoption of blockchain, there organizations had devoted substantial resources and IT budget allocations toward blockchain research and development initiatives. Additionally, in four non-adopting cases, our interviewees who had oversight on IT budget allocations had worked in the organization a period of more than ten years. Additionally, these interviewees had more than 15 years' experience in the IT industry. These interviewees indicated that while they were aware of blockchain technologies, they were unlikely to use their current or future IT budgets to pursue blockchain research and development initiatives. This finding suggests that top managers whose perceptions of new IT innovations may be biased by substantial same-company/industry experience (Daellenbach *et al.*, 1999). This in contrast to previous research which identified that "longer careers in a particular company or industry should enhance a manager's knowledge of the trends in the industry and make him/her more open to research and development investments in innovation" (Hayes and Abernathy, 1980). Concerning the second finding, as can be seen from Table IV and Figure 1, most of the adopting organizational interviewees had medium to high levels of blockchain awareness while most of the non-adopting organizations had no or low levels of blockchain awareness. In terms of the third finding, our analysis identified that top management supportive actions were not static during the adoption process. Complex blockchain adoptions, especially related to large-scale projects, are rarely predictable. Issues relating to training, resources, trading partners and legislation frequently emerge. For instance, in four of the non-adopting cases, we saw that decision makers were influenced by uncertainty with regards to blockchain legislation. The interviewees reported that because existing regulatory frameworks underpin traditional centralized and trusted models of security processing, migrating to a new decentralized model would takes years of cross-jurisdictional cooperation. However, top management in adopting organizations, most notably large enterprises, had gained insights from regulators and were assured that substantial change in the regulatory position on blockchain and distributed ledger technologies is unlikely any time soon. This confirmation enabled top management to positively adjust their behavior toward blockchain adoption. These findings are in line with existing research which suggests that management existing knowledge base, attitude about a specific IT and management's ability to adjust their behaviors positively influences the adoption of an IT innovation (Rogers, 1995; Thong and Yap, 1995; Dong *et al.*, 2009).

5.1.2 Pattern 2: large companies are more likely to adopt blockchain than SMEs. Concerning organizational size, we found that 5 out of the 11 large organizations and 3 out of the 9 SMEs adopted blockchain. This finding supports previous innovation adoption research that has shown how organizational size positively affects an organizations willingness to adopt an IT innovation (Pothukuchi *et al.*, 2002; Lee and Xia, 2006). The interviewees expressed two significant reasons for adopting or rejecting blockchain which can be sourced to the size of their organization. First, for the organizations that adopted blockchain, their decisions were motivated by the need to reduce complexity and lower supply chain investment costs associated with transactions (e.g. transfer of tangible and intangible value) while also reaping the benefits of enhanced security, efficiency and transparency which is associated with blockchain transactions. The large costs and time-consuming nature associated with traditional supply chain transactions, which in some

cases involved thousands of actors, were some of the main considerations in their decisions to make blockchain a strategic imperative. Conversely, the complexity of a large-scale digital transformation that would be encompassed in migrating from traditional centralized systems to decentralized ones also led other large organizations to reject blockchain. For the SMEs that adopted blockchain, they were similarly motivated by the enhanced speed, security, transparency and cost effectiveness afforded by blockchain transactions. These findings in relation to blockchain adoption for the purposes of supply chain efficiency have also been reported in previous research (e.g. Crosby *et al.*, 2016; Lansiti and Lakhani, 2017). On the other hand, for the SMEs who did not adopt blockchain, decisions were motivated by the fact they were operating in small business networks (e.g. supply chains) which would not necessitate the use of blockchain. Furthermore, the interviewees from SMEs in larger business networks acknowledged that unless the leading actor in the business network decides to implement blockchain technologies, they will be reluctant to do so because of the levels of complexity involved.

Second, most interviewees expressed the significance of blockchain business use cases. According to Fichman (2004, p. 315), "organizations that are larger, more diverse, have greater technical expertise, possess supportive senior management, operate in more competitive contexts, and perceive the innovation as more beneficial and compatible, are more likely to adopt a larger number of innovations, to adopt them earlier, and to implement them more thoroughly." The fact that large organizations possess more resources in terms of finances, infrastructure and skilled employees implies that these companies can engage in increased experimentation with the IT innovation. Ultimately, larger organizations can create their own business cases more readily. For instance, all the large companies who adopted blockchain were operationalizing "complex" private permissioned instances of the technology (e.g. private blockchains). These interviewees also indicated that given the inherent negatives of traditional blockchain transactions (e.g. scaling of speed and costs) that their organizations were researching blockchain transactions that can be conducted "off-chain." It was also interesting to note that for both SMEs and large organizations that adopted Blockchain, decisions were motivated by the ability to experiment with blockchain technologies, prior to adoption, on "cost effective" pay-as-you go cloud development platforms. This motivation may be reinforced by the characteristics of Ireland as a developed country. As highlighted earlier, the Bloomberg innovation index for 2018 ranked Ireland in 13th place. The index scores countries using seven criteria, including research and development spending, concentration of high-tech public companies and patent activity (Jamrisko and Liu, 2018). Additionally, motivated by the proliferation of business use cases, increased levels of trust and the need to lower the investment costs in IT infrastructure cloud computing technologies are now being used on a mainstream basis in Ireland from storage and IT development perspectives (Carcary *et al.*, 2014). Conversely, the perceived levels of complexity and the lack of business use cases led to both large and SMEs rejecting blockchain. This finding with regards to complexity serving as an adoption barrier confirms the arguments of existing research (e.g. Morabito, 2017; Lindman *et al.*, 2017). Based on our findings, we conclude that large organizations are more inclined to adopt blockchain than SMEs.

5.1.3 Pattern 3: organizational readiness for IT innovation increases the likelihood of blockchain adoption. In total, 8 of the 20 case study organizations demonstrated sufficient organizational readiness for IT innovation in terms of possessing satisfactory levels of financial resources, blockchain competent employees and IT infrastructure. These eight cases adopted blockchain technologies. This finding is line with the existing literature that argues that enterprises with sufficient organizational readiness are more likely to be adopters of blockchain (Swan, 2015; Tapscott and Tapscott, 2016).

With regards to blockchain expertise an IDA report (IDA, 2017) suggests that Ireland's IT workforce, by in large, possess core foundational software development skills which can be leveraged by organizations to capitalize on the emergence of blockchain innovations. Based on our analysis, it emerged that the core competencies required for blockchain are broader than the core technology. The nuanced and ambiguous nature of blockchain skills and competencies was cited as a major barrier to blockchain adoption by both SME and large non-adopting interviewees. Thus, it would seem logical that to bridge the current blockchain skills gap (e.g. the skills that exist and the skills that are being produced), professional certifications and university add-on courses/modules are needed which are specific to blockchain technologies.

In the case of another IT innovation, namely cloud computing, organizational adoption rates began to dramatically increase following the emergence of use cases by IT service providers and government agencies who demonstrated how cloud technologies could be used effectively (Morgan and Conboy, 2013; Clohessy *et al.*, 2017). Blockchain organizational adoption rates seem to be following a similar trajectory with use case examples beginning to slowly emerge. We envisage that, given the increasing significance of secure IT (e.g. enterprise cloud, virtual currencies, cashless payments), elements of blockchain technologies will underpin the majority of SME and large IT services in the future not only here in Ireland but at a global level. Moving forward, there needs to be a national awareness about what blockchain is and is not. This can be achieved through collaborative engagement and dialogue with both SME, large and public sector organizations. This will build a knowledge base that companies and the public can access.

It should be noted from Figure 1 that there are overlaps between large organizations and organizational size and SMEs and top management support. Concerning the former, in accordance with the existing literature (Mehrtens *et al.*, 2001) we treated these variables separately. In terms of the latter, this overlap is expected (Ramdani and Kawalek, 2007) because our interviewees were key decision makers (e.g. company owner, CEO, IT manager) and their support for the adoption of a new IT innovation is vital (Premkumar and Roberts 1999).

Finally, our data analysis suggests that an organization's ability to experiment with blockchain technologies "on the cloud" prior to adoption positively affects their adoption decision. It was interesting to hear our blockchain adopting SME interviewees reflect on how the nature of these cloud development platforms (e.g. pay per use model, sandbox environments, low cost up-front investments, open source) played a pivotal role in their decision to adopt the IT innovation. This finding is in line with extant research that argues that an enterprises' ability to experiment with a new IT innovation increases their likelihood of adoption (Ramdani and Kawalek, 2007). Collectively, these findings can have practical implications for IT vendors in terms of developing marketing strategies that would target potential adopters.

5.2 Limitations

It is worth highlighting some limitations of our study and areas that may represent fruitful direction for additional research. First, our study focused on three specific organizational factors that influence a company's decision to adopt blockchain. As noted in Section 2.2, this narrowing of the scope in relation to these factors was intentional as they are the most commonly used organizational factors in IT innovation adoption studies. We acknowledge that this narrowing of scope means that we did not explore other organizational factors that were identified in our literature review. Furthermore, as highlighted by Table III, we also identified environmental and technological factors that also merit further investigation. We envisage that future research that adopts a broader scope might result in a more

comprehensive analysis of blockchain adoption in Ireland. Second, we identified that top management support is crucial to adopting blockchain. It would be interesting to delve deeper into how these managers make decisions concerning IT innovations (governance structures, personal characteristics, etc.). Finally, our study was based on 20 Irish cases, divided across eight industry sectors. Although we used prescribed research protocols to ensure reliability and validity, the findings should be interpreted cautiously. For instance, certain sectors were not included in our study (e.g. government, health) which may have influenced our findings. Additionally, while Ireland is categorized as a developed country, certain aspects (Jamrisko and Liu, 2018) mean that direct comparisons with other developed countries cannot be made. While our qualitative approach resulted in interesting findings on the blockchain adoption process, we do encourage future research to explore an increased number of organizations using quantitative-based research approaches to further investigate the influence of organizational factors.

6. Conclusion and implications

This study investigated how organizational factors influenced blockchain adoption in organizations based in a developed country. Specifically, we explored blockchain awareness in companies based in Ireland and investigated how the following several organizational factors influenced the blockchain adoption process: organizational size, organizational readiness and top management support.

6.1 Scientific contributions

This study makes several important scientific contributions. First, our study provides a cumulative overview (Table VIII) of specific organizational considerations that provide motivations as to why both large and SME companies based in a technology developed country such as Ireland chose to adopt blockchain or not adopt blockchain. We also have identified several blockchain adoption patterns (Section 5). We postulate that these considerations and patterns may explain the low blockchain adoption rates in Ireland. Future blockchain adoption research could explore how our findings in relation to these considerations and patterns are comparable with other technology developed countries with similar features to Ireland (e.g. Israel, Denmark, Finland and so on).

Further, there was consensus among the respondents, once we had provided them with our standardized encapsulation of what blockchain was, that blockchain could provide a fundamental underpinning pillar to the digitized Irish economy that has seen a major increase in the production and consumption of data. However, the pace of the technology was identified as a concern with respondents who are struggling keeping up with the demands of the technology.

Second, the findings revealed that top management support and organizational readiness are significant enablers of blockchain adoption. These findings are in line with the existing literature that argue that these factors have positive influences on IT innovation adoption (Rogers, 1995; Lacovou *et al.*, 1995; Weiner, 2009). Previous IT adoption literature (Zhu *et al.*, 2006; Oliveira and Martins, 2010; Yuen *et al.*, 2010) assume that organizations operating in technologically developed countries exhibit a largely coordinated approach with regards to new IT innovations. Contrary to this assumption, our study demonstrated that top management support is reinforced by a cultural factor where new IT innovations are often categorized as a high priority at the chief-suite level but not at board level. This is compounded by the fact that the adoption of new IT innovations within the organizations is often uncoordinated (e.g. bottom-up, top-down approaches). Future research could investigate in more detail how the relationship between top management support and new IT innovations is influenced by Irish culture, or in a broader context, the characteristics of developed countries.

Finally, previous IT innovation adoption literature suggests that organizations size has a positive influence on a company's IT innovation adoption process (Damanpour, 1992; Thong, 1994). This study demonstrates that large organizations are more likely to not only adopt blockchain but are also more likely to conduct increased levels of blockchain research and development activities. We believe that this finding is directly related to the complexity of the IT innovation that makes it highly compatible for companies with a high resource capacity. We envisage that as blockchain continues to evolve as a commercial entity and the availability of cloud-based blockchain development tools increase, the IT innovation will become more amenable to organizations with fewer resources.

6.2 Practical contributions

Our study also has significance from a practical perspective. First, our findings concerning the low level of blockchain awareness and the lack of information pertaining to viable business use cases indicate that the Irish government could play a more significant role in promoting the benefits of blockchain technologies. Further, our findings could also encourage IT providers to formulate enhanced strategies aimed at disseminating information pertaining to blockchain technologies. Second, the positive influence of top management support and organizational readiness, particularly about core competencies, on blockchain adoption suggests that equipping managers with the requisite knowledge and skills will be crucial in adopting these IT innovations. In order to expedite this process our findings suggest that there is a need for Irish Universities and/or other Irish course providers to formulate new blockchain-based curriculum encompassing the core competencies delineated in Section 4.3.4. Finally, it was encouraging to note that the several SMEs who adopted blockchain used cloud-based blockchain platforms and tools to overcome the constraints of their initial low levels of organizational readiness. Therefore, we encourage SMEs with low levels of organizational readiness to explore cloud-based blockchain development platforms and tools when contemplating whether to adopt blockchain.

References

Anderson, N., Potočnik, K. and Zhou, J. (2014), "Innovation and creativity in organizations: a state-of-the-science review, prospective commentary, and guiding framework", *Journal of Management*, Vol. 40 No. 5, pp. 1297-1333.

Armstrong, C.P. and Sambamurthy, V. (1999), "Information technology assimilation in firms: the influence of senior leadership and IT infrastructures", *Information Systems Research*, Vol. 10 No. 4, pp. 304-327.

Bajaj, A. (2000), "A study of senior information systems managers' decision models in adopting new computing architectures", *Journal of the Association for Information Systems*, Vol. 1 No. 1, pp. 1-58.

Barrett, M., Davidson, E., Prabhu, J. and Vargo, S.L. (2015), "Service innovation in the digital age: key contributions and future directions", *MIS Quarterly*, Vol. 39 No. 1, pp. 135-154.

Bear, K., Drury, N., Korsten, P., Pureswaran, V., Wallis, J. and Wagle, L. (2016), "Blockchain rewires financial markets: trailblazers take the lead", IBM Institute for Business Value, New York, available at: https://public.dhe.ibm.com/common/ssi/ecm/gb/en/gbp03469usen/GBP03469USEN.PDF (accessed February 2, 2017).

Beck, R. (2018), "Beyond bitcoin: the rise of Blockchain world", *Computer*, Vol. 51 No. 2, pp. 54-58.

Beck, R., Avital, M., Rossi, M. and Thatcher, J.B. (2017), "Blockchain technology in business and information systems research", *Business & Information Systems Engineering*, Vol. 59 No. 6, pp. 381-384.

Beck, R., Becker, C., Lindman, J. and Rossi, M. (2017), "Opportunities and risks of Blockchain technologies (Dagstuhl Seminar 17132)", cited in *Dagstuhl Reports* Vol. 7, No. 3, Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik.

Benbasat, I., Goldstein, D.K. and Mead, M. (1987), "The case research strategy in studies of information systems", *MIS Quarterly*, pp. 369-386.

Carcary, M., Doherty, E. and Conway, G. (2014), "The adoption of cloud computing by Irish SMEs–an exploratory study", *Electronic Journal Information Systems Evaluation*, Vol. 17 No. 1, pp. 1-14.

Chen, G., Xu, B., Lu, M. and Chen, N.S. (2018), "Exploring blockchain technology and its potential applications for education", *Smart Learning Environments*, Vol. 5 No. 1, pp. 1-10.

Christensen, C.M., Raynor, M.E. and McDonald, R. (2015), "What is disruptive innovation", *Harvard Business Review*, Vol. 93 No. 12, pp. 44-53.

Clohessy, T., Acton, T. and Morgan, L. (2017), "The impact of cloud-based digital transformation on IT service providers: evidence from focus groups", *International Journal of Cloud Applications and Computing (IJCAC)*, Vol. 7 No. 4, pp. 1-25.

Clohessy, T., Acton, T., Godfrey, R. and Houston, M. (2018), "The adoption of Blockchain in Ireland: examining the influence of organisational factors", A National University of Ireland Galway and Blockchain Association of Ireland Industry Report, May 10.

Crosby, M., Pattanayak, P., Verma, S. and Kalyanaraman, V. (2016), "Blockchain technology: beyond bitcoin", *Applied Innovation*, Vol. 2 No. 2, pp. 6-10.

Cuomo, J., Ramamurthy, S. and Wallis, J. (2016), "Fast forward: rethinking enterprises, ecosystems and economies with blockchains", IBM Institute for Business Value, New York, available at: ibm.biz/blockchainstudy (accessed February 8, 2017).

Daellenbach, U.S., McCarthy, A.M. and Schoenecker, T.S. (1999), "Commitment to innovation: the impact of top management team characteristics", *R&D Management*, Vol. 29 No. 3, pp. 199-208.

Damanpour, F. (1991), "Organizational innovation: a meta-analysis of effects of determinants and moderators", *Academy of Management Journal*, Vol. 34 No. 3, pp. 555-590.

Damanpour, F. (1992), "Organizational size and innovation", *Organization Studies*, Vol. 13 No. 3, pp. 375-402.

Dong, L., Neufeld, D. and Higgins, C. (2009), "Top management support of enterprise systems implementations", *Journal of Information Technology*, Vol. 24 No. 1, pp. 55-80.

Eisenhardt, K.M. (1989), "Building theories from case study research", *Academy of Management Review*, Vol. 14 No. 4, pp. 532-550.

Espinel, V. (2015), "Deep shift: technology tipping points and societal impact", World Economic Forum, Geneva, available at: www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf (accessed March 6, 2017).

Fichman, R.G. (2004), "Going beyond the dominant paradigm for information technology innovation research: emerging concepts and methods", *Journal of the Association for Information Systems*, Vol. 5 No. 8, pp. 314-355.

Fitzpatrick, R., Murphy, J. and O'Neil, D. (2017), "Redrawing the lines: FinTech's growing influence on financial services", PWC, London, available at: www.pwc.com/jg/en/publications/pwc-global-fintech-report-17.3.17-final.pdf (accessed April 21, 2018).

Folkinshteyn, D. and Lennon, M. (2016), "Braving bitcoin: a technology acceptance model (TAM) analysis", *Journal of Information Technology Case and Application Research*, Vol. 18 No. 4, pp. 220-249.

Gangwar, H., Date, H. and Ramaswamy, R. (2015), "Understanding determinants of cloud computing adoption using an integrated TAM-TOE model", *Journal of Enterprise Information Management*, Vol. 28 No. 1, pp. 107-130.

Grandon, E.E. and Pearson, J.M. (2004), "Electronic commerce adoption: an empirical study of small and medium US businesses", *Information & Management*, Vol. 42 No. 1, pp. 197-216.

Greckhamer, T., Misangyi, V.F., Elms, H. and Lacey, R. (2008), "Using qualitative comparative analysis in strategic management research: an examination of combinations of industry, corporate, and business-unit effects", *Organizational Research Methods*, Vol. 11 No. 4, pp. 695-726.

Guo, Y. and Liang, C. (2016), "Blockchain application and outlook in the banking industry", *Financial Innovation*, Vol. 2 No. 1, pp. 1-12.

Hayes, R.H. and Abernathy, W.J. (1980), "Managing our way to economic decline", *Harvard Business Review*, Vol. 58 No. 4, pp. 67-77.

Heyvaert, M., Maes, B. and Onghena, P. (2013), "Mixed methods research synthesis: definition, framework, and potential", *Qual. Quant.*, Vol. 47 No. 2, pp. 659-676.

IDA (2017), "Ireland the European location for FinTech and Blockchain", available at: www.idaireland.com/newsroom/publications/irelandforfintech (accessed March 8, 2018).

Ito, J., Narula, N. and Ali, R. (2017), "The Blockchain will do to the financial system what the internet did to media", *Harvard Business Review*, March 9, available at: https://hbr.org/2017/03/the-blockchain-will-do-to-banks-and-law-firms-what-the-internet-did-to-media

Jamrisko, M. and Liu, W. (2018), "The US drops out of the top 10 in innovation ranking", available at: www.bloomberg.com/news/articles/2018-01-22/south-korea-tops-global-innovation-ranking-again-as-u-s-falls (accessed March 8, 2018).

Jang, H. (2010), "An empirical study on the factors influencing RFID adoption and implementation", *International Journal Management Review*, Vol. 5 No. 2, pp. 55-73.

Jarvenpaa, S.L. and Ives, B. (1990), "Information technology and corporate strategy: a view from the top", *Information Systems Research*, Vol. 1 No. 4, pp. 351-376.

Jarvenpaa, S.L. and Ives, B. (1991), "Executive involvement and participation in the management of information technology", *MIS Quarterly*, Vol. 15, pp. 204-224.

Joo, Y.B. and Kim, Y.G. (2004), "Determinants of corporate adoption of e-marketplace: an innovation theory perspective", *Journal of Purchasing and Supply Management*, Vol. 10 No. 2, pp. 89-101.

Kaganer, E., Pawlowski, S.D. and Wiley-Patton, S. (2010), "Building legitimacy for IT innovations: the case of computerized physician order entry systems", *Journal of the Association for Information Systems*, Vol. 11 No. 1, pp. 1.

Karahanna, E., Straub, D.W. and Chervany, N.L. (1999), "Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs", *MIS Quarterly*, Vol. 23 No. 2, pp. 183-213.

Kiayias, A. and Panagiotakos, G. (2016), "On trees, chains and fast transactions in the Blockchain", IACR Cryptology ePrint Archive No. 545, Edinburgh.

Kimberly, J.R. and Evanisko, M.J. (1981), "Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations", *Academy of Management Journal*, Vol. 24 No. 4, pp. 689-713.

Kitchenham, B. and Brereton, P. (2013), "A systematic review of systematic review process research in software engineering", *Information and Software Technology*, Vol. 55 No. 12, pp. 2049-2075.

Kokina, J., Mancha, R. and Pachamanova, D. (2017), "Blockchain: emergent industry adoption and implications for accounting", *Journal of Emerging Technologies in Accounting*, Vol. 14 No. 2, pp. 91-100.

Kosba, A., Miller, A., Shi, E., Wen, Z. and Papamanthou, C. (2016), "Hawk: the blockchain model of cryptography and privacy-preserving smart contracts", *Security and Privacy (SP), 2016 IEEE Symposium on*, pp. 839-858.

Kulkarni, U.R., Robles-Flores, J.A. and Popovič, A. (2017), "Business intelligence capability: the effect of top management and the mediating roles of user participation and analytical decision-making orientation", *Journal of the Association for Information Systems*, Vol. 18 No. 7, pp. 516-541.

Kushnir, D. and Sandén, B.A. (2011), "Multi-level energy analysis of emerging technologies: a case study in new materials for lithium ion batteries", *Journal of Cleaner Production*, Vol. 19 No. 13, pp. 1405-1416.

Lacovou, C.L., Benbasat, I. and Dexter, A.S. (1995), "Electronic data interchange and small organizations: Adoption and impact of technology", *MIS Quarterly*, Vol. 19 No. 4, pp. 465-485.

Lansiti, M. and Lakhani, K.R. (2017), "The truth about blockchain", *Harvard Business Review*, Vol. 95 No. 1, pp. 118-127.

Law, C.C. and Ngai, E.W. (2007), "ERP systems adoption: an exploratory study of the organizational factors and impacts of ERP success", *Information & Management*, Vol. 44 No. 4, pp. 418-432.

Lee, G. and Xia, W. (2006), "Organizational size and IT innovation adoption: a meta-analysis", *Information & Management*, Vol. 43 No. 8, pp. 975-985.

Li, Z., Wang, W.M., Liu, G., Liu, L., He, J. and Huang, G.Q. (2018), "Toward open manufacturing: a cross-enterprises knowledge and services exchange framework based on blockchain and edge computing", *Industrial Management & Data Systems*, Vol. 118 No. 1, pp. 303-320.

Lindman, J., Tuunainen, V.K. and Rossi, M. (2017), "Opportunities and risks of Blockchain Technologies–a research agenda", *Proceedings of the 50th Hawaii International Conference on System Sciences*, *HI*.

Lippert, S.K. and Govindarajulu, C. (2006), "Technological, organizational, and environmental antecedents to web services adoption", *Communications of the IIMA*, Vol. 6 No. 1, pp. 147-160.

McKinsey (2017), "Blockchain technology in the insurance industry", available at: www.treasury.gov/initiatives/fio/Documents/McKinsey_FACI_Blockchain_in_Insurance.pdf (accessed March 8, 2018).

Mehrtens, J., Cragg, P.B. and Mills, A.M. (2001), "A model of Internet adoption by SMEs", *Information & Management*, Vol. 39 No. 3, pp. 165-176.

Mehta, D. and Striapunia, K. (2017), "FinTech 2017, market size, business models, blockchain and company profiles", Statista Report, Hamburg, available at: www.statista.com/study/45600/statista-report-fintech/ (accessed July 9, 2018).

Mendling, J., Weber, I., van der Aalst, W., Brocke, J.V., Cabanillas, C., Daniel, F. and Gal, A. (2017), "Blockchains for business process management-challenges and opportunities", *ACM Transactions on Management Information Systems (TMIS)*, Vol. 9 No. 1, p. 4.

Miles, M.B., Huberman, A.M. and Saldana, J. (2013), *Qualitative Data Analysis*, Sage, Arizona.

Moeller, T. and Schwerin, S. (2017), "Privacy-friendly blockchain technologies: an overview of Blockchain technology and the 'GDPR' ", available at goo.gl/zz4Ci2 (accessed February 28, 2018).

Molla, A. and Licker, P.S. (2005), "Perceived e-readiness factors in e-commerce adoption: an empirical investigation in a developing country", *International Journal of Electronic Commerce*, Vol. 10 No. 1, pp. 83-110.

Morabito, V. (Ed.) (2017), "Blockchain value system", *Business Innovation through Blockchain*, Springer, Cham, pp. 21-39.

Moran, O. (2018), "Bitcoin could crash and burn – but blockchain jobs are here to stay", available at: www.techcentral.ie/bitcoin-crash-burn-blockchain-jobs-stay/ (accessed February 28, 2018).

Morgan, L. and Conboy, K. (2013), "Key factors impacting cloud computing adoption", *Computer*, Vol. 46 No. 10, pp. 97-99.

Myers, M.D. (2013), *Qualitative Research in Business and Management*, Sage, London.

Nakamoto, S. (2008), "Bitcoin: a peer-to-peer electronic cash system", available at: www.Bitcoin.org/bitcoin.pdf (accessed February 28, 2018).

O'Dair, M., Beaven, Z., Neilson, D., Osborne, R. and Pacifico, P. (2016), "Music on the blockchain", Blockchain for Creative Industries Research Cluster Report, Middlesex University, London, pp. 1-29.

Oliveira, T. and Martins, M.F. (2010), "Understanding e-business adoption across industries in European countries", *Industrial Management & Data Systems*, Vol. 110 No. 9, pp. 1337-1354.

Ordanini, A., Parasuraman, A. and Rubera, G. (2014), "When the recipe is more important than the ingredients: a qualitative comparative analysis (QCA) of service innovation configurations", *Journal of Service Research*, Vol. 17 No. 2, pp. 134-149.

Pare, G. (2004), "Investigating information systems with positivist case research", *Communication Association Information Systems*, Vol. 13 No. 1, pp. 233-264.

Pilkington, M. (2016), "Blockchain technology: principles and applications", in Olleros, F.X. and Zhegu., M. (Eds), *Research Handbook on Digital Transformations*, Edward Elgar, Northampton, pp. 225-254.

Pisa, M. and Juden, M. (2017), "Blockchain and economic development", Centre for Global Development, London, available at: www.cgdev.org/sites/default/files/blockchain-and-economic-development-hype-vs-reality_0.pdf (accessed April 3, 2018).

Plewa, C., Troshani, I., Francis, A. and Rampersad, G. (2012), "Technology adoption and performance impact in innovation domains", *Industrial Management & Data Systems*, Vol. 112 No. 5, pp. 748-765.

Pothukuchi, V., Damanpour, F., Choi, J., Chen, C.C. and Park, S.H. (2002), "National and organizational culture differences and international joint venture performance", *Journal of International Business Studies*, Vol. 33 No. 2, pp. 243-265.

Premkumar, G. and Roberts, M. (1999), "Adoption of new information technologies in rural small businesses", *Omega*, Vol. 27 No. 4, pp. 467-484.

Puschmann, T. and Alt, R. (2016), "Sharing economy", *Business & Information Systems Engineering*, Vol. 58 No. 1, pp. 93-99.

Ramdani, B. and Kawalek, P. (2007), "SME adoption of enterprise systems in the Northwest of England", *IFIP International Working Conference on Organizational Dynamics of Technology-Based Innovation. Springer, Boston, MA, June*, pp. 409-429.

Rihoux, B. and Ragin, C. (2009), *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*, Sage Publications, Thousand Oaks, CA.

Ritchie, J., Spencer, L. and O'Connor, W. (2003), "Carrying out qualitative analysis", in Ritchie, J. and Lewis, J. (Eds), *Qualitative Research Practice: A Guide for Social Science Students And Researchers*, Sage, London, pp. 219-262.

Rogers, E. (1995), *Diffusion of Innovations*, 4th ed., Free Press, New York, NY.

Sabherwal, R., Jeyaraj, A. and Chowa, C. (2006), "Information system success: individual and organizational determinants", *Management Science*, Vol. 52 No. 12, pp. 1849-1864.

Schwandt, T.A., Lincoln, Y.S. and Guba, E.G. (2007), "Judging interpretations: but is it rigorous? Trustworthiness and authenticity in naturalistic evaluation", *New Directions for Evaluation*, Vol. 2007 No. 114, pp. 11-25.

Seebacher, S. and Schüritz, R. (2017), "Blockchain technology as an enabler of service systems: a structured literature review", *International Conference on Exploring Services Science*, Springer, *Cham and Chicago, IL*, pp. 12-23.

Shrier, D., Sharma, D. and Pentland, A. (2016), *Blockchain & Financial Services: The Fifth Horizon of Networked Innovation*, MIT Science Connection, Cambridge, MA, pp. 1-10.

Strauss, A. and Corbin, J. (1998), *Basics of Qualitative Research: Procedures and Techniques for Developing Grounded Theory*, Sage, Thousand Oaks, CA.

Swan, M. (2015), *Blockchain: Blueprint for A New Economy*, "O'Reilly Media", CA.

Swanson, E.B. (2004), "How is an it innovation assimilated", *IFIP Working Conference on IT Innovation for Adaptability and Competitiveness. Springer, Boston, MA*, pp. 267-287.

Tapscott, D. and Tapscott, A. (2016), *Blockchain Revolution*, Portfolio/Penquin, New York, NY.

Thong, J.Y. and Yap, C.S. (1995), "CEO characteristics, organizational characteristics and information technology adoption in small businesses", *Omega*, Vol. 23 No. 4, pp. 429-442.

Tornatzky, L.G. and Fleischer, M. (1990), *The Processes of Technological Innovation*, Lexington Books, Lexington, MA.

Treat, D., McGraw, L., Helbing, C. and Brodersen, C. (2017), "Blockchain technology: preparing for change", available at: www.accenture.com/t20160608T052656Z__w__/us-en/_acnmedia/PDF-5/Accenture-2016-Top-10-Challenges-04-Blockchain-Technology.pdf (accessed March 2, 2018).

Treiblmaier, H. (2019), "Toward more rigorous blockchain research: recommendations for writing blockchain case studies", *Front. Blockchain*, Vol. 2 No. 3, doi: 10.3389/fbloc.2019.00003.

Van de Weerd, I., Mangula, I.S. and Brinkkemper, S. (2016), "Adoption of software as a service in Indonesia: examining the influence of organizational factors", *Information & Management*, Vol. 53 No. 7, pp. 915-928.

Venkatesh, V. and Davis, F.D. (2000), "A theoretical extension of the technology acceptance model: four longitudinal field studies", *Management Science*, Vol. 46 No. 2, pp. 186-204.

Vom Brocke, J., Simons, A., Riemer, K., Niehaves, B., Plattfaut, R. and Cleven, A. (2015), "Standing on the shoulders of giants: challenges and recommendations of literature search in information systems research", *CAIS*, Vol. 37, No. 1, pp. 205-224.

Wang, H., Chen, K. and Xu, D. (2016), "A maturity model for blockchain adoption", *Financial Innovation*, Vol. 2 No. 1, pp. 1-5.

Wang, P. (2009), "Popular concepts beyond organizations: exploring new dimensions of information technology innovations", *Journal of the Association for Information Systems*, Vol. 10 No. 1, pp. 1-30.

Wang, Y.M., Wang, Y.S. and Yang, Y.F. (2010), "Understanding the determinants of RFID adoption in the manufacturing industry", *Technological Forecasting and Social Change*, Vol. 77 No. 5, pp. 803-815.

Webster, J. and Watson, T. (2002), "Analyzing the past to prepare for the future: writing a literature review", *MIS Quarterly*, Vol. 26 No. 2, pp. xiii-xxiii.

Weiner, B.J. (2009), "A theory of organizational readiness for change", *Implementation Science*, Vol. 4 No. 1, pp. 1-9.

Woodside, J.M., Augustine, F.K. Jr and Giberson, W. (2017), "Blockchain Technology adoption status and strategies", *Journal of International Technology and Information Management*, Vol. 26 No. 2, pp. 65-93.

Yang, Z., Sun, J., Zhang, Y. and Wang, Y. (2015), "Understanding SaaS adoption from the perspective of organizational users: a tripod readiness model", *Computers in Human Behavior*, Vol. 45, pp. 254-264.

Yin, R.K. (2014), *Case Study Research: Design and Methods*, 5th ed., Sage Publications, Thousand Oaks, CA.

Yu, D. and Hang, C.C. (2010), "A reflective review of disruptive innovation theory", *International Journal Of Management Reviews*, Vol. 12 No. 4, pp. 435-452.

Yuen, Y.Y., Yeow, P.H., Lim, N. and Saylani, N. (2010), "Internet banking adoption: comparing developed and developing countries", *Journal of Computer Information Systems*, Vol. 51 No. 1, pp. 52-61.

Zamani, E.D. and Giaglis, G.M. (2018), "With a little help from the miners: distributed ledger technology and market disintermediation", *Industrial Management & Data Systems*, Vol. 118 No. 3, pp. 637-652.

Zhu, K., Kraemer, K.L. and Xu, S. (2006), "The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business", *Management Science*, Vol. 52 No. 10, pp. 1557-1576.

Zyskind, G. and Nathan, O. (2015), "Decentralizing privacy: using blockchain to protect personal data", *Security and Privacy Workshops (SPW)*, IEEE, pp. 80-184.

Further reading

Ramdani, B., Kawalek, P. and Lorenzo, O. (2009), "Predicting SMEs' adoption of enterprise systems", *Journal of Enterprise Information Management*, Vol. 22 Nos 1/2, pp. 10-24.

Swanson, E.B. (1994), "Information systems innovation among organizations", *Management Science*, Vol. 40 No. 9, pp. 1069-1092.

Treiblmaier, H. (2018), "Case studies for blockchain use cases: a bottom-up research agenda", *Communication of the Association for Information Systems (CAIS)*, Vol. 34 No. 3, pp. 555-577.

Walsh, C., O'Reilly, P., Gleasure, R., Feller, J., Li, S. and Cristoforo, J. (2016), "New kid on the block: a strategic archetypes approach to understanding the Blockchain", *International Conference on Information Systems, Dublin, December*.

Corresponding author
Trevor Clohessy can be contacted at: trevor.clohessy@gmit.ie