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Blockchain as a disruptive technology for business: A systematic review

Julie Frizzo-Barker[a,*], Peter A. Chow-White[a], Philippa R. Adams[a], Jennifer Mentanko[a], Dung Ha[b], Sandy Green[c]

[a] School of Communication, Simon Fraser University, Burnaby, BC, Canada
[b] Department of Science and Technology Studies, Cornell University, Ithaca, NY, USA
[c] College of Business and Economics, California State University, Northridge, CA, USA

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ABSTRACT

Blockchain is the latest 'disruptive innovation' that has caught scholars' attention. It is the underlying technology for Bitcoin and other digital currencies. Stakeholders like developers, entrepreneurs, and technology enthusiasts claim blockchain has the potential to reconfigure the contemporary economic, legal, political and cultural landscape. Skeptics claim the concept and its applications remain ambiguous and uncertain. Business scholars began publishing studies on the emergence and impact of blockchain, bitcoin, and related projects in 2014. In this study, we conduct a PRISMA guided systematic review of blockchain research in the business literature from 2014 to 2018. Our results show a rapid increase of studies over the five year period. The findings also convey key insights about the current state of scholarly investigation on blockchain, including its top benefits and challenges for business and society. We found that blockchain remains an early-stage domain of research in terms of theoretical grounding, methodological diversity, and empirically grounded work. We suggest research directions to improve our understanding of the state of blockchain and advance future research of this increasingly important and expansive area.

1. Introduction

Blockchain is an emerging and potentially disruptive technology that business scholars have recently begun investigating. The first and most famous blockchain application is Bitcoin. Its anonymous inventor, Satoshi Nakamoto released it in 2009 during the global financial crisis. Their goal was to create a new kind of digital currency that was decentralized and removed the control of governments, banks, and other traditional financial institutions (Nakamoto, 2009). Blockchain is a decentralized, digital ledger that facilitates peer-to-peer value transfers of all sorts, from digital currency to physical commodities and land titles, without the need for an intermediary such as banks, accountants, or lawyers. Dubbed "the trust machine" (Economist, 2015), blockchain technology is at the heart of many exciting prospects aimed at improving efficiency, transparency, and security, across all sorts of business and social transactions. Since its creation, Bitcoin and a host of alternative cryptocurrencies, known as "alt coins," has captured public attention as a source of fascination, skepticism, and debate for economists and financial experts. Some of the earliest media coverage characterized cryptocurrencies as evil (Krugman, 2013) due to their association with nefarious commerce on the dark web (e.g. illicit weapons and drugs) and since they often escape public record or regulation. Soon after, other journalists hailed cryptocurrencies as a solution to the pressing problems of the current economy, such as poverty, debt, and hyperinflation (Vigna & Casey, 2016). More broadly, stakeholders like developers, entrepreneurs, and technology enthusiasts claim blockchain has the potential to reconfigure the contemporary economic, legal, political, social landscape.

The technology is simple yet powerful - literally a chain of blocks of information, each verified by a distributed network of nodes. To conceptualize the rapid development of blockchain technologies, Melanie Swan (2015) organizes the different types of blockchain activity into three categories. Blockchain 1.0 is currency, as in digital payment systems and cryptocurrencies. Blockchain 2.0 is contracts, as in the more sophisticated value transfers of stocks, bonds, loans, mortgages and titles via smart contracts. Blockchain 3.0 is applications beyond finance, as in government, health, science, arts and culture. Recent research has explored blockchain's potential to help citizens reclaim control of their personal data (Mainelli, 2017), make the insurance industry more transparent (Disparte, 2017), manage supply chains (Kamble, Gunasekaran, & Sharma, 2019; Behnke & Janssen, 2019; Tönnissen & Teuteberg, 2019; Queiroz & Wamba, 2019; Kshetri, 2018),

* Corresponding author at: Simon Fraser University, School of Communication, 8888 University Dr., Burnaby, BC, V5A 1S6, Canada.
E-mail address: jfrizzob@sfu.ca (J. Frizzo-Barker).

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manage employee benefits (Ying, Jia, & Du, 2018), and transform electronic health records (Halamka, Lippman, & Ekblaw, 2017). Over the past decade, the emergence of blockchain has sparked myriad initiatives to re-imagine, and in some cases begin to disrupt, financial systems through cryptocurrencies. These types of changes can have far reaching effects on companies and industries because they disrupt information systems and social relations. The field of information management is particularly concerned with the various technologies and activities that influence changes in patterns of behaviour in customers, people, and organizations. Blockchain enthusiasts claim that the technology will have a significant effect on precisely these processes and a host of others such as AI (Salah, Rehman, Nizamuddin, & Al-Fuqaha, 2019; Makridakis, 2018) and Internet of Things (Khan & Salah, 2018).

Scholars of technology and society have shown that innovations do not consist solely of new technical devices, but also of new social and organizational arrangements (Callon, Law, & Rip, 1986). Scholars who investigate emerging technologies are concerned with core questions such as "What is this innovation?", "How are organizations adopting it?," "What can we do with it?," and "How does it contribute to organizational change?" Researchers have explored these questions about the Internet (Castells, 2000), social media (Kietzmann, Hermkens, Mccarthy, & Silvestre, 2011), and big data (Boyd & Crawford, 2012; Frizzo-Barker, Chow-White, Mozafari, & Ha, 2016), for example. In the earliest stages of blockchain scholarship, business scholars explore its instrumental value for achieving new levels of corporate efficiency and profitability (Tapscott & Tapscott, 2016).

Business scholars tend to be early movers or "early adopters" (Rogers, 2010). They tend to investigate emerging phenomenon like the Internet, social media, big data, and now blockchain, to understand their role in organizational change. Like the Internet, blockchain is projected to be the cornerstone of new types of business and social interaction. It is already affecting these, through its decentralized architecture, trustless and permissionless systems, smart contracts, as well as data, privacy, and information management. According to its advocates, blockchain is a prime example of a 'disruptive innovation' (2016, Christensen & Raynor, 2013; Christensen, 1997; Hwang & Christensen, 2008; Pan, Pan, Song, Ai, & Ming, 2019). Disruptive technologies, like the Internet, are rarely 'positive' or 'negative,' but productive of and produced in contexts of social change (Pinch & Bijker, 1987).

The Internet enabled communication and social relations to spread globally at a reach and speed never before seen in human history. It changed how we understand time and space, both expanding and intensifying human relations and organizations. The Internet connected us and helped create a global village (McLuhan, 1964). Blockchain is changing the nature of social relations and organizations *in* the global village. Blockchain is changing the interactive effect of human relations by facilitating trustless technologies such as the smart contract. A smart contract removes the need to build trust between individuals and organizations through intermediaries like lawyers and social activities like meetings where actors get to know one another. Smart contracts build the transactional relationship of a contract into technical code that is executed automatically. Business scholars strive to understand what new social and economic forms will be produced by actors developing blockchain technologies and applications. For example, scholars have investigated blockchain as a disruptive innovation for an array of civic arenas including e-voting, degree verification, and land registries (Tapscott & Tapscott, 2016; Thakur, Doja, Dwivedi, Ahmad, & Khadanga, 2019). Based on this context, we analyze the earliest available business scholarship on blockchain through a systematic review.

Scholars have started to publish systematic reviews of blockchain research in a number of fields. For example, Kuo, Zavaleta Rojas, and Ohno-Machado (2019)) conducted a systematic review of the adoption of blockchain platforms in health care. Yli-Huumo, Ko, Choi, Park, and Smolander (2016)) conducted a systematic review of blockchain technology from a technical perspective, focused on topics such as security, performance, data integrity, privacy, and scalability of blockchain practices. Their study also highlighted a gap in scholarship and the need for further blockchain research in other domains including business. We aim to fill this gap. Our systematic review picks up where their study left off. There is a need for research on the social, economic, and ethical dimensions of blockchain adoption and diffusion. For example, Mori (2016) found that only 20 percent of the barriers to adopting blockchain technologies are technology based, while the other 80 percent are attributable to business and communication-based practices. We explore the state of research about blockchain in business scholarship to understand how scholars are defining blockchain, where they are investigating it, and the most prominent benefits and challenges currently at play. Our study complements Yli-Huumo et al. (2016) technical-focused systematic review by analyzing important business processes that also shape blockchain.

In this study, we conduct a systematic review of business scholarship on blockchain from the earliest available publications, the inception in the field, in 2014 to the end of 2018, investigating the first five years of available data. This study is designed to support scholars and, potentially leaders and decision-makers to think about the benefits, risks, and gaps in our current knowledge of blockchain practices in order to guide future research and application. The value of blockchain for business and society remains uncertain. By conducting early-stage analysis of emerging technologies, scholars can convey their findings back to the influential community of practitioners and developers who shape these innovations in order to identify potential problems and help design best practices and opportunities. When scholars translate and communicate knowledge effectively through social media, news outlets, interviews, and presentations, research findings can ideally do more than simply inform the academic audience. Scholars can positively influence technology development, directly or indirectly, through various stakeholders.

2. Methodology

We conducted a systematic review of scholarly research on blockchain technology in the business literature. Systematic reviews are a form of meta-analysis designed to collect, investigate, and summarize what is known and what is not known about a "specific practice-related question" (Briner, Denyer, & Rousseau, 2009). Our search timeline included the years 2014-2018. Research-based studies of blockchain's impact are beginning to proliferate. At the same time, each study in this rapidly developing area is inevitably limited in scope and reflective of diverse findings. This poses a risk to the accumulation of knowledge and the integration of findings among business leaders and researchers (Briner et al., 2009). Systematic reviews are an effective way of addressing fragmentation as a "means of evaluating and interpreting all available research relevant to a particular research question or topic area or phenomenon of interest" (Kitchenham, 2004). Systematic reviews are common in the medical domain, and recently social scientists have begun to adopt them as a tool for understanding complex, emerging fields of scholarship. This is increasingly important for scholars today, as research proliferates across a wide variety of traditional and non-traditional academic channels, including books, journals, social media, and websites. Systematic reviews are used across a broad range of disciplines and qualitative studies have established a place for themselves within the methodology, as evidenced by initiatives such as the Cochrane qualitative methods group (Dixon-Woods & Fitzpatrick, 2001) and textbooks such as *Systematic Reviews in the Social Sciences* (Petticrew & Roberts, 2005) and *An Introduction to Systematic Reviews* (Gough, 2017). Researchers can use a wide range of theoretical perspectives to produce qualitative evidence, however, this data is often more difficult to synthesize. Systematic reviews within the social sciences have limited uptake because of their tendency to be descriptive, as opposed to theory-driven. We acknowledge this to be the case in this paper. While we followed the primary goals of systematic review as set

out by PRISMA (Liberati et al., 2009; Moher, Liberati, Tetzlaff, & Altman, 2009), we also framed the paper through the theoretical lenses of disruptive innovations (Christensen & Raynor, 2013) and diffusion of innovations (Rogers, 2010) to analyze our results. Systematic reviews have a number of positive features for the social sciences. As an assessment tool for early stage research on blockchain, a systematic review is an effective exploratory methodology. Systematic reviews bridge the "research-practice gap" (Rousseau, 2006). Like the sciences, the synthesis of studies can be integrated into professional practice (Sackett, 1997). There are a number of steps to conduct a systematic review.

2.1. Definition of research questions

The first stage of a systematic review is to define a set of research questions. The purpose of this study is to provide an overview of the current research on blockchain from the business literature. With this in mind, we devised these research questions:

- **RQ1: How does the business literature define blockchain?**

This simple yet revealing question demonstrates how the very definition of an emerging technology is often shrouded in confusion. We begin to trace the development of this new area of research by analyzing how the definitions vary. We predict that variation and ambiguity in this definition will decline as *blockchain* transitions into a more widely accepted and understandable concept.

- **RQ2: What research topics have business scholars addressed in current research on blockchain?**

This question was designed to gain a comprehensive overview of which sectors business scholars have researched in relation to blockchain. Some examples of topics we coded include banking and finance, governance and regulation, accounting, supply chain, education, and healthcare.

- **RQ3: What are the top benefits associated with blockchain in the business literature?**

A systematic analysis of blockchain's main benefits provides a clearer picture of incentives driving stakeholders to adopt and deploy blockchain technology. This will help researchers and practitioners to understand the current needs blockchain is effectively addressing across business and society at large, in order to continue building upon them.

- **RQ4: What are the top challenges and risks associated with blockchain in the business literature?**

Understanding the barriers and problems that blockchain practitioners and researchers face is beneficial in deciding where future research and development efforts should be directed. We gain a clearer picture of the most pressing challenges and risks by analyzing our population.

2.2. Conducting the search

In phase two, data collection, we developed our search protocol, which outlines the methods used to undertake a systematic review. This process is designed to reduce researcher bias, since a systematic review is often a collaborative effort (Kitchenham, 2004). First, we consulted several business scholars and librarians to identify the top databases relevant to our study. We selected [1] Business Source Complete, [2] SpringerLink, and [3] Web of Science, with the search term *blockchain* We searched for papers that included this term in their title, abstract, or keywords.

2.3. Screening and selection of relevant articles

Next, we evaluated the articles based on the inclusion criteria to determine their relevance to our study. An article had to include the term blockchain as the core technology under analysis. This was typically evidenced by its emphasis in the title, abstract, and/or keywords. We selected only academic peer-reviewed journal articles and excluded others for the following reasons: [1] articles without full availability, [2] articles not available in English, [3] articles that discussed blockchain from a technical, engineering, or computing science perspective, [4] magazine articles, law notes, conference papers, book chapters, or articles without a reference list, [5] duplicate articles, and [6] posters.

The identification and inclusion process of our systematic review is presented in Fig. 1. Our initial search of these three databases in June 2019 yielded 2293 articles. Once we eliminated duplicates and entries without full-text availability, we were left with a population of 529 papers. Next, our research team, including a professor, two doctoral students, and a masters student, reviewed this collection of articles for relevancy. In the first round of our inclusion process, we assessed the articles for their relevance based on title and type of journal. This process led to the selection of 529 articles. Any articles we did not agree upon, were also excluded from the population.

In the next round of revisions, we assessed the articles based on their abstracts, which resulted in a selection of 155 papers. We eliminated 374 articles that are only concerned with the technological attributes of blockchain, not in peer-reviewed journals, not following journal article formats, and those not focused primarily on blockchain. Next, we read the remaining articles in full to confirm that they belonged within the parameters of our study. By 'too technical' we refer to papers that focused mainly on mathematical equations or in-depth data on how to code a blockchain-based app, for instance. The articles that were not focused enough on blockchain may have included one passing mention of the word but not a substantial enough discussion to warrant analysis. Thus we identified 155 relevant articles in our final population for analysis.[1]

2.4. Coding and analysis process

We used the data analysis software NVivo12 to create a database of the articles, code them, and conduct the analyses. The team created a coding scheme which we used to classify the articles in accordance with each of the research questions. We also used the program to catalogue basic information about each paper, including the title, author, year of publication, and name of publication. Our coding team included a professor, four PhD candidates, and two masters students. First, we coded the population to identify basic information about the papers including type of paper (conceptual or empirical) and country of authors. Next, we coded the studies to address each of our research questions: what are the definitions, topics, benefits, and challenges related to blockchain represented in these papers? Within each of those nodes, we created sub-categories to represent the various answers we found.

3. Results

In this section, we present our initial analysis of the population. We categorized the studies by publication year, geographic distribution,

[1] Due to scope and space constraints, this review focuses on scholarship, not individual cryptocurrencies, blockchain, platforms, or blockchain consortiums unless they are mentioned as an object of analysis in the individual papers. The goal of our research is to examine the scholarship at large. There are a number of excellent sources of information on individual cryptocurrencies, platforms, and blockchain such as CryptoBriefing.com, Binance Research (info.binance.com/en/research/), Messario.com, eveningstar.com, and coinmarketcap.com.

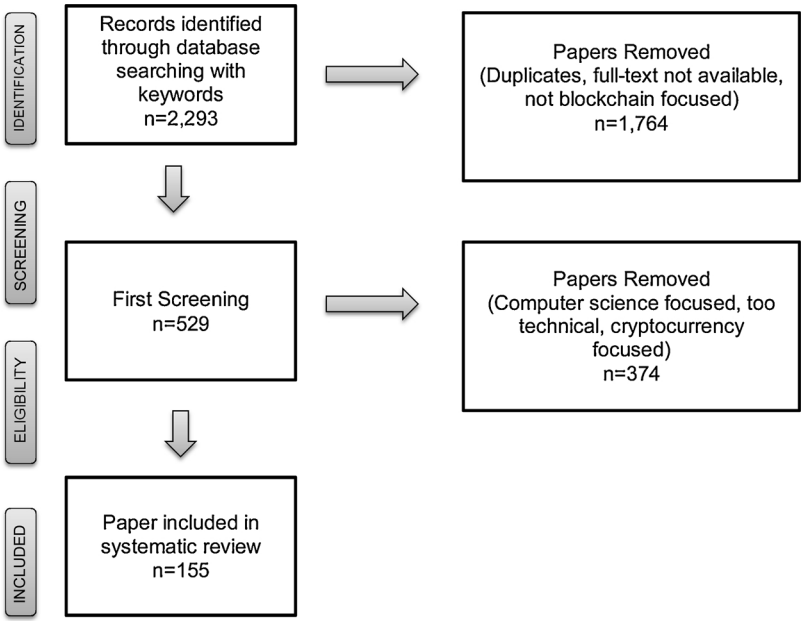

Fig. 1. Identification and inclusion process of the systematic review.

and type of paper using NVivo12 software. This section reports on these data items.

3.1. Publication year and geographic distribution

Fig. 2 shows the distribution of publications per year across the timeline of our population. The first paper was published in 2014 (Segendorf, 2014), which highlights how recently blockchain has emerged as a topic of research in the business literature. Comparatively, Yli-Huumo et al. (2016) identified the first paper on blockchain from a technical perspective was published in 2013.

The publication dates distribution over time is as follows: 1 paper (1%) was published in 2014, 3 papers (2%) in 2015, 23 papers (15%) in 2016, 44 (27%) in 2017, and 84 papers (54%) in 2018. This rapid upward trajectory is a trend we would expect to see, given the lag-time of academic research and publishing, on a compelling new technology that was only introduced publicly in 2009. The papers came from a wide variety of journals. The journal that published the largest number of papers in our population was Strategic Change, which published nine of the studies (6%) in our population.

We found a transnational interest in blockchain technology due to a wide geographical distribution of authors based in 34 different countries (see Fig. 3). The majority of papers were published by authors located in the United States (47, 30%), followed by the UK (17, 11%) and China and Germany (both with 11 studies, 7%). Next notable countries include Canada (9, 6%), Australia (6, 4%), and Romania and the Netherlands (both with 5, 3%). The rest of the countries published four papers or fewer (see Fig. 3).

We also analyzed the geographic distribution by continent (See Fig. 4). The regions with the most articles were Europe (43%) and North America (37%) followed by Asia (14%). The regions with the least amount was Oceania (Australia, 4%), Africa and South America (each with 1%). Blockchain projects and scholarship are active all over the world with a significant number focused on addressing social issues such as identification and economic issues such as underbanking. At this stage of the research agenda, there are many more publications originating from global north countries than ones from the global south.

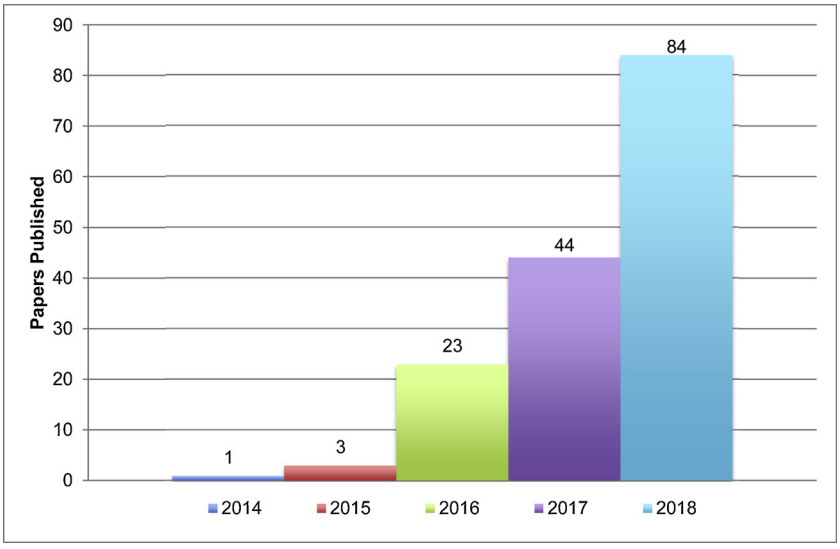

Fig. 2. Publication year of the selected papers.

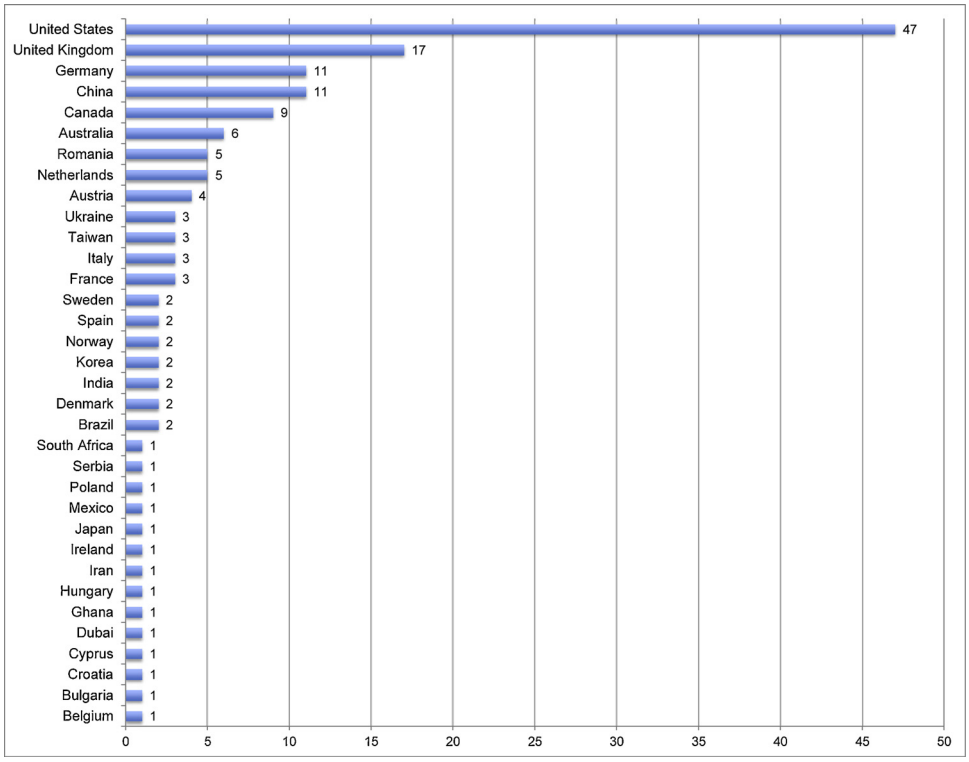

Fig. 3. Geographic distribution by country.

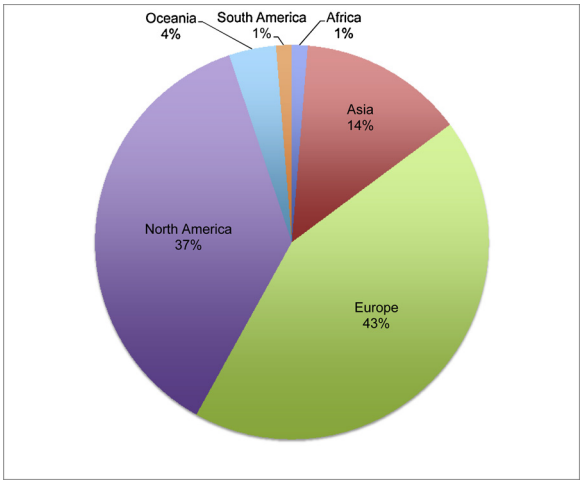

Fig. 4. Geographic distribution by continent.

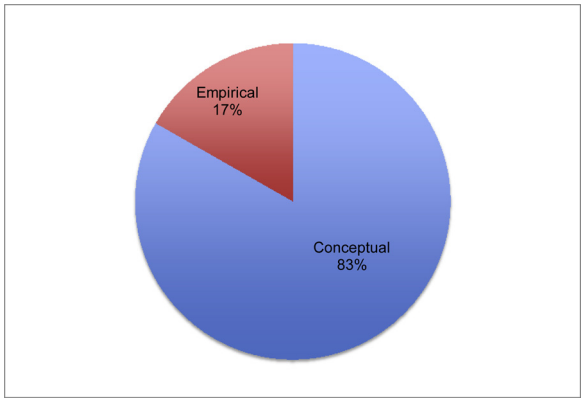

Fig. 5. Conceptual vs. Empirical Studies.

3.2. Classification of the relevant papers

We first analyzed the relative proportion of conceptual and empirical papers, to investigate the current state of research and study design in blockchain scholarship (see Fig. 5). To clarify our classification process, empirical papers focus on observable or measurable blockchain activities and processes through a variety of qualitative and quantitative approaches. Conceptual papers discuss ideas, applications, theories, benefits and challenges of blockchain, but do not collect primary data or analyze secondary data. From our total population of 155 papers, 83% (n = 129) were conceptual in nature, and 17% (n = 26) were empirical. 2016 marked the first appearance of empirical research - a case study of a bank's strategic planning for an investment in a FinTech company in Taiwan (Hung & Luo, 2016).

Fig. 6 shows the ratio of conceptual vs. empirical papers over the period. The figure shows that the ratio of conceptual papers and empirical papers changes very little over time. It's reasonable to see the blockchain space, or any new space of innovation, as rapidly evolving, in the academy as much as in industry. However, the figure clearly shows the academic pace of change from exploratory research to empirical investigation remains in the very early stages. This ratio of conceptual to empirical research is typical of early scholarship on emerging phenomenon (Frizzo-Barker, Chow-White, Mozafari et al., 2016).

New concepts, such as blockchain in this case, typically diffuse into the literature beginning with exploratory discussion around definitions, predictions, opportunities, drawbacks, excitement, and skepticism, which are later tested, observed, and measured empirically in practice. The conceptual papers offer important commentary, frameworks, theories, and critiques of blockchain from diverse points of view. The proliferation of these types of papers indicates the newness of the field. Some of these papers rely on personal observation, hypothesizing, or preliminary reflection on how blockchain applications will affect certain industries, which contributes to the fragmentation of blockchain research at the present. These perspectives lay the groundwork for

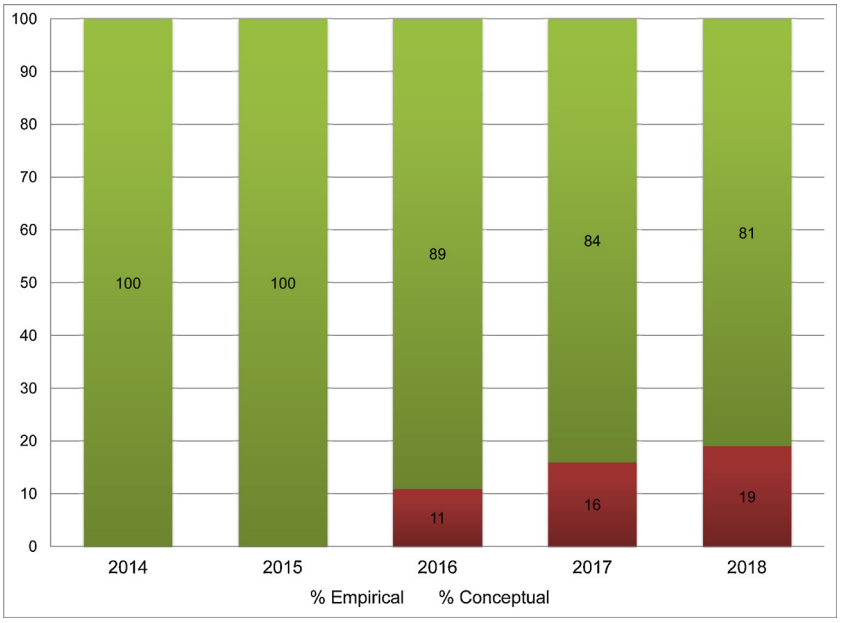

Fig. 6. Conceptual vs. Empirical Studies Over Time.

blockchain diffusion through the front-line accounts of early adopters. Overall, our findings demonstrate that blockchain research remains in the early phases of scholarship, both conceptually and, especially, empirically, in business.

In addition to this high-level breakdown, we categorized the types of papers we found according to their various research methods (see Fig. 7). We identified a majority of exploratory studies (63%), followed by theoretical frameworks (14%), case studies (12%), scoping and systematic reviews (5%), statistics (3%), interviews (1%), comparative studies (1%), and survey (1%).

The large percentage of exploratory papers across the time period clearly indicates the newness of the field as evidenced by titles such as "What is Bitcoin?" (Segendorf, 2014) or simply "Blockchain" (Nofer, Gomber, Hinz, & Schiereck, 2017). Many of these papers focus on introducing and defining blockchain, and exploring how it may affect a particular aspect of business or society. Other exploratory papers demonstrate the early stage skepticism and enthusiasm often seen around new technologies with titles including "Bitcoin Will Bite the Dust" (Hutchinson & Dowd, 2015) and "Is a 'smart contract' really a smart idea? Insights from a legal perspective" (Giancaspro, 2017).

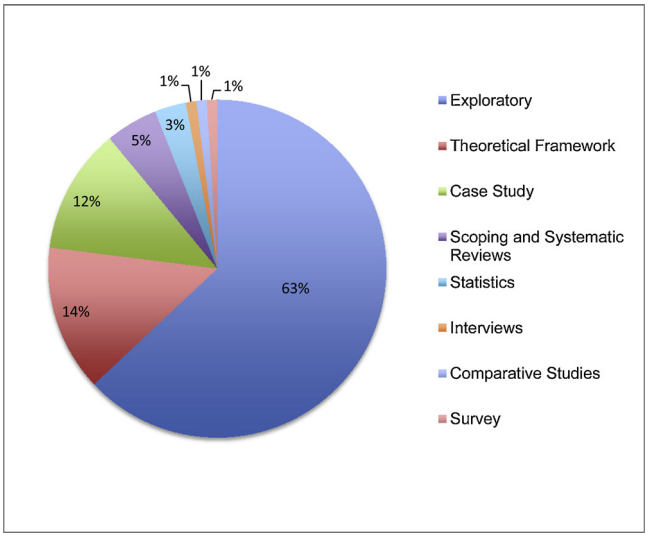

Fig. 7. Research Methods.

The second most popular type of papers were those analyzing blockchain through various theoretical and conceptual frameworks (14%). Several studies explored blockchain through the lenses of business ethics (Dierksmeier & Seele, 2016), innovation (Nowiński & Kozma, 2017) and capitalism and economics (Davidson, De Filippi, & Potts, 2018; Kniepert & Fintineru, 2018). These papers offers bigger picture perspectives on blockchain's potential impact on business and society, as well as practical frameworks for integrating blockchain into areas such as supply chain, accounting, and e-commerce (Coyne & McMickle, 2017; Ryan, 2017).

Next we identified a population of case studies (12%). Some of these examine blockchain's current impact in particular countries, such as FinTech applications in Taiwan (Hung & Luo, 2016), cryptocurrency for small and medium businesses in Ukraine (Ivashchenko, 2016), and privacy protection for online taxi-hailing as well as healthcare applications, both in China (Yue, Wang, Jin, Li, & Jiang, 2016; Zhang, Zhong, & Tian, 2017). Other types of case studies included experiments, assessments, and simulations. For instance, Lemieux (2016) conducted a risk-based assessment of a proposed implementation of blockchain for a land registry system in a developing country, outlining its strengths and limitations as a long-term solution for maintaining trustworthy digital records. Finally, we identified smaller percentages of scoping and systematic reviews (5%), statistics-based studies (3%), interviews (1%), surveys (1%), and comparative analyses (1%).

4. Discussion

In this section, we present our second stage of analysis: a discussion of the answers we identified for each of our research questions. Following this, we outline the limitations and validity of this study, and implications for future research.

4.1. RQ1: How does the business literature define blockchain?

We found 90% of the papers in our population defined blockchain (see Table 1). This finding is of particular significance since one of the main goals of any systematic review is to reduce and clarify the fragmentation associated with an emerging concept or initiative. As one paper from our population aptly notes: "The terms 'blockchain' means too many different things to different people and, as a result, it has

Table 1
Definitions of blockchain cited in the literature.

Definition	Percentage of Studies*	Exemplary Paper
"Distributed or Decentralized Ledger"	59%	Appelbaum and Smith (2018) "Blockchain Basics and Hands-on Guidance: Taking the Next Step toward Implementation and Adoption"
"Trust, Security and Transparency"	27%	Hawlitschek et al. (2018) "The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy"
"Chain of Blocks"	21%	Sun et al. (2018) "Application of Blockchain Technology in Online Education"
"Peer-to-Peer"	17%	Scott et al. (2017) "Exploring the rise of blockchain technology: Towards distributed collaborative organizations"
Bitcoin or Cryptocurrency Specific References	15%	Cai and Zhu (2016) "Fraud detections for online businesses: a perspective from blockchain technology"
"Disruptive Technology"	15%	Hassani et al. (2018) "Banking with blockchain-ed big data"
"Value Transfer"	9%	Ivashchenko (2016) "Using Cryptocurrency in the Activities of Ukrainian Small and Medium Enterprises in Order to Improve their Investment Attractiveness"
"Infrastructure"	6%	Beck, Avital, Rossi, and Thatcher (2017)) "Blockchain Technology in Business and Information Systems Research"

* If studies described several features, we coded for each.

become almost impossible to have a conversation in this space without stakeholders talking past each other" (Birch, Brown, & Parulava, 2016). Tracing the various definitions of a new concept is therefore a useful place to begin this analysis. The definitions vary because the technology is in a very early stage of adoption. The concept covers an emerging set of social, technical, and economic relations as well as many different applications.

The earliest origins of the concept of blockchain are inextricably tied to the Bitcoin cryptocurrency. We therefore found several instances of interchangeable use between 'blockchain' and 'Bitcoin' in the definitions from the earliest part of our data set. In fact, Nakamoto (2009), the anonymous inventor of Bitcoin, does not mention the word 'blockchain' or 'ledger' in their well-known white-paper. Rather, they refer to it as "an electronic coin as a chain of digital signatures." Scholars tend to define new terminology more frequently as it first emerges in the literature, and less so over time as the diversity of definitions solidify and merge into popular use. For instance, *social media* is rarely defined in popular media or academic literature anymore, where it might have been a decade ago. Moreover, big data's definition seems to have settled on a collection of V's: volume, variety, velocity, veracity, etc. (Frizzo-Barker, Chow-White, Mozafari et al., 2016). Referring to Bitcoin and blockchain as synonyms is like Facebook being synonymous with social media. A global community of scholars and industry experts are currently working to standardize various aspects of blockchain technology including its definition, for the International Standards Organization (International Standards Organization, 2018).

Most papers included several definitional concepts in order to describe blockchain, and we coded for all of these. In doing so, we aimed to identify the salience of each definitional concept rather than categorizing each paper with a single definition. By far the most popular term and definition across the population and the timeframe we analyzed, was the concept of blockchain as a "distributed or decentralized ledger" (59%). These definitions highlight the elimination of the traditional middlemen associated with most value transactions. Decentralization is a key feature of blockchain. According to scholars and advocates, the organizational replacement of a single, centralized authority makes the protocol fairer and more secure. For example, Appelbaum and Smith compare blockchain to a "gigantic Google document accessible to network members, with some members granted different levels of access, and augmented with cryptography and other security tools to protect and secure information" (2018, p. 30). This epitomizes the most revolutionary quality of blockchain technology. It uses consensus protocols across a network of nodes to valid transactions in an incorruptible, irreversible way.

After decentralization, the next most salient definition of blockchain related to "trust, security, and transparency" (27%). Because transactions are verified by the entire distributed network, and considered to be free of human error or corporate intermediaries, blockchain has been coined "the trust machine" (Economist, 2015). Blockchain's association with trust, security and transparency is at the heart of its revolutionary qualities for many key stakeholders, innovators and users. One of the papers in our population, a literature review of blockchain technology and trust in the sharing economy, highlights the fact that trust is a key building block of society, and "plays an essential role in the formation of interactions and relationships in the context of peer-to-peer marketplaces and services" (Hawlitschek, Notheisen, & Teubner, 2018, p. 50). Trust

The next common definition of blockchain focused on the literal meaning of the word: a chain of blocks of information (21%). These papers described the sequential nature of recording *blocks* of data (in most examples, Bitcoins) onto a singular, verified *chain* of custody, or ledger. For instance, a paper exploring blockchain use in online education described the technology as a chain of chronologically ordered blocks of data (Sun, Wang, & Wang, 2018).

Blockchain involves "peer-to-peer" transactions, which 17% of the studies mentioned in their definition. According to Scott et al., blockchain is based on "collaborative, open-source principles and peer-to-peer networks that suggest a commitment to principles like decentralization, social solidarity and disintermediation" (Scott, Loonam, & Kumar, 2017, p. 423). Next, we identified a group of papers that defined blockchain inextricably with Bitcoin or cryptocurrency-specific references (15%). This reinforces our finding that blockchain has only recently emerged as a technological development with applications beyond the cryptocurrency world. Because of its historical roots, blockchain has often been framed as simply an aspect of Bitcoin, as illustrated in this example from our population: "Blockchain is built on the Bitcoin protocol, the first peer-to-peer (P2P) electronic case systems that allow payments to be sent online from one entity to another without the intervention of a financial institution" (Cai & Zhu, 2016).

We also found a group of papers that labeled blockchain a "disruptive technology" (15%). For instance, Hassani, Huang, and Silva (2018)) cite blockchain's potential for improving transaction speeds, enhancing security and reducing costs in the banking sector. We noted that traditional intermediaries such as banks, which grassroots blockchain advocates sought to circumvent, are now highly invested in taking advantage of the technology to improve their own legacy systems. Other definitions included characteristics such as "value-transfer" (9%) and "infrastructure" (6%).

The variety of blockchain definitions used across the population indicate the newness of the term. One paper cited the three developmental stages of blockchain, all of which remain in the early stages of their potential: "Blockchain 1.0 for digital currency, Blockchain 2.0 for digital finance, and Blockchain 3.0 for digital society" (Zhao, Fan, & Yan, 2016). Our findings confirm that blockchain has not yet reached a widely accepted or easily understood definition in scholarship, much less in mainstream public discourse.

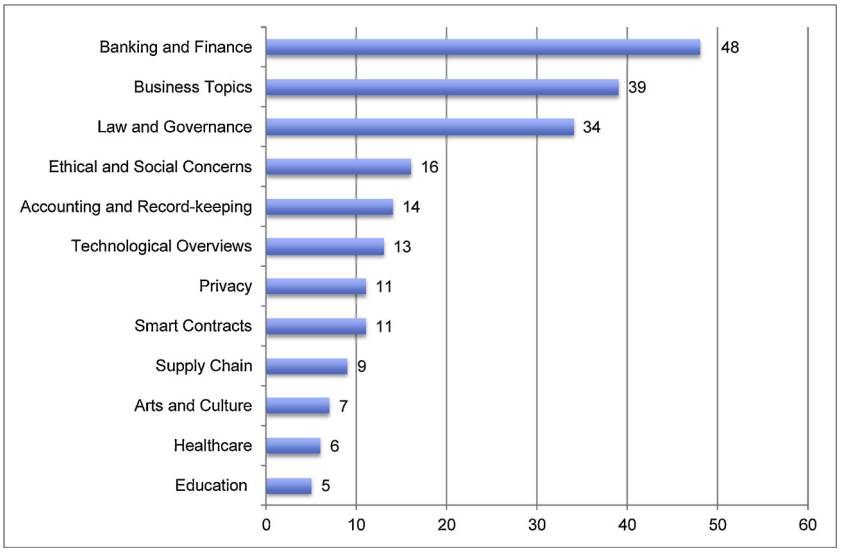

Fig. 8. Studies focused on blockchain in relation to these topics.

4.2. RQ2: What research topics have business scholars addressed in current research on blockchain?

We designed this research question to gain a comprehensive overview of blockchain research in various sectors of society (see Fig. 8). Similarly to the definitions, we coded for salience of topics, which sometimes involved more than one topic per paper. For example, one study focused on smart contracts in the context of law and governance, and another explored smart contracts in the context of healthcare and privacy, so we coded for each of these categories separately (de Ridder, Tunstall, & Prescott, 2017; Angeles, 2018).

The greatest number of papers in our population focused on blockchain in relation to banking and finance (31%). We also identified papers that focused chiefly on other areas of business (25%), law and governance (22%), ethical and social concerns (10%), accounting and record-keeping (9%), technological overviews (8%), privacy (7%), smart contracts (7%), supply chain (6%), arts and culture (4%), healthcare (4%), and education (3%). We also noted the emergence of some significant new terminology across the population.

Papers that focused on banking and finance (31%) often discussed the current and speculative opportunities and challenges of incorporating blockchain into various institutional processes. Although one of blockchain's core characteristics is its ability to side-step traditional intermediaries, many banks and financial institutions are striving to adopt the benefits of distributed ledger technology while mitigating third-party risk (Canaday, 2017). As one commentator notes, Wall Street seems to have learned the lesson that Silicon Valley has taught industries over the past decades: "embracing your biggest threat is the only way to prevent yourself from being overturned" (Metz, 2016). J.P. Morgan, Visa, the Nasdaq Stock Market, and the New York Stock Exchange are just a few examples of financial giants leading the charge into blockchain territory. Goldman Sachs has even filed a patent for blockchain-based transaction settlements (Guo & Liang, 2016). The Royal Bank of Canada was testing their own blockchain to move money between their operations in Canada and the US, even planning to take their legacy system offline in 2018 (Scuffham, 2017). Overall, we found that major institutions have a positive outlook toward improving efficiencies and lowering costs through blockchain technology.

Additionally, we noticed the concept of *fintech*, or financial technology, was used across many of these particular papers. Some of the topics explored in relation to fintech included equity crowdfunding, insurance, private securities, real-time accounting, and smart identities (Ashta & Biot-Paquerot, 2018; Cai, 2018). Kursh and Gold (2016) review some of the approaches used by universities to teach fintech and blockchain in business and technology programs, ranging from overview to specialized courses. They cite our own institution, Simon Fraser University, as one that has experimented with Bitcoin as a payment method for both tuition and bookstore purchases, installed BTMs (Bitcoin Teller Machines) around campus, and established a Bitcoin Club to help students learn about fintech.

Another set of papers focused on blockchain's impact on other business arenas (25%), such as business models and innovations, e-commerce, management, start-ups, and global market efficiencies. Again, we noted the early-stage tone and exploratory perspectives of the reports, including overviews of business innovations and research opportunities (Zhao et al., 2016), and a maturity model for blockchain adoption (Wang, Chen, & Xu, 2016). One conceptual framework study examined blockchain's potential to bring transparency and cost-savings to the manufacturing industry (Ko, Lee, & Ryu, 2018).

We coded for several significant topics overlapping with these areas of business including smart contracts (7%) and supply chain (6%). Smart contracts, one of blockchain's most ground-breaking new applications, are "computer protocols that facilitate, verify, execute, and enforce the terms of a commercial agreement" (Swan, 2015). They are a prime example of the increasing sophistication of blockchain technology. Smart contracts are automated, peer-to-peer agreements of all kinds, which may facilitate import/export transactions, registration of legal documents, property transfers, or voting processes (Cuccuru, 2017). They may be facilitated by various blockchains, although Ethereum has been the most popular in its association with smart contracts. In addition, we noted the salience of blockchain's impact on revitalizing supply chain management. After cryptocurrency, supply chain is one of the most popular use cases for blockchain, as evidenced by various chains developed for this purpose including HyperLedger, VeChain, Modum, and Waltonchain. For instance, Walmart has tested two supply chain initiatives powered by Hyperledger Fabric, a blockchain built by IBM, to track Chinese pork and Mexican mangoes from producer to consumer (Hackett, 2017). These supply chain initiatives have the potential to introduce new efficiencies and lower the cost of logistics, and to identify food-borne illnesses in seconds instead of weeks. Other studies in our population explore a permissioned blockchain to track Canada's cannabis supply chain (Abelseth, 2018), and a theoretical framework for applying blockchain in supply chain management (Treiblmaier, 2018). This type of physical asset digitization and tracking is a significant innovation of its own, the benefits and challenges of which merit future research.

Articles about law and governance (22%) highlighted the fact that blockchain technology may require changes to regulations at almost every level of society: individual corporations (Yermack, 2017), national governments (de Meijer, 2015), and the financial industry as a whole (Primm, 2016). At the national level, the US is taking a cautious stance toward developing regulatory rules pertaining to blockchain, in order to allow freedom for innovation. China has expressed a cautious attitude toward the technology, calling for regulation sooner than later (Guo & Liang, 2016). By comparison, the UK is a leader in the regulatory sandbox approach, offering flexible space for innovation, with Australia and Singapore following their lead (de Meijer, 2015). At the industry level, US financial service firms are keen to update legacy bank infrastructure with distributed ledger technologies, yet the industry currently lacks regulatory guidance to navigate operational and systemic risk (Primm, 2016). At the corporate level, the concept of placing blockchains at the center of record-keeping processes requires a significant shift in current business practices. Yermack (2017) outlines how such a shift might impact corporate governance in terms of greater transparency of ownership, improvements in liquidity, and the new costs associated for investors and managers.

We found a small but significant number of papers devoted to ethical and social concerns (10%). They offer an important contrast to the majority of blockchain research, which has focused mainly on practical business or technical concerns. This small group of papers is significant because the possible pitfalls and overall cultural impact of an emerging technology are typically only realized in retrospect, as we have seen recently with commentary on social media and smartphones (Lewis, 2017). They also broaden our understanding of the socio-political or psychological elements of blockchain innovation. For example, Garrod (2016) suggests that although blockchain has come to represent freedom from the state and markets, this does not necessarily reflect an accurate understanding of how capital, power, and automation work. One paper focused on cryptocurrencies and business ethics (Dierksmeier & Seele, 2016). The paper includes a useful framework for analyzing whether cryptocurrencies are beneficial, detrimental, or ambiguous, at the macro, meso and micro levels. Finally, Kshetri (2017) investigated whether blockchain will be effective to break the poverty chain in the global south.

One of the major questions across the population is how blockchain may disrupt existing jobs or technologies. Often an emerging technology can either improve or displace others (Christensen, 1997). For example, we found a set of papers focused on accounting and record-keeping (9%). If blockchain technology effectively diffuses into corporate culture as the new system of record inside organizations, and record-keeping thus becomes distributed and peer-to-peer, the role of accountants may decrease or be forced to evolve. In our study population, Brandon (2016) explores blockchain-based accounting practices as a possible future for business information systems. Where early accounting systems used single-entry ledgers (profit/loss statement), and modern accounting systems use double-entry ledgers (multiple categories of financial reporting), blockchain accounting applications may be triple-entry ledgers. They would involve three entries (debit, credit, and cryptographic signature of transaction) and three parties (buyer, seller, and blockchain network). This is another area that requires more research as it unfolds.

We also identified a group of papers that presented technological overviews of blockchain (8%) that were not tied to a particular area of business or society (Andolfatto, 2018; Appelbaum & Smith, 2018; Holub & Johnson, 2018). Again, this speaks to the emerging nature of the technology, and business scholarship exploring it, as the papers are definitional and explanatory in nature. Privacy was another salient topic related to blockchain (7%), often explored in conjunction with other topics such as healthcare, governance and cyber-security, as sectors particularly focused on the safety and identity of citizens (Benchoufi & Ravaud, 2017; Kshetri, 2017). For instance, Yue et al. (2016) propose a blockchain application called Healthcare Data Gateway to enable patients to own, control and share their health data, improving both medical progress and privacy standards simultaneously. The last several topics we identified represent the ways blockchain is influencing society beyond business and finance, including arts and culture (4%), healthcare (4%) and education (3%).

4.3. RQ3: What are the top benefits associated with blockchain?

The benefits of blockchain technology are often framed in technological, structural, or financial terms. This section identifies those benefits and extends them a step further to understand how those benefits may potentially improve business and society at large. All but 2% of the papers identified one or more potential or current benefits of blockchain, so we coded for all of those.

The top benefit associated with blockchain for business and other social applications, cited by 50% of studies, is its trust-free, transparent nature which eliminates the need for intermediaries. In 2009, Nakamoto, highlighted the fact that blockchain overrides the root problem of trust, which has been eroding, in relation to conventional currencies and the global economy (Hutchinson & Dowd, 2015). Cryptographic transactions remove the need to trust a third-party middleman, since transactions are completed securely based on network verification as opposed to people or organizations. This trust-free concept is now applicable beyond digital currencies, in the form of smart contracts undergirding decentralized autonomous organizations (DAOs) or corporations in which various management functions are automated by code instead of humans (Brühl, 2017; Buterin, 2014; Gainsbury & Blaszczynski, 2017). Blockchains can facilitate governance functions such as voting and forming coalitions (Zhao et al., 2016). This can enable small investors, entrepreneurs and creatives to be involved in corporate governance, in order to protect their rights and interests. For instance, blockchain could be used to promote transparency and greater equity in the music industry, by addressing issues of ownership, payments, and creating a single universal database of copyrights (O'Dair & Beaven, 2017).

Blockchain's decentralized structure, cited as a benefit by 46% of papers, offers many overlapping advantages to those outlined above. Its underlying protocol, based on public and private key cryptography, makes both its integrity and security virtually indisputable (Sun, Yan, & Zhang, 2016). This fosters a strong assurance of reliability and resilience in blockchain-based networks, which were cited by 15% of papers as a key benefit of blockchain (Xu, Xu, & Li, 2018, 2018). Blockchain is explored as a decentralized, resilient technology, that can in turn increase the resilience of individuals, communities and ecosystems. For instance, companies going public can issue shares directly without a bank syndicate, and shareholders can trade in a blockchain-based secondary market (Nofer et al., 2017). In the securities industry, blockchain eliminates the need for a trusted third party to verify the location or ownership of funds or to guarantee a master copy to clear transactions (de Meijer, 2016). Small and medium-sized businesses could greatly benefit from online payment solutions such as Stripe. They can integrate and process payments through the Internet without the need for a merchant account or passing through any banking infrastructure (Canaday, 2017).

Studies also cited blockchain's potential to increase business efficiency (24%) and lower transaction costs (19%). For instance, *regtech*, or regulation technology, is designed to improve the effectiveness of financial services regulation (Birch et al., 2016). Perhaps one of the most compelling and progressive benefits blockchain provides is lowered transaction costs for remittances, which are a lifeline for millions of people around the world, especially in rural areas and across the global south (Larios-Hernández, 2017). Through blockchains like Ripple, both banks and end users save costs on remittances. Blockchain's steadily increasing rapidity represents a major leap for business efficiency in the form of near real-time settlements. Since blockchains are designed to eliminate fraud and to bypass software malfunctions,

value transactions in these distributed networks can be processed almost immediately, even before they are confirmed on the blockchain (Greenspan, 2016). Cong, Du, and Vasarhelyi (2018)) assess blockchain's paradigm shift for accounting and auditing organizations, which have built their empires on the centralized concept of keeping data within four walls.

Blockchain's financial benefits were explored by a number of studies (15%). For instance, Ante, Sandner, and Fiedler (2018)) investigated whether blockchain-based ICOs represent unwarranted hype or the dawn of a new era of startup financing. Zalan (2018) highlights the financial and economic opportunities associated with blockchain for international business and entrepreneurship, focused on the accelerated internationalization of firms that are 'born global' on blockchain.

Studies also referenced the interconnected concepts of security (20%), privacy (12%) and data ownership (8%) as benefits of blockchain. Blockchain's decentralized structure facilitate these features of the technology. Network-based verification ensures that distributed data storage cannot be tampered with, unlikely centralized data storage which is currently the norm in traditional and web-based business processes. Trading personal data for various web-based utilities such as email, social media, and online shopping has become commonplace, but consumers have become more aware of how corporations may monopolize their data. Blockchain technologies address both of these concerns. This is because information about the transaction itself is made public, while data about the sender or recipient remains private. In this way, information is both anonymous and transparent (Ivashchenko, 2016).

However, anonymity is continually evolving in the world of cryptocurrencies. Security experts liken this form of anonymity to writing books under a pen name. Once the link is made between the book and the author's true identity, or in this case a Bitcoin address and one's personal details, anonymity can be comprised (MIT Tech Review, 2017). The typical culprits are web trackers and cookies - bits of code embedded into websites that provide information to third parties about how people use the site. Some cryptocurrencies such as Monero, specialize in total anonymity, using ring signatures, ring confidential transactions, and stealth addresses, to hide the sender, amount, and receiver of the transaction, respectively (Monero, 2017 n.d.). Beyond cryptocurrencies, this consideration of data privacy is especially pertinent in cases of health-related data. Digitized health data is of particular concern in terms of privacy (Frizzo-Barker, Chow-White, Charters, & Ha, 2016). Blockchain presents a promising new solution to the dilemmas at stake in the field of cutting edge healthcare, since patients may now opt to share their health data on a blockchain, while protecting their privacy (Yue et al., 2016).

Many of the examples of blockchain's advanced security are found in studies on supply chain logistics. A recent scam in logistics involves fictitious pick-ups where a con artist shows up at a shipper's dock with fabricated documents. A pilot project called T-Mining is a blockchain that gives clearance for personnel to pick up a load (Banker, 2017). Taking this a step further, Finnish company Kouvala Innovation has partnered with IBM to develop a SmartLog project, designed to create a global blockchain platform for the logistics industry, in which shipping containers can dynamically organize their own routes (del Castillo, 2017).

4.4. RQ4: What are the top challenges and risks associated with blockchain?

Similarly to the benefits outlined above, most of the challenges associated with blockchain in previous research to date has focused on technical issues. In this section, we outline the various challenges and risks we found documented in our systematic review population, and how they apply to business practices and organizations. Challenges refer to barriers or constraints of the technical or cultural sort, whereas risk refers to exposing an individual, group, or organization to danger, harm or loss, whether financial or social. Once we coded the challenges and risks cited in each study, we grouped them into several categories of analysis: technical, corporate, and societal. Interestingly, 23% of papers did not list any type of challenge or risk associated with blockchain, compared to only 2% that did not list any benefits. This speaks to the relatively positive and forward-thinking sentiment we found across the population, in its exploration of blockchain as a disruptive technology.

At the technical level, there are myriad challenges yet to be resolved for blockchain technologies. Yli-Huumo et al. (2016) explore the technical limitations of blockchain in depth in their systematic review, guided by Swan's (2015) framework. They cite challenges including: throughput, latency, size and bandwidth, security, wasted resources, usability, versioning, hard forks, and multiple chains. Several of these were cited by papers in our population, although they were typically mentioned in passing and discussed in far less technical detail from a business or management perspective. This is a key finding in contrast between the technical systematic review of blockchain and this systematic review. The former focused heavily on technical challenges and how to resolve them, while our population focused heavily on opportunities and improvements for business or social enterprise. When challenges were cited, they were generally mentioned in passing and framed as hurdles to overcome.

The technical challenges and risks we identified in our systematic review, mentioned by 41% of papers, included scalability, reliability, volatility, security, wasted resources, negative environmental impact, and lack of universal standards. Scalability is proving to be an issue as blockchain's popularity grows, since its initial design was not intended for wide scale use and adaptation. Scaling the blockchain has been an active area of technical research for several years, and a variety of solutions are currently being tested (Kasireddy, 2017). Risks to do with reliability refer to the fact that, while blockchain technology has a reputation for maintaining information integrity, it cannot guarantee the reliability of information added in the first place. This could have serious negative impacts for smart contracts such as land registries (Lemieux, 2016). As blockchain remain in the early phases of maturation, volatility remains a concern, especially for cryptocurrencies. All of the challenges listed above can influence spikes and crashes in the cryptocurrency market, as investors continue to grapple with the actual versus perceived value of this new asset class.

Another blockchain challenge receiving a great deal of attention now is wasted resources related to latency, production costs, and energy inefficiencies. Disparaging media headlines have reported that the energy required to process one Bitcoin transaction is the same amount of energy needed to power nine homes in the US for one day. Also, the world's largest Bitcoin mines are powered by hydroelectric dams in China (Holthaus, 2017). These sensational claims do not take into account the amount of energy to produce paper fiat currency is much higher than cryptocurrencies. The strict verification process required to complete a transaction is part of blockchain's design. For instance, Bitcoin is notoriously slow with a capacity of seven transactions per second, compared to the Visa network's 2000 transactions per second (Chapron, 2017). It is worth noting, however, that these same limitations do not exist for private blockchains, which can achieve up to 1000 transactions per second, since they are able to ensure that each node on the network is a trusted source with high-quality computer power and bandwidth (Kasireddy, 2017). Yet as demand for blockchain solutions grow, and networks become as robust as Bitcoin, this can lead to a significant latency of confirmation time, and a significant waste of computing resources (Zhao et al., 2016). This is a pressing concern requiring future research and practical solutions. Blockchain will not be able to fully flourish if it is seen as a major detriment to global energy resources or clean energy solutions.

At the corporate level, we identified several challenges including: issues to do with governance and regulation (34%), the adoption hurdle of successfully integrating blockchain into current business and

management practices (29%), and the lack of common standards (5%). Decentralized public ledgers offer transparency and distributed forms of governance. However, privacy chains like Monero and PIVX lack the ability to comply with financial know-your-customer (KYC) regulations. Centralized and permissioned blockchains such as Hyperledger have closed governance, unlike the governance that is typical and often favored among most legacy projects, which makes accounting possible for legal compliance in national contexts like the United States (de Meijer, 2015). Interoperability is key to the widespread adoption of blockchain, requiring collaboration between regulators and tech firms to define common industry standards and protocols (de Meijer, 2016). In response to this pressing challenge, various actors created blockchain consortiums to develop the technology and address common problems. The largest financial consortium, R3, includes more than 100 banks, regulators, trade associations and professional services firms (Irrera, 2017). The R3 developed a platform called Corda designed to help streamline future upgrades to various blockchain applications more easily.

The adoption barrier referred to both the human elements of corporate culture, education and communication, as well as technical elements of interoperability, switching costs, and the network effect. One study in our population notes that only 20 percent of barriers to adoption are technology based, while the other 80 are attributable to current business processes and models, and therefore "any enterprise looking to adopt blockchain technology will need to update their business processes and maintain ongoing discussion with stakeholders" (Mori, 2016, p. 208). Business practices such as vision-casting, stakeholder education, and effective organizational communication will be essential tools for successful blockchain adoption. Additional barriers to blockchain's successful diffusion are switching costs and the network effect (Luther, 2016). Switching costs refer to the labor and budget required to transition from any incumbent system to a blockchain-based system. The network effect refers to the concept that the value of a good or service is based on the total number of those using it. In other words, even if cryptocurrencies, smart contracts, or blockchain-based health apps are superior solutions to those presently used, there is a significant hurdle to making the transition. In order for effective diffusion to happen, the blockchain ecosystem requires a stronger workforce of technological talent to roll out blockchain applications across various industries and companies. The relatively scarce population of experts working on blockchain initiatives is expensive, and most often employed by FinTech startups (Banker, 2017).

At the societal level, we coded for papers that raised the risks of privacy and surveillance (15%), security (12%), fraud and crime (11%), corporatization (10%) and various other social and ethical concerns (9%) to do with blockchain. Interestingly, we found that issues such as privacy and security were reported as both benefits and risks of blockchain, according to our population. This reflects two sides of the same coin: the increased security and privacy measures built into the design of blockchain are a clear benefit for peer-to-peer transactions side-stepping intermediaries. But transparency and accountability are also necessary to combat uses of blockchain for illicit activity such as fraud and crime. The public perception of cryptocurrency has started to shift away from its earliest days, when it received predominantly negative press coverage for facilitating criminal activity, money laundering and other illicit activities (de Meijer, 2015). Harwick (2016) argues that a distinction between types of fraud is necessary: protocol-level theft and counterfeiting are difficult on the blockchain, but the protocol itself has no special way to prevent other types of fraud that are socially engineered. In other words, bad data in, bad data recorded and protected permanently. Filipova (2018) poses several important questions on these topics including, who takes responsibility when users suffer losses due to mistakes entered on public blockchains or smart contracts, how can potential crime be investigated without privacy breaches about user identities, and how can users request deletion of their data in blockchains? These are questions that still need to be addressed as blockchain technology matures.

Xu (2016) notes that blockchain's security related challenges may include account take-over, digital identity theft, hacking, and the 51% attack. A challenge unique to blockchain security is the potential for a 51% attack. In a distributed network relying on miners to verify transactions, this type of attack may occur when a single miner node has exceptionally more computational resources than the rest of the network nodes, and can therefore dominate the approval of transactions, with the possibility of allowing manipulation, fraud, double-spends, or theft (Xu, 2016). However, there have been no successful attacks on the system to date (Swan, 2015).

Several papers raised social and ethical concerns (9%) challenging the utopian idealism of blockchain solutions. Just as corporate dominance has increasingly shaped our use of the Internet through regulation, advertising, and tracking, big financial firms may monopolize blockchain technology, further entrenching their current position as regulators and intermediaries for value transactions. Banks such as Deloitte and Goldman Sachs are already heavily invested in blockchain initiatives, in order to cut costs and further avoid national-level regulation (Garrod, 2016). The potential risks associated with smart contracts should also be considered, in terms of how self-enforcing contracts without regulatory guidelines may play out for better or worse.

Related to these social and ethical concerns, some papers raised the issue of corporatization (10%), or how the benefits of this decentralized technology may become undesirably centralized and monopolized by the same few corporations that dominate the tech and finance sectors. Marsal-Llacuna explores this risk, with the optimistic view that "blockchain's virtual and physical networking symbiosis will allow the citizen to become an active code-maker instead of the code-receivers we are nowadays" in the context of Internet technologies (2018, p. 228).

4.5. Limitations

Systematic review methodology has a number of limitations such as publication bias, sample selection bias, inconsistent coding or data interpretation, and the combination of qualitative and quantitative studies in the population. Publication bias is a common challenge in systematic review, referring to the fact that positive results are more often published in academic journals than negative ones (Kitchenham, 2004). In order to address this, we searched the most comprehensive databases for peer-reviewed papers and scoured a large pool of results.

Sample selection bias refers to the potential distortions that may occur due to the criteria used to select studies and define the study population. These may be caused by a poorly designed search protocol. In order to overcome this, we conducted a pilot search and discussed our inclusion criteria in detail, in person, with the whole team of coders.

Next, we address inconsistent coding or data interpretation, which can occur amongst researchers who may understand and extract data in different ways. The team of researchers worked in close collaboration on each stage of the data selection process and discussed any scenarios of uncertainty in order to come to a unanimous decision on what to include. We conducted this process iteratively, through in-person discussions conducted in the research lab. The coding process itself was also discussed extensively in person and rolled out collaboratively.

5. Limitations of existing literature and future research directions

Early systematic reviews on blockchain research focused on subfields in the discipline and specific regions of the world. Schuetz and Venkatesh (2019) conducted a comprehensive review through an information management and information systems lens while Hughes et al. (2019) reviewed adoption in finance in India. Our global view of the business scholarship found a number of gaps in knowledge which point to future directions for research. We discuss some of the most pressing areas for further inquiry below.

- The papers in our population describe many blockchain issues and potential uses, often at the conceptual level. However, empirical studies are just starting to emerge. We need more data-driven studies about specific blockchain solutions for new business and social applications as well as their roles and impacts in various industries and sectors.

Future Direction: Investigate empirical case studies of blockchains, cryptocurrencies, platforms, applications, partnerships, and consortiums, through a variety of qualitative and quantitative research methods.

- While we did find global interest and authorship across the literature, we need to know a lot more about non-western contexts such as Africa and South America, where blockchain may have the opportunity to affect some of its most influential socio-economic change. Over two billion in developing economies have limited or no access to traditional banking services, and blockchain entrepreneurs are beginning to address this gap with new solutions for value exchange (Larios-Hernández, 2017). Further studies on positive and negative implications of blockchain within specific cultural contexts will be necessary to develop blockchain both economically and socially.

Future Direction: Continue to examine the successes and failures of emerging blockchain initiatives across a greater range of global contexts, especially in the global south.

- Organizational studies scholars have shown how rhetoric and discourse impact the diffusion of innovations in business contexts (Green, 2004). Relatedly, we found that innovators and early adopters have driven much of the mainstream discussion of blockchain and cryptocurrencies thus far, which is to be expected in the diffusion of a new innovation (Ligaya, 2017). In addition and moreover, we surmise social media might have both enabling and disabling impacts on the development of various blockchain technologies.

Future Direction: Investigate how discourse about blockchain and cryptocurrencies shapes the diffusion and adoption of the technology in key contexts such as the media, policymaking, practice, and the public sphere.

- Concerns of scalability, interopability, and wasteful energy consumption are some of the challenges raised throughout the papers in our population. Further research will be required to monitor whether and how organizations adapt and innovate to make blockchain solutions successful. We expect blockchain consortiums and technology leaders to produce new insights for how the technology may unfold most strategically, yet empirical research of these initiatives in situ will demonstrate their actual impact.

Future Direction: Explore how technology leaders will mitigate the uncertainty and volatility of blockchain technologies.

- Regulation is already beginning to play a major role in the adoption of blockchain and cryptocurrencies globally. How this will develop will depend on complex interactions at the transnational level between countries, and at the local level of nation states, such as the banning of ICOs in China in 2017 (Pauw, 2017). As another example, recreational cannabis was recently legalized in British Columbia, Canada, and IBM is urging the provincial government to use a blockchain-based supply chain to track marijuana sales, which would make an interesting regulation case study if it is in fact developed (Ligaya, 2017). Although legislators and legal scholars will rightly influence these developments, academics and practitioners from a wide variety of fields will be needed to constructively contribute to this conversation.

Future Direction: Analyze the burgeoning area of blockchain regulation and legislation.

- One of the most important signals we identified in our study is Mori's (2016) argument that only 20 percent of the barriers to adopting blockchain are technological, while the other 80 percent are attributable to organizational and business practices. Based on this, we propose that a fruitful line of inquiry on blockchain would focus on the successes and failures of organization practices around implementing such new technologies.

Future Direction: Conduct more studies on organizational practices and decision-making around the adoption of blockchain technologies.

6. Conclusion

In this study, we map out the early stages of blockchain research, including its potential as a disruptive innovation in society, and its diffusion within the business literature. We found evidence of an enthusiastic, exploratory literature focused on blockchain, although the domain is in its earliest stage of scholarly research. The ratio of conceptual (83%) to empirical papers (17%) demonstrates this, which we would expect to be the case for scholarship on a new phenomenon (see Fig. 4 above). The studies in our population demonstrate how blockchain technology is at the heart of the latest attempts to improve transparency, efficiency, and security across a wide range of value transactions. Yet, scholars tempered the optimistic tones with discussion of risks and challenges including technical and organizational barriers to implementing the technology more widely. Overall, we found a dearth of empirical research and sophisticated theory building. While the blockchain ground is fertile for researchers, scholarship is falling behind the rapid development.

This study makes an original contribution to early stage blockchain literature by exploring the business and organizational implications of this emerging technology instead of technical aspects. This study contributes to business scholarship in two ways. First, the Internet disrupted traditional business models and created new profitable ones. As this study shows, blockchain is beginning to have a disruptive effect on industries such as financial services, money, supply chain, and media, just to name a few. Corporate and academic leaders are racing to understand what blockchain is, how it works, what impact it will have on existing organizations and business models, and how it will create new ones. Second, business scholars want to know how blockchain is going to change governance and business practices. Smart contracts, decentralized organizations, and trustless technologies are changing how we organize and how we make money. When information and communication technologies change, so does business and social norms. Contracts are a fundamental feature of organizations and business models. Blockchain smart contracts turn our social relations into computer code that create and distribute computational trust.

Blockchain technology is rapidly developing through a phase of uncertainty. It may become an integral element of business practice, expanding beyond its current primary application in the financial sphere. Scholarship on emerging technologies can play an instrumental role in helping key stakeholders understand how blockchain may shape society, and how developers and users may shape the technology as it is still in development. Like any new technology, it will introduce new benefits and risks into society.

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review.

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