Blockchain Technology:
Changes and Challenges for Accounting and Accountants

Mélissa Fortin

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By: Mélissa Fortin

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Signed by the final examining committee:

Dr. Saif Ullah, Chair

Dr. Emilio Boulianne, Thesis Supervisor

Dr. Michel Magnan, Thesis Supervisor

Dr. Laurence Daoust, Examiner

Dr. Sophie Audousset-Coulier, Examiner

Dr. , Examiner

Dr. , Examiner

Dr. Theophanis C. Stratopoulos, External Examiner

Approved by

Dr. Kathleen Boies, Graduate Program Director

«Date»

Dr. Anne-Marie Croteau, Dean

ABSTRACT

Blockchain Technology: Changes and Challenges for Accounting and Accountants

Mélissa Fortin, Ph.D.
Concordia University, 2023

This dissertation reports three essays relating to changes and challenges for accounting and accountants with regard to the nascent blockchain technology. These essays all focus on different phases of blockchain development and explore the impact the technology is having on the accounting profession. Blockchain emerged with Bitcoin in 2008 and since then, various applications are possible, such as finance, supply chain, health, and insurance, to name a few. In the first study, I explore the case study of impak Finance, the first Initial Coin Offering (ICO) based on cryptocurrency accepted by the regulator in Canada. I conducted 8 interviews from the key stakeholders to understand the benefit and the risk of this ICO. In this context, I find that audit firms didn't have the tools to support emergent companies that use cryptocurrency and cannot meet the requirements of the regulator in terms of financial information. This situation has rarely occurred in the history of auditing and it remains a current difficulty in the market to find an audit firm to give an opinion on financial statements. My second study is based on the Bitcoin story. Drawing on a netnography of the early Bitcoin community from the technology's formation in 2008 through to the disappearance of its founder in 2011, this paper aims to explore the role of accounting in the development of a new financial system. We propose that Bitcoin is more than a form of digital currency, but rather a new accounting regime (Jones & Dugdale, 2001) that effectively takes accounting expertise away from accountants. The theoretical root of the accounting regime is from Giddens' modernity theory. It is urgent that accountants take an interest and educate themselves on the blockchain issue to seize this opportunity before becoming redundant or absent, as the Bitcoin story demonstrates, the ledger is an accounting regime without accountants. In the third and last study, I conducted 28 interviews about blockchain applications and implementation into business and explore how triple-entry accounting evolves with blockchain technology. Ultimately, I illustrate how triple-entry accounting, which is intrinsic to blockchains, modifies and simplifies the processing of accounting operations. Additionally, participants in the blockchain network operate with a single ledger, driving a single version of reality that creates a consensus and generating real-time information. My findings raise questions regarding the future role of accountants as internal control experts.

RÉSUMÉ

Technologie blockchain : Changements et défis pour la comptabilité et les comptables

Cette thèse comprend trois essais relatifs aux changements et aux défis pour la comptabilité et les comptables avec la technologie émergente *blockchain*. Ces essais se concentrent tous sur différentes phases de développement de la blockchain et explorent l'impact de la technologie sur la profession comptable et plus globalement, pour la comptabilité. La blockchain est apparue avec le bitcoin en 2008 et depuis, diverses applications sont possibles comme la finance, la chaîne d'approvisionnement, la santé, l'assurance pour n'en citer que quelques-unes. Dans la première étude, j'explore avec l'étude de cas d'impak Finance, le premier *Initial Coin Offering* (ICO) basé sur les crypto-monnaies accepté par le régulateur au Canada. J'ai mené 8 entretiens avec les principales parties prenantes pour comprendre les avantages et les risques de cette ICO. Dans ce contexte, j'ai constaté que les cabinets d'audit ne disposaient pas de l'outil nécessaire pour soutenir les entreprises émergentes qui utilisent des crypto-monnaies et ne peuvent pas répondre aux exigences du régulateur en termes d'informations financières. Cette situation s'est rarement produite dans l'histoire de l'audit et reste une difficulté actuelle sur le marché pour trouver un cabinet d'audit pour donner une opinion sur les états financiers. Ma deuxième étude est basée sur l'histoire du bitcoin. En s'appuyant sur une netnographie de la première communauté Bitcoin, depuis la formation de la technologie en 2008 jusqu'à la disparition de son fondateur en 2011, cet article vise à explorer le rôle de la comptabilité dans le développement d'un nouveau système financier. Il est proposé que Bitcoin soit plus qu'une forme de monnaie numérique, mais plutôt un nouveau régime comptable (Jones et Dugdale, 2001) qui retire effectivement l'expertise comptable aux comptables. La racine théorique de ce régime comptable provient de la théorie de la modernité de Giddens. Il est urgent que les comptables s'intéressent et se forment à la problématique de la blockchain pour saisir cette opportunité avant de devenir effacé ou impertinent, car comme le démontre l'histoire du Bitcoin, le registre est un régime comptable sans comptables. La troisième et dernière étude, j'ai mené 28 entretiens sur les applications et la mise en œuvre de la blockchain dans les entreprises et j'explore comment la comptabilité à triple entrée évolue avec la technologie blockchain. Finalement, j'illustre comment la comptabilité à triple parties, intrinsèque aux blockchains, modifie et simplifie le traitement des opérations comptables. Deuxièmement, les participants au réseau blockchain opèrent avec un seul grand livre, conduisant une version unique de la réalité qui crée un consensus et générant des informations en temps réel. Mes conclusions soulèvent certaines questions concernant le rôle futur des comptables en tant qu'experts et référence en contrôle interne.

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Contribution of Authors

The two essays were submitted to two different academic journals with peer reviews, which also explains the implications of a co-author, at this stage, into some essays of my thesis. For each of my thesis papers, I provided the initial intellectual impetus to launch the research project. My co-authors guided me through the subsequent stages of writing, sharing their knowledge with me but also teaching me the rudiments of publication. For the methods sections, I coded all three datasets from the three essays. I wrote countless drafts of each paper, experimenting with different theoretical lenses and structures. Professor Boulianne, one of my thesis supervisors, and Professor Pimentel contributed additional expertise in the areas of information systems and auditing. The ultimate outcome is a joint effort, with the two co-authors contributing to writing and developing the research papers to be published.

Chapter 2: Professor Boulianne and I conducted the 8 interviews. Professor Boulianne participate in data analysis and manuscript writing. The article is published in *Accounting Perspectives* (2020).

Chapter 3: Professor Pimentel participated in the data analysis and in manuscript writing. The paper is in the first round of revisions at *Critical Perspectives on Accounting*.

Chapter 4: This chapter is sole-authored. I did all the collection and data analysis alone, and the paper was accepted to the *Journal of Information Systems* Conference in September 2022.

All authors reviewed the final manuscripts and approved of their contents.

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CHAPTER 1 - INTRODUCTION

1. Introduction

Change is a defining characteristic of society. The pace of change has dramatically accelerated in the recent decades, partly through technological innovation. Accounting is no exception and is currently undergoing significant transformations both peripherally and at the core of its foundations as a field of expertise. Many of these substantial transformations are related to digitalization and emerging technologies, one of them being the blockchain and, more specifically, the Bitcoin, which is to say the first blockchain and the basis for cryptocurrency transactions. Blockchain is still considered an emerging technology. Several synonyms are used to designate this technology: Internet 4.0, trustless internet system, Bitcoin, cryptocurrencies, and distributed ledger, to name only the most frequently used. In this first chapter, I go back over the history of blockchain to situate the three essays of my thesis in its evolution.

1.1. Evolution of Blockchain

1.1.1. Before 2008

Although Bitcoin was the first established and usable cryptocurrency, there have been previous attempts to create online currencies with cryptographically secured records. Cryptographic signatures were developed in the 1970s. The smart contract was proposed in 1994 by Nick Szabo. Two examples of these attempts were B-money, ideated by Dai (1998), and Bit Gold, which were both attempted but never fully developed.

1.1.2. Emergence of the First Cryptocurrency: Bitcoin

Bitcoin emerged after the 2007–2008 global financial crisis, in response to strong criticism of the current banking system. At the time, critics, including the founder of Bitcoin, believed that widespread losses were caused by mismanagement (Boulianne & Fortin, 2020) and agreed that a group of financiers from all over the world were conspiring with the intent to increase their wealth at the expense of ordinary people (Beck et al., 2016; Davidson et al., 2018; De Filippi & Hassan, 2016; Harz & Boman, 2019). According to Peck (2017), Bitcoin was created as a solution: "the cryptocurrency was touted by its early champions as an antidote to the inequities and corruption of the traditional financial system" (Peck, 2017, p. 27).

Bitcoin was born with the white paper called "Bitcoin: A Peer-to-Peer Electronic Cash System" (Nakamoto, 2008) and built on the early proposal for B-money. The founder of Bitcoin, Satoshi Nakamoto, whose real identity remains a mystery to this day, grew increasingly vocal about his libertarian inclinations on online message boards (Dodd, 2018). The purpose of the Bitcoin project was to create a "decentralized payment system […] based on a public transaction ledger [operating] in a distributed manner" (Garay et al., 2015, p. 281). This system purported to carry out near-instantaneous peer-to-peer payments

without a financial intermediary needing to be involved, all with low transaction fees. The central problem Nakamoto wanted to solve with Bitcoin was double spending in cash transactions.

1.1.3. Emergence of Ethereum

Ethereum was introduced in Vitalik Buterin's (2013) white paper and addressed several limitations of Bitcoin's scripting language. "What Ethereum intends to provide is a blockchain with a built-in fully fledged Turing-complete programming language that can be used to create 'contracts' that can be used to encode arbitrary state transition functions, allowing users to create any of the systems described above, as well as many others that we have not yet imagined, simply by writing up the logic in a few lines of code." (Ethereum White Paper, 2013, p. 1). The intent of Ethereum was to create "arbitrary consensus-based applications that have the scalability, standardization, feature-completeness, ease of development and interoperability offered by these different paradigms all at the same time." (Ethereum White Paper, 2013, p. 13). The cryptocurrency know as Ether was to facilitate blockchain-based smart contracts and apps. Also, the emergence of Ethereum has allowed the emergence of Initial Coin Offerings (ICOs).

1.1.4. Blockchain for Business Applications

While the potential applications of blockchain technology have been well-documented, an understanding of its actual uses in accounting and auditing is limited. Wiatt (2019) focuses on practical applications of blockchains for the ability to create, store, and share accurate records such as digitizing the supply chain, tracking operations for diamonds, providing farm-to-fork food labelling, and preserving academic records. Wiatt's (2019) paper sets the stage for research such as the kind presented in the current proposal and motivates the necessity for in-depth discussion on the impacts of technology.

Karajovic et al. (2019) study the phases of blockchain integration for the accounting profession, and more generally the accounting industry. The first phase is early adoption, and this is what is happening now. It consists in the exploration of distributed ledgers and blockchains by major audit firms (the Big Four). These influential firms are testing blockchains in different forms, like developing interoperable digital assets (PwC), improving supply chain management (Deloitte), experimenting with editable permissioned blockchains through a partnership with Accenture (EY), and developing blockchain infrastructure with IBM (KPMG). Karajovic et al. (2019) propose a second phase in three to five years where they predict there will be mainstream adoption by a critical mass. This second step will affect the greatest use of internal accounting management. The current proposal looks at these "early adopters" to understand the changes in internal accounting operations of organizations.

In Table 1, I present a summary of the three different generations of the development of blockchain technology. For each generation, with my dissertation, I explore the impact for accounting (information) and the accounting profession. The table presents the scope of the different blockchains I studied.

TABLE 1 - GENERATION OF BLOCKCHAIN

	1st Generation 2008–2009	2nd Generation 2015	3rd Generation 2017–2018
Objective of the blockchain	Transfer mechanism	Smart contract	Faster transaction Lower cost More security
Type of blockchain	Public/ permissionless	Public /permissionless	Hybrid, consortium, private Permissioned
Example	Bitcoin	Ethereum ICOs	Hyperledger, R3 Corda
Type of consensus	Proof of work	Proof of stake	Several different consensuses possible
Essay of my thesis	Paper #2	Paper # 1	Paper #3

However, the literature is still nascent and conceptual, and significant gaps still exist in my understanding of the impact of blockchain for accounting and accountants. Pimentel and Boulianne (2020) conclude that academic accounting literature on blockchains seems to have reached a plateau, as "there has been an abundance of academic studies offering a high-level overview of the risks and opportunities associated with this technology" (p. 17). Li et al. (2018) present a scoping review of blockchain technology in business organizations and find that 80% of academic publications are conceptual studies presenting ideas, concepts, or theories about blockchain usage in the business world. Based on their analysis, Li et al. (2018) state that there are several gaps in the literature, which I seek to remedy directly with my study, as "there is also a lack of empirical studies examining the incentives leading business organizations to invest in and adopt blockchain technology" (p. 4480). Thus, case studies are strongly needed to gain insights from companies that have decided to adopt the technology.

Further, Lombardi et al. (2021) highlight this need for empirical studies: "[g]iven the major influences and potential for disruption and change, and the scarcity of empirical evidence in the literature, there is a need of compelling empirical studies, especially in the light of the overwhelming proportion of conceptual articles in our dataset." (p. 1554). My main goal with this research project is to fill this gap in the literature with a case studies to give insight from practices and explore blockchain's impact. The main objective of my dissertation is to provide a better understanding and a critique of blockchain technology for accounting and the profession of accountants.

In the next section, I review the three streams of literature, identify the opportunities that inspired my research questions, and provide an overview of each essay.

1.2. Accounting Literature Review and Motivation for My Three Studies

1.2.1. Tensions for the Accounting Profession

In such a context, there are three distinct stress factors that the emergence of blockchain puts on the accounting profession. The literature shows that Bitcoin, or more widely the blockchain, have different ways to make accounting information more trustworthy and timely, and to improve its quality through providing a compelling alternative to current accounting and auditing systems (e.g., Coyne & McMickle 2017; Kokina et al. 2017; Schmitz and Leoni, 2019; Bonson and Bednárová, 2019). As a disruptive technology, blockchain also represents a form of threat to the accounting profession: digitalization, replacement for bookkeeping, and reconciliation work (ICAEW, 2019).

The first stress factor I identified has to do with the accounting profession's attempt to break out of the traditional boundaries of its field through a learning challenge, all the while maintaining barriers to protect existing professional privileges. In other words, accounting professionals wish to be included in this change and not merely technology specialists. CPA Canada concurs in a compendium on blockchain and its opportunities, mentioning that "anyone can have a stake in blockchain - not just technology specialists - our inclusion in the process is not a given and we need to proactively seize our opportunity" (CPA Canada, 2019, p. iv).

The second stress factor identified through my field observations is the conflict between the innovators and the "keepers" of professional tradition, i.e., a clash in practice between accountants who will build new expertise to expand the range of services and the traditional auditor arrangements. Indeed, the groups of innovators must deconstruct known and long-standing audit procedures and practices to build new ones (Pimentel et al., 2021). Another group of auditors is opposed to using and auditing this new technology because it involves too much uncertainty and risk for an auditor to give an opinion on the information contained in the blockchain. In the same group of accountants using traditional logic, these auditors are looking to apply the dominant logic of verification through documentary evidence from third parties. They are looking for contracts and external, tangible evidence although, with blockchain, such evidence no longer exists with a third party. Blockchain becomes an opportunity to diversify the services of audit firms and, therefore, of a business' logic. To offer such a blockchain consultation and service, firms and accountants must bring major changes to their practices, often going against traditional ones. The three studies of my thesis show that, up until now, accountants seem to have a surprising amount of difficulty grasping this opportunity for widen the boundaries.

The third stress factor increasingly evoked both in practice and in the academic literature, which certainly explains why accountants must develop new structures in their daily work, is the fear of seeing work disappear. In the current context where new technologies grow rapidly, there is great pressure upon the accounting profession: it is believed that the profession could disappear. In a few years, I expect to see automated audit reports, recording accounting information, automated controls where information will be uploaded by blockchain extracting and analyzing them in real time. Such examples of the evolution

of auditing technology led me to believe that the accounting profession could very well disappear (Abreu et al. 2018; ICAEW, 2019). Thus, accountants must prove their added value to firms or companies to avoid being replaced by computer systems. Blockchain is considered a stressing factor because it questions the very relevance of accountants. Blockchain technology disrupts the traditional accountant's work. To explore and understand these changes for the profession, I selected two concepts, which I studied and, regarding the ICO, Bitcoin, and private or hybrid blockchain, appeared to be a relevant opportunity. Thus, investigating the risks and benefits of a new financing form like ICO and the story of Bitcoin appears relevant.

1.2.2. Sociology of the Profession

Understanding the role of accountants in the increasingly popular area of decentralized finance can have important implications for the future of the profession. Drawing on the concepts of jurisdictions or boundaries of the accounting profession (Abbott, 1988; Friedson, 2001), I will explain why the accounting regime of Bitcoin is not "owned" by accountants, but rather by unelected coders not relying on the expertise of accountants. The lack of esoteric knowledge (Larson, 1977) allowed us to highlight the ways through which the accounting profession has not succeeded in protecting this knowledge due to an excessive level of bureaucracy in the profession, which prevents any kind of flexibility when a new technology emerges on the market.

Abbott (1988) argues that occupations should be studied as the interdependent system they form, rather than one at a time. Within this system, abstract knowledge is seen as the key to winning skill conflicts and surviving the endless competitive game. "We most stop studying single professions – medicine especially – and start studying work. We need histories of jurisdictions – who served them, where they came from, how the market was created, how conflicts shaped participants. The most important subject for such investigation will be understudied profession like accounting and psychology. In particular, the jurisdiction of money requires the kind of attention long received by health" (Abbott, 1988, p. 325). Abbott's (1988) recommendation to stop studying individual professions and focus instead on accounting in the context of interprofessional relationships echoes in this article, where it applies to the intersection of new technology, the possibility of new knowledge, and accounting. Abbott accepts the suggestion of studying jurisdictions, but warns us that we should study whether jurisdictional conflicts occur rather than assuming they are a professional life's a priori. He goes on, saying that encounters within the system of professions may look like hybridization or competition. Rather than assuming a competitive pattern of interprofessional relations, we should be examining cases free of such competitive patterns to describe and understand what happens when experts such as accountants don't seek to dominate practice in all their possible jurisdictions. Thus, the investigation of Bitcoin seems to be the appropriate field to more deeply understand how accounting can be impact boundaries of the profession.

1.2.3. Cognitive Conditions of Professional Monopoly (Larson, 1977)

The modern model of professions such as accounting emerges as a "consequence of the necessary response pf professional producers to new opportunities for earnings income. A collective effort was needed on the part of the actual or potential sellers of services to

capture and control expanded markets" (Larson, 1977, p. 10). From the Larson perspective, modern professions historically exist because they acquired restricted market of practice, expanded their control area, and widened their competitive markets in order to improve their position within the capitalist society's emergent stratifications systems (p. 16).

Even though technical and cognitive conditions of the emergence of the profession are abundantly discussed, I focused on Larson's (1977) framework. The latter has been very rarely used in the accounting literature but, more importantly, it allowed me to analyze the new phenomenon of Bitcoin in light of the changes it implies for the accounting profession. The factors Larson lists facilitate market control and standardization.

To control a profession, a body of knowledge both esoteric and theoretical, and therefore difficult to routinize, is one on the conditions, though not an enough condition in gaining control of a competitive market. The best cognitive competences for gaining the monopoly lie in being sufficiently distinct from the convenience of the professionals, which must be formulated or codified to offer a standardized product. Especially with new techniques or new bodies of knowledge, this novelty of knowledge should facilitate the emergence of protective barriers by inventors or first users. Bitcoin appeared of great interest to me to deepen and illuminate this phenomenon of protection and control of the accounting profession. "[W]here everyone can claim to be an expert, there is no expertise" (Larson, 1977. p. 31): this is the case with Bitcoin. Different professions such as accountants and lawyers have either claimed or wanted to be the expert in this new "market." Only professionalism, Larson (1977) argues, is truly capable of handling special knowledge, knowledge that is esoteric not because it is secret but because it is specialized and takes time and effort to acquire.

Professional phenomenon does not have clear boundaries (Larson, 1977, p. xi). Abbott (1988) has shown that interprofessional competition in overlapping fields of work (or "jurisdictions") is a fundamental aspect of any professional life. This notion of jurisdiction meets Larson's (1977) idea of market control and standardized knowledge. Jurisdictional boundaries frame the field of work in which a profession's expertise is widely regarded as legitimate. They are inherently unstable, competing groups being perpetually in conflict. Larson (1977) specifies: a conflict situation in not a given. In her historical study of medicine, for example, there is no conflict, unlike what she observes in the engineering world. In these conflicts, each group uses jurisdictional claims to persuade audiences (namely clients and government) that its jurisdiction is legitimate and that its members possess the appropriate expertise and values to efficiently perform work in their own field. A new technology and market or business opportunity like blockchain thus generates instability in jurisdictional boundaries. It is interesting to observe the adaptation of professional accountants to this new opportunity, but also to witness the jurisdictional boundaries of a profession broadening and growing vaguer. I think it is important to understand the impact of blockchain technology, which represents a new opportunity for the accounting profession, and to study whether it is sufficiently esoteric to preserve accounting profession expertise with a new, emerging technology.

1.2.4. Double- and Triple-Entry Accounting

Double-entry accounting was introduced by Luca Pacioli (1494). The benefit of the system is the robustness, integrity, and auditability of transaction data captured and generated (Carlin, 2019). These characteristics and the simplicity of the model have ensured that the system has endured in the history of accounting for over 600 years without being questioned. The first criticism came from Ijiri, who questioned several foundations of the double-entry system and proposed a model that would better capture the essence of time in accounting information. One of the unique features that is integrated and made possible by blockchain is triple-entry accounting. Its underlying idea and framework predate the emergence of blockchain. The term "triple-entry bookkeeping" first appears in a conceptual paper written by Yuji Ijiri in 1982. Grigg (2005) further develops the concept, which constitutes, with Ijiri's, the only two concepts of triple-entry accounting proposed so far. Blockchain is the technology that would be able to support the architecture and operation of triple-entry accounting. In Chapter 4, I go into more detail on this topic.

1.3. Research Questions

In my dissertation, I investigate three generations of blockchain, three different stages to understand the changes to accounting and for accountants. Since my goal was to understand more deeply the impact of blockchain, as well as to make a critique, several of my research questions all start with "how."

For Chapter 2:

(1) *What are the risks and benefits for the firm, the investors, and the financial regulator when launching either an unregulated or a regulated ICO?*

For Chapter 3:

(2) *How do accounting concepts contribute to the development of the Bitcoin blockchain?*
(3) *How does Bitcoin challenge the hegemony of accountants over this accounting knowledge?*

For Chapter 4:

(4) *How does blockchain permit triple-entry accounting?*
(5) *How does blockchain impact and change accounting operations?*

1.4. Overview of Chapter 2 – Risks and Benefits of Initial Coin Offerings: Evidence from impak Finance, a Regulated ICO

Several options exist for a firm in need of financing; among these are venture capital, angel investors, crowdfunding, and initial public offerings (IPOs), to name a few. With the advent of blockchain technology, a new option emerges: the initial coin offering (ICO). An ICO exists when a firm issues cryptoassets (also called tokens), through a blockchain, to be sold to investors to get funding. ICOs have exploded, being seen as a highly efficient new mechanism for raising capital for new projects in the fintech area, with the potential to

transform business and financial models (CPA Ontario, 2018). A key specificity with ICOs is that significant money may be raised at low cost, in a short period of time, and in many cases without the involvement of financial regulators, which means they could be deemed "unregulated." The legal uncertainty around tokens issued by ICOs (whether they qualify as securities or not) is a key reason why ICOs have proliferated so quickly, at barely any cost for the issuers, contrasting with other regulated funding involving significant costs to raise funds and then to cover compliance costs. The unresolved legal status surrounding ICO tokens (securities or not) is considered by some as a business opportunity to raise significant funds. Jurisdiction, for legal and tax purposes, is also an issue for authorities, as ICOs may be run from anywhere, including tax havens. Regulations on ICOs vary from country to country, ranging from prohibition (China) to relative accommodation (Singapore, Switzerland) and the possibility of becoming regulated (Canada). Competition between countries to attract investments in fintech, while considering investors' protection, puts pressure on financial regulators worldwide. Canada places fifth on a crypto-friendly index ranking countries based on how they treat fintech initiatives, including for ICOs (Novak & Pochesneva, 2019).

In this context, this study aims to provide a better understanding of the business and the regulated environments surrounding ICOs, showing differences between unregulated and regulated ICOs. Key stakeholders identified are the firms operating in the blockchain space, the investors, and the financial regulators. To get deeper insight, I conducted a case study of a firm that launched a regulated ICO. My case firm is impak Finance, the first regulated ICO in Canada. Based on prior research and interviews of key respondents, I developed a framework identifying key stakeholders' main risks and benefits of performing an ICO.

1.5. Overview of Chapter 3 – Bitcoin: An Accounting Regime

This paper digs into Bitcoin's system architecture and history to explore the relationship between this technology, accountants, and accounting knowledge. I choose to study Bitcoin because it is the original cryptocurrency and first large-scale application of blockchain technology, making it something of a vanguard for the blockchain industry. Bitcoin is also an appealing choice because its system architecture is built on strong criticism of the traditional financial system (Nakamoto, 2008).

Methodologically, the paper mobilizes a netnography of the early Bitcoin community to explore the discourse underpinning the formation of this new technology. By mining forum posts and emails between Satoshi Nakamoto (the founder of Bitcoin) and members of the Bitcoin community over the period of 2008 (when the technology was released) to 2011 (when Nakamoto disappeared), I can explore how these individuals mobilize accounting vernacular to establish a new financial order based on the tenets of decentralization, cryptography, and sophisticated computer programming. Additionally, I am able study how non-accountants fuse accounting language with programming code to create new ideas about how financial transactions should be recognized and processed. Altogether, this allows me to conclude that where Bitcoin displaces accountants, it makes accounting especially relevant, as accounting provides a vocabulary for Bitcoin developers to make sense of the challenges facing the development of a new financial system.

Theoretically, this analysis builds on the work of Jones and Dugdale (2001) and their concept of an "accounting regime." An accounting regime frames accounting as a technology that is at once "a system of governance (…) that is socially constructed (…) and a set of social practices that generate information" (p. 58). The concept of an accounting regime provides us with a framework to explore the ways in which accounting concepts can be used to create new interpretative schemas for understanding financial flows. We also integrate sociological theories on professional knowledge (Abbott, 1988; Freidson, 2001; Larson, 1977) to explore how accounting, as a prescribed body of knowledge and controlled by a group of experts, can be taken away from accountants, and the potential threats this can pose to the jurisdictional boundaries of the profession.

I find that Bitcoin is an accounting regime that prescribes new ways for recording and measuring transactions. It creates a new ledger for evaluating these transactions that fuse accounting concepts with technological imperatives. In fact, the ways in which Bitcoin architecture is designed are often discussed in (programming) code, as this is a language shared and understood by Bitcoin programmers. I demonstrate that this accounting regime is not owned by accountants, but rather by unelected coders who have co-opted the traditional knowledge of accountants. I argue that these non-accountants are able to appropriate accounting knowledge because it is not sufficiently esoteric (Larson, 1977). Where accountants are unable to make an entry into the blockchain space because of high barriers to entry in terms of knowledge acquisition and mastery (Pimentel et al., 2021), non-accountants can easily integrate and mobilize accounting ideas. While the method does not allow me to probe Bitcoin community members directly, I offer a tentative explanation for how Bitcoiners have come by appropriate accounting knowledge. Ultimately, the use of accounting knowledge by non-accountants in a system aimed at disintermediating financial transactions poses a threat to the jurisdiction of accounting professionals, as accountants are unable to protect the "cognitive exclusiveness" (Larson, 1977, p. 181) of their knowledge base.

1.6. Overview of Chapter 4 – Towards a Single Trust: Blockchain Early Adopters and the Impact on Accounting and Accountants

Since its first application as Bitcoin, blockchain technology has been used in a myriad of other ways. Proclaimed as a game changer, blockchain is expected to revolutionize the way transactions are seen and performed and supply chains are managed. Indeed, large companies across a variety of industries have already begun exploring its potential. For example, Walmart is currently exploring blockchain to track food for improved safety,[1] and tech giant IBM has invested more than $200 million in blockchain research. Blockchain "refers to a growing list of digital records of transactions organized into blocks that are linked together by cryptography" (AICPA, 2020, p. 2). Blockchain, which is also referred to as a distributed ledger technology, enables trackable, transparent, and secure information and transactions without any controlling intermediary (Stein Smith, 2019). Transactions and information are simultaneously recorded and synchronized within the network.

[1] https://digital.hbs.edu/platform-rctom/submission/walmart-and-block-chain-it-takes-two-to-mango/

With this paper, I aim to understand how the advent and implementation of permissioned blockchains[2] transform accounting practices. As Bonsón and Bednárová (2019) note, "after analyzing the characteristics of blockchain architecture, private blockchain architecture seems to be an interesting tool for accounting, as it might offer solutions for better auditability, automated control, and reliability of data" (p. 736). Dai and Vasarhelyi (2017) argue that blockchain plays the role of an accounting system that "distributes the power of transaction verification, storage, and management to a group of computers in order to prevent any unauthorized data changes" (p. 6). Up until now, the bulk of academic research focused on these potential changes and tended to be rather conceptual. Only a limited number of studies look at the changes occurring within organizations. The specific type of blockchain I am studying introduces the notion of triple-entry accounting, which can disrupt business processes. Therefore, it is necessary to understand the impact of blockchain on business processes. This is thoroughly explored in some of the recent accounting information systems literature (Albizri & Appelbaum, 2021).

In recent years, there have been significant developments in all areas of accounting influenced by new technologies, such as blockchain, which introduces a new way to store accounting information. Blockchain challenges an old accounting system that has not been changed for a long time: double-entry accounting. As demonstrated by Cai (2021) and supported by Maiti et al. (2021), blockchain leads to a new form of accounting recording, triple-entry accounting. Triple-entry accounting is an enhancement to the traditional double-entry system in which all accounting entries involving outside parties are cryptographically sealed using the blockchain and linked by a transaction within a third-party entity in a common ledger. The concept of triple-entry accounting first emerged with Ijiri (1986), who proposed a conceptual idea based on physics to integrate the notion of time in financial statements to reduce the desire of top management to manage a company in the short term. More than 20 years later, this idea of triple-entry accounting appears with Grigg (2005), who proposes cryptographic signatures and a model that is more like what we see now with blockchain. With the emergence of blockchain, it seems that triple-entry accounting resurfaced with concrete applications. In 2016, Deloitte published a short document about the potential of blockchain, including how triple-entry accounting can be a game changer (2016). Cai (2021) explored blockchain applications based on this triple-entry accounting framework.

[2] To avoid confusion concerning distributed ledger, blockchain technology, and permissioned blockchain, I use the term blockchain in this paper to refer specifically to permissioned blockchain (private or hybrid blockchain). "A permissioned blockchain is […]: only members approved members (peers) can join the network. Each peer belongs to one organization, and the group of all organizations participating in the network is called a consortium." (Calderón & Stratopoulos, 2020, p. 309-310). Hybrid blockchain can define as "supply chain systems will be formed through integrations of blockchain into current systems, and a hybrid system with public on-chain data and private off-chain data will be used" (Bellucci et al., 2022, p.138).

Building on a qualitative research method, I conducted 28 semi-structured interviews with early adopters, i.e., blockchain experts, accountants, and chief executive officers (CEOs) who chose to implement blockchain technology within their organizations. More specifically, I explored how an organization's system can be reconfigured to adapt to new accounting practices, generating a new way of collecting, storing, processing, and communicating information. My analysis reveals two broad insights. Firstly, it highlights the simplification of accounting operations with triple-entry accounting, which offers a higher degree of transparency. Secondly, and most importantly, it illustrates how a single version of reality, with a single ledger for all blockchain network participants, tends to decrease transaction costs and improve relations with suppliers. Such observations lead us to explore the changing role of accountants, who can no longer be considered the gatekeepers of financial reporting.

1.7. Thesis Structure

The dissertation is organized as follows. The first three chapters present each doctoral essay and were written as stand-alone papers. The remainder of this dissertation discusses the three studies in detail. In the last chapter (Chapter 5), I discuss the contribution of the three essays to my dissertation and suggest directions for future research.

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CHAPTER 2

RISKS AND BENEFITS OF INITIAL COIN OFFERINGS: EVIDENCE FROM IMPAK FINANCE, A REGULATED ICO

2.1. Abstract

This study provides a better understanding of the business and the regulated environment surrounding Initial Coin Offerings (ICOs). An ICO is a call for funding to raise funds through a blockchain, where cryptoassets are issued. Key stakeholders involved are the firms launching ICOs, the investors and the financial regulators. We conducted a case study of a firm that launched an ICO, impak Finance, the first regulated ICO in Canada. Based on the interviews of key respondents, we developed a framework identifying the main risks and benefits for firms to perform an ICO, showing differences between unregulated and regulated ICOs.

Our study makes a number of research and practical contributions. First, we document the case of the first regulated ICO in Canada. The interviews conducted provided access to privileged insider information. Second, very few studies have been conducted on the impact of blockchains as a financing vehicle. ICOs using blockchains may be disruptive not only from a technology standpoint but also from a financial standpoint. While the possible applications of blockchains are unknown to us to date, we do know that blockchains have the potential to challenge the traditional financial system monitored by financial regulators. Lastly, the study identifies, through a framework, the risks and benefits of performing an ICO in an unregulated versus a regulated context, which has practical implications for firms operating in the fintech space. We trust that this framework will be useful for firms using ICOs, for investors and for financial regulators.

2.2. Introduction

Several options exist for a firm in need of financing; among these are venture capital, angel investors, crowdfunding and initial public offerings (IPOs), to name a few. With the advent of blockchain technology, a new option emerges: the initial coin offering (ICO). An ICO exists when a firm issues cryptoassets (also called tokens), through a blockchain, to be sold to investors to get funding. ICOs have exploded, being seen as a highly efficient new mechanism for raising capital for new projects in the fintech area[1] with the potential to transform business and financial models (CPA Ontario 2018). For instance, from January 2013 to March 2020, ICOs allowed firms to raise over US$29 billion.[2] A key specificity with ICOs is that significant money may be raised at low cost, in a short period of time, and in many cases without the involvement of financial regulators, which could be deemed "unregulated." The legal uncertainty round tokens issued by ICOs (do they qualify as securities or not) is a key reason why ICOs have proliferated so quickly, at barely no costs for the issuers, contrasting with other regulated funding involving significant costs to raise funds and to then cover compliance costs. The unresolved legal status surrounding ICO tokens (securities or not) is considered by some as a "business opportunity" to raise significant funds. Jurisdiction, for legal and tax purposes, is also an issue for authorities,

as ICOs may be run from anywhere, including tax havens. Regulations on ICOs vary from country to country, ranging from prohibition (China) to relative accommodation (Singapore, Switzerland) and the possibility of becoming regulated (Canada). Competition between countries to attract investments in fintech, while considering investors' protection, put pressure on financial regulators worldwide. Canada places fifth on a crypto-friendly index ranking countries based on how they treat fintech initiatives, including for ICOs (Novak et al. 2019).

In this context, this study aims to provide a better understanding of the business and the regulated environments surrounding ICOs, showing differences between unregulated and regulated ICOs. Key stakeholders identified are the firms operating in the blockchain space, the investors, and the financial regulators. To get deeper insight, we conducted a case study of a firm that launched a regulated ICO. Our case firm is impak Finance, the first regulated ICO in Canada. Based on prior research and interviews of key respondents, we developed a framework identifying the main risks and benefits to performing an ICO for key stakeholders. Our main research question is as follows: What are the risks and benefits for the firm, the investors, and the financial regulator when launching either an unregulated or a regulated ICO?

Our study makes a number of research and practical contributions, of which we highlight a few. First, we document the case of the first Canadian regulated ICO through the examination of interviews with key stakeholders involved. We are not aware of any study having done this before. The interviews conducted provided access to privileged insider information. Calls for conducting qualitative research to get insights on motivations to launch ICOs, and to invest in ICOs, have been made (Schmitz and Leoni, 2019; Fisch, 2019). Second, very few studies have been conducted on the impact of disruptive technologies, such as blockchains, utilized as a financing vehicle. ICOs using blockchains may be disruptive not only from a technology standpoint but also from a financial standpoint. While the possible applications of blockchains are unknown to us to date, we do know that blockchains have the potential to challenge the traditional financial system monitored by financial regulators. Prior research paid little attention to ICOs. Last, the study identifies, through a framework, the risks and benefits of performing an ICO in both an unregulated and a regulated context, which has practical implications for those involved in the fintech space. We are not aware of studies integrating the three stakeholders referred to—namely, a firm launching an ICO, the investors, and the financial regulator. We trust that this framework will be useful for future research, for firms operating in the crypto space, and for the financial regulators.

The article proceeds as follows: we present background information on ICOs and related concepts, followed by a review of previous literature to then bring to light the risks and benefits of ICOs in an unregulated context; next we describe the method; and then we present the findings. The last section offers a conclusion, limitations and future research.

2.3. Background information and previous literature

2.3.1. Blockchains

Why blockchains? We need to go back to the global financial crisis of 2007–2008, one of the most serious crises since the 1930s.3 It started in the United States with the failure of high-risk mortgage loans (subprime), leading to the bankruptcies of several major banks, impacting the global financial market. This financial crisis, due to excessive risk-taking by banks, significantly eroded the confidence of consumers and firms in financial institutions worldwide—a context that was then conducive to the development of the concept of blockchains. Nakamoto (2008) proposed blockchains, an electronic cash system, using a peer-to-peer computer network allowing online payments directly from one party to another without going through financial institutions, hence eliminating the third party. Nakamoto also proposed to create a cryptocurrency, namely Bitcoin, instead of using fiat currencies such as the U.S. dollar, the euro, or the Canadian dollar. Accordingly, financial transactions may be performed between computer users using cryptographic proof, without the involvement of financial institutions such as banks (Crosby, Pattanayak, Verma, and Kalyanaraman, 2016). Blockchains and Bitcoin were hatched as an act of defiance "touted by its early champions as an antidote to the inequities and corruption of the traditional financial system" (Peck, 2017).

Blockchains can be defined as shared distributed ledgers that facilitate the process of recording transactions and tracking assets within a network of computers. An asset can be tangible (car, land) or intangible, such as intellectual property (patent, copyright). Another definition is a technology that allows the registration of transactions that is organized in chronological order and that relies on a distributed network of users via the Internet (Desplebin, Lux, and Petit, 2018). Abreu, Aparicio, and Costa (2018: 1) point out the characteristics making this distributed network so attractive: "This ledger information operates with encrypted data to implement identification, authentication, and authorization of access to information. Integrity and trust in data, which is in the information systems, are the main objectives of blockchain technology." A key characteristic of blockchain is the absence of a central authority in charge of management and control. In short, no banks are needed to validate and control transactions, and no central banks to issue and control currencies.

2.3.2. Cryptoassets

Cryptoassets refer to listings on a firm's balance sheet that exist and are transacted on a blockchain and have some tradeable value (Pimentel et al. 2020). This includes cryptocurrencies as well as digital tokens running on a blockchain. Historically, cryptoassets have often been referred to as cryptocurrencies, Bitcoin being the first cryptocurrency issued. Following Bitcoin, hundreds of cryptoassets have been issued, among them the most known Ethereum, Ripple and Litecoin. With a fiat currency like the Canadian dollar, a government acts as a trusted party and guarantees the value of the currency. Yet with cryptoassets, there are no third trusted parties or central securities depositories. According to Finma (2018), there are four main types of cryptoassets: cryptocurrencies, which are tokens that are used as a means of payment for acquiring goods

or services or as a means of money transfer; utility tokens, which are used to grant access digitally to an application service, or a digital platform; asset tokens, representing debt or equity (which some qualify as securities) that can be used for investment purposes; and hybrid tokens which may be, for example, a utility and payment token at once. The possibilities of various types of tokens contribute to the debate of whether they qualify as securities or not, which also challenges the presentation of cryptoassets in financial statements.

2.3.3. Digital Platforms

Digital platforms are used to carry out transactions of cryptoassets. Available on the web, these platforms of exchanges provide the ability to buy and sell cryptoassets. Some platforms offer investors access to information, such as prices, orders, and trades. Platforms are considered the weak link in the blockchain ecosystem, since the vast majority are not regulated (CSA, 2018b). Frauds have been reported on the trading platforms, yet not on the blockchain system itself, which is proven to be reliable and secure in terms of recording and validating transactions.

The Canadian Securities Administrators (CSA) warns investors of the risks of relying on platforms managing cryptoassets, such as the absence of a trustworthy authority monitoring the platforms. A further issue is the reliability of information provided, as investors only have access to information provided by the issuer, without any verification from a third party. As well, some cryptoassets can only be used on a specific platform or for certain functionalities, products, or services.

2.3.4. Initial Coin Offering (ICO)

An ICO can be defined as an open call for funding by a firm to raise funds through a blockchain, where cryptoassets are issued (Adhami et al. 2018). An ICO is as an alternative fundraising model similar to equity crowdfunding. Investors may invest in cryptoassets with the objective that the firm's projects will become successful, increasing the value of the cryptoassets held (Debler 2018). The typical steps of an ICO include 1) the dissemination of a white paper describing the firm's project (e.g., new products, applications, services); 2) promotion of the ICO on the web and media; and 3) the launch of the ICO, with the issuance of cryptoassets in exchange for funds (Deng et al. 2018). These steps can be completed very quickly, within a few months, and as of now without the involvement of a financial regulator. The important step is the white paper, which is similar to a prospectus. A prospectus is a document providing details about the proposition of a firm's project to get funding. The white paper presents the planned project, the team involved, the sought-after investors and the funds needed, together comprising an assessment of the project for potential investors. With regard to the price asked for the token issue, a "pre-ICO price" is determined by the management team, whereas the post-ICO price is determined by the market, say by the network's participants (Kaal et al. 2018).

2.3.5. Previous literature

Schmitz and Leoni (2019) provided a comprehensive and recent review of academic literature and professional reports on blockchain and its main implications for the

accounting and auditing fields. Their study finds that the most-covered themes are governance, transparency and trust, continuous audit, smart contract, and the accountants' and auditors' new roles. There was no mention of ICOs in their review. Very recently, the Journal of Accounting and Finance published a special issue on blockchain, with nine articles covering topics such as smart contracts, technology risks, security, roles of accountants and auditors, and tokenization, with no articles covering ICOs or using a case study method.4 We thus expand our review, employing the keywords ICO, initial coin offering, ITO, initial token offering, benefit and risk (and combinations of these keywords) covering the period 2013–2020, as the first ICO was launched in 2013 by Mastercoin. We considered the articles and papers engaging in ICOs within the context of our study; our selection is in line with the approach of Kim and Kuljis (2010) and Schmitz and Leoni (2019), who suggest focusing on relevant articles and papers to obtain greater insights from a literature review.

As a new financing vehicle, ICOs have been studied by the entrepreneurial finance field (e.g., Adhami et al., 2018; Huang, Meoli, and Vismara, 2019; Masiak, Block, Masiak, Neuenkirch, and Pielen, 2020; Ackermann, Bock, and Bürger, 2020; Amsden and Schweizer, 2019). These studies cover token underpricing, the amount raised by ICOs, and liquidity, where risks identified are from the investors' perspective and fall mainly into the high volatility of cryptoassets and possibility of frauds (Conley, 2017). Kaal and Dell'Erba (2018) also examined the risk factors for investors and the lack of clear guidance from the financial regulator. For Dimitropoulos (2020), there are significant challenges on how to regulate blockchains using ICOs, described as a "Wild West" featuring "appealing projects" to attract "uninformed investors." Current research asks questions rather than providing answers; for instance, Moll and Yigitbasioglu (2019: 11) ask, "What form of regulation is required to govern the practice of raising capital through ICOs?" Fisch (2019) suggests that investors should better understand key determinants before investing in ICOs—namely, the firms' white papers, the token supply, and the technology standard used. He also explains how regulations could be developed as ICOs gain more widespread adoption. To prevent fraudulent ICOs, where the firm disappears after raising funds, Fisch puts forward that financial regulators could enforce the publication of quality white papers. He also mentions that "little is known about ICO investors" and it is "absolutely crucial to better understand investors in ICOs to more comprehensively understand the dynamics of ICOs" (Fisch, 2019: 20). As future research, Fisch suggests conducting qualitative research to investigate firms' motivations to launch ICOs, and investors' motivations to invest in ICOs.

More specifically, Sapkauskiene and Visinskaite (2020) concluded "ICO is becoming more frequent, but it has not been thoroughly researched and it is still not clear how its advantages and risks affect its success" (p. 1479), pointing to a lack of empirical evidence. Venegas (2017) took an investors' perspective and reported that they irrationally underestimate the risks of investing in ICOs, going against the basic principle of diversification (say invest in different geographies, sectors and asset classes). For Venegas, in a decentralized network economy, the level of risks may be even higher due to blockchain concentration; everything may live on a few networks such as Bitcoin or Ethereum. On the future of ICOs, Joo et al. (2019) mention that this funding

channel highly depends on appropriate regulations supervision and "a better understanding of risks and benefits" by key stakeholders.

In short, prior literature covers ICOs risks from the investors' viewpoint, with some studies alluding to the role to be played by the financial regulators. We are not aware of studies integrating the three-referred stakeholders, namely the firms launching ICOs, the investors and the financial regulators. Regarding to method, prior studies are either reviews of prior research, descriptive or quantitative, while our study takes a qualitative approach using interviews of key informants. As pointed out by Schmitz and Leoni (2019), a "qualitative realistic case study of blockchain adoption may provide in-depth insights into its impacts, including investigating the perceptions and experiences of key players" (p. 339) where interviews may "be conducted to provide first-hand information from early adopters" (p. 340). We thus contribute to the literature by suggesting a framework of ICO risks and benefits, from the perspective of three key stakeholders, in context of when firms operate in a regulated or unregulated environment. As a first regulated ICO, our case study, impak Finance, may be considered an early adopter.

At present, in some jurisdictions, it is still possible to launch an unregulated ICO. Accordingly, in the next section we present the risks and benefits that firms and investors may encounter in an unregulated business context. In the present paper, we discuss an ICO as either unregulated or regulated, in reference to the Canadian context. Depending on the jurisdiction in which the firm is operating, the financial regulator may apply different rules and laws. For instance, ICOs are totally banned in China, while allowed in Canada.

2.3.6. Risks and Benefits for Firms and Investors When Performing Unregulated ICOs

Claimed key benefits to raising funds using ICOs, including speed-to-launch, low costs, and few compliance requirements, are very attractive benefits for startups and small and medium-sized enterprises that cannot afford the costs and time required by traditional funding sources (Deng et al., 2018). Firms in the dynamic blockchain space need to move fast. Other claimed benefits are the efficiency and reliability of transactions in blockchains, where funds can be collected from around the world and be quickly verified. Firms using blockchains for ICOs can raise significant funds in a very short time period and without geographical restrictions.

With blockchain being nascent technology, digital platforms for trading cryptoassets include significant risks, calling for specific expertise to assure the robustness of issuing firms' information systems (CSA, 2018b). According to the CSA (2019), platforms may operate in jurisdictions that have limited asset protection for investors in case of bankruptcy or insolvency, and the information available for trading is not considered reliable. These platforms are subject to significant cybersecurity risks due to lack of internal controls. To illustrate, QuadrigaCX was the largest cryptocurrency exchange platform in Canada. The unexpected death of its CEO, who was the only one in possession of the passwords to client accounts, left holders of cryptoassets with no possibility to retrieve their funds. The investigation reports the absence of basic internal controls. As a result, more than 76,000

unsecured cryptoasset holders claimed a total of C$214 million. When Quadriga declared bankruptcy, the investors lost everything. Consequently, platforms of cryptoasset exchanges pose risks for firms raising funds through an ICO, as well as for investors having no asset protection in case of bankruptcy or insolvency. A related element to consider is the volatility of the cryptoasset market as there is no central authority to provide stability. To illustrate, the volatility of Bitcoin, the first and most recognized and established cryptocurrency, ranged from US$1,027 to US$19,657 between 2017 and 2019. That being said, this volatility depends on the currency it is benchmarked against. Over the last few years, currencies from established countries have, surprisingly, likewise shown high volatility, including the British pound, the Turkish lira, the New Zealand dollar, and the Japanese yen.

From an investor's perspective, buying cryptoassets from an ICO represents a new investment opportunity that did not exist before. Some ICOs provide investors with "anonymity" and potentially significant returns yet no confirmation on the real identity and legitimacy of the issuing firm. For some, using ICOs to raise funds is an ideal vehicle for shady projects, fraud, or money laundering activities.7 For unregulated ICOs, investors have no protection from regulators and no possibility of legal action. It appears that firms performing ICOs may reap significant benefits in terms of cost savings, while investors seem to bear great risks. We now turn to the research method.

2.4. Method

We conducted a case study of the first regulated ICO in Canada, impak Finance (impak.eco/en/). The case study allows the capture of a rich and in-depth comprehension of interrelated phenomena (blockchains, ICOs, and cryptoassets) and the ability to involve key stakeholders. Our research approach refers to a paradigmatic case that aims to establish a novel perspective and the understanding of a new phenomenon (Cooper and Morgan, 2008). We performed eight semi-structured interviews with seven key respondents who had expertise in the fintech area, including blockchains, and experience in dealing with ICOs, including with regard to the risks and benefits for parties involved.

We identified three key stakeholders for our study on regulated ICOs, say the firm itself, the financial regulator and the investors. We decided to contact these three different groups of informants to get a better understanding of ICOs. For the case firm, we had the opportunity to interview a top executive who, based on prior research, promised to be the most relevant informant about the firm with regard to its strategy, management and operations. This executive fully cooperated and answered all our questions on the firm's ICO experience.

For the financial regulator, we conducted two interviews, one with an expert working for the regulator and one with a fintech expert who had worked for years at the regulator, including on ICOs. Accordingly, in the context of our study, we believe we have interviewed key informants with regard to the case firm and the financial regulator. During the interview with the impak top executive, he revealed the importance of two key players when launching a regulated ICO: the lawyer and the auditor. We thus interviewed these two experts to gain more insights.

For the investors, we tried to reach them using our network of contacts, but because investing in impak was not well perceived among the investor community, we never got any names. As an alternative, we scrolled through impak's Facebook page and read comments posted over a period of two years. Based on that search, we found only six individuals who clearly indicated having invested in impak. We contacted all six investors with requests for interviews, but only two agreed. Moreover, when we asked these two investors, at the end of each interview, if they could refer us to other investors for our study (with a snowball approach in mind), neither was willing to suggest names. Of the many comments posted on impak's Facebook page, we have selected two relevant quotes illustrating the issues raised in our article. Given the qualitative nature of our inquiry, the findings are not intended to be generalizable but rather aim to provide a better understanding of the business and the regulated environment surrounding the first regulated ICO in Canada. Accordingly, we need to keep in mind the boundary conditions of our qualitative inquiry when interpreting the study's findings, including our limited set of interviewees.

All interviews were recorded and transcribed, with the exception of one where detailed notes were taken during the meeting by the interview team. The table below provides the profiles of the interviewees and the appendix lists the questions asked. Confidentiality was provided to ensure that interviewees would speak freely and give us the most accurate information of the phenomenon.[8] We also examined publicly available documentation on the case firm to obtain a better knowledge of the firm and its projects.[9]

Insert Table here

Data analysis was done based on Langley (1999) and Yin (2013). Our data analysis focused on the interviews conducted using thematic analysis. This involved identifying themes when analyzing the interviews and grouping all elements with the same theme. We aimed at obtaining a descriptive understanding of data collected. The interview transcripts were categorized using the research objectives, themes from the stakeholder model, a risk management perspective and themes identified in the literature. We considered the interaction of these elements in the coding, generating a grouping of risks and benefits for each key stakeholder. Interview transcripts were re-read with a focus on risks and benefits. Our data analysis entailed an iterative process, going back and forth between data and emerging findings.

2.4.1. The Case Firm

The case firm is impak Finance. The firm was established in May 2016 in Montreal, Canada. Impak's mission is to produce a positive social and environmental impact through an ecosystem of financial services powered by financial technologies. The organization wanted to create the first digital currency with a social purpose. One of the main firm's objectives is:

> to give a voice to every citizen wishing to use own money as a force for the good […] citizens will be able to identify impak merchants and have access to products and services aligned with their values. They will be able to actively

> participate in transforming the world every day by responsibly choosing which companies their money will support. (impak Finance 2017, white paper, page 9)

Impak aims to create an ecosystem connecting users (consumers) with merchants prequalified as having socially responsible business practices. The currency to be used in this ecosystem is the impak coin, MPK, a virtual cryptoasset. Users use MPK as a token within the network to purchase goods and services from the participating merchants, and then get 5 percent of those purchases back in MPK. In short, consumers buy from ecoresponsible firms approved by impak and receive rewards in MPK.

Impak management attended a conference in Toronto in March 2017 entitled Canadian Crowdfinance Summit, at which the idea was represented to use ICOs to raise funds. The main rationale for using ICO was "it's fast and it's a non-dilutive financing" (top executive at the case firm; Interviewee #2*)*. Impak was drawn to the idea as a way to create "the cryptocurrency impak coin and a reward token system" (Interviewee #2). This conference was an important turning point as it prompted the firm to adopt a new financing model and to create its own cryptoassets, named MPK. From the start, impak management sought to do the right thing and contacted the financial regulator to get approval to launch a regulated ICO.

In its white paper, impak enumerated the key risks involved for investors, informing them that "participation in crowdsale at this time is highly speculative due to the stage of the corporation development, and requirement to raise additional financing to carry out its long-term business plan" (impak Finance 2017, white paper, p. 42). There are risks related to impak and its industry (e.g., limited operating history, no assurance of profitability, stringent regulations, no guarantee of success and future growth) and risks related to a crowdsale (e.g., pricing, no guaranties of liquidity for MPK, restrictions on resale of MPK, changes in the law, complete loss). Impak aimed to fully inform current and future investors of the risks implicated. Figure 1 provides a general description of the case firm to the public from its website.

Insert Illustration 1 here

We now turn to research findings.

2.5. Findings

We present background information on the risks and benefits for firms and investors when performing regulated ICOs. Then, we cover the first regulated ICO in Canada, the financial regulator's experience, the investor's experience, and conclude with a framework of the risks and benefits of ICOs.

2.5.1. Risks and Benefits for Firms and Investors When Performing Regulated ICOs

In Canada, the financial regulators may regulate ICO activities to raise funds. In such a context, risks and benefits are different for firms and investors. A major perceived

benefit is the credibility associated with the firm's project as the financial regulator has examined the fund raising project, providing some legitimacy and protection to investors.

Firms undertaking regulated ICOs are required to comply with stringent rules required by the financial regulator, including KYC (Know Your Customer) and AML (Anti-Money Laundering) rules. Operating in a regulated environment may offer peace of mind to management and owners and may provide the firm, in the dynamic ICO market, with a competitive advantage as investors may look to invest funds in firms operating within a regulated framework. But with regulations come boundaries, restrictions and exchange rules. Requirements by the regulator to launch an ICO include sound governance practices, effective internal controls, reliable financial reporting and various compliance mechanisms (CSA 2017, 2018, 2019). All these represent additional burdens for firms. To reduce these burdens, financial regulators in some countries developed fast-track programs called sandboxes. In Canada, the CSA adhered to the sandbox initiative, providing some exemptions for firms operating in the fintech space and wanting to launch ICOs involving securities, namely an investment contract.[10] From an investor's perspective, the financial regulator's involvement may provide some evidence of legitimacy to an ICO. In such a case, investors may obtain regulatory protection. That said, as any other investment under regulations, it then comes down to the investors to evaluate whether the firm's project is worthwhile pursuing.

ICOs have led to tensions between the security regulators and ICO advocates, including entrepreneurs and investors. One challenge is how to balance investor protection and investment in blockchain technology while supporting innovative projects beneficial to the economy (CPA Ontario 2018). For instance, the SEC sued the Waterloo-based messaging app Kik Interactive for having launched an unregulated ICO, violating securities laws (Kik argues it did not sell a security token but a utility token). The massive capital raised with ICOs is challenging the relevance of the current stringent financial regulatory system, which was designed before the digital age (Deng et al. 2018). For ICO advocates, do we really need financial regulators in the crypto space? And if so, what may be their added value? In response to this, Canadian regulators have approved a few ICOs through the sandbox program, including our case firm impak Finance.

2.5.2. Launching of the First Regulated ICO in Canada

Impak Finance was the first regulated ICO launched in Canada. In September 2017, the firm obtained exemptions from prospectus and dealer registration from the Canadian regulators to issue MPKs to Canadian and foreign investors (for instance, they sold MPKs to over a hundred American residents). From the ICO, impak raised more than to C$1.4 million. To do so, a first key activity was the implementation of a trading platform for investors to buy MPKs. Since, as mentioned earlier, there was no regulated crypto exchange platforms, the financial regulator asked impak to develop its own proprietary platform. The regulator had requirements concerning the classification of investors and their identity. According to interviewee #2, impak reached a category of investors who were investing in cryptoassets for the first time. An internal survey indicates that two thirds of the investors were not familiar with blockchains

and the crypto space. For impak, this type of investor profile was associated with the eco-responsibility project, and the firm's core values and commitment to sustainability.

The platform developed by impak played both the role of a broker and verifier of investors. This process was approved by the regulator and they worked closely with them to finalize the authentication process. KYC (Know Your Client) and AML (Anti-Money Laundering) were key elements to accept, or not, investors. Investors could buy MPKs by 1) credit card (which was linked to a legitimate bank and permitted identification), 2) Bitcoin or 3) Ether. The majority of investors (75%) used credit cards to purchase MPKs. Impak's executive director provides clarifications on the profile of investors sought:

> So we put in place a rigorous qualification process for investors; we could have been more liberal and accepted funds from dubious sources, but that went against impak's mission and DNA; we are thinking of a cryptocurrency for the long term; impak goes against the perception that cryptocurrencies are to make a quick buck, tax-free, in anonymity. (Interviewee #2)

For instance, one of the questions to qualify investors was: What do you want to do with your impak coin? If the answer was to "hide" them, the potential investor was automatically disqualified from the investment process as the objective of impak was not speculation. In total, 8,000 applications were received; of those, 3,000 were checked in detail and approved by the firm, resulting in 2,266 investors who bought MPKs (as a reminder, this unique case of a regulated ICO did not provide anonymity for investors, thereby bucking one of the blockchain principles of providing pseudo-anonymity).

2.5.3. Financial Regulator's First Experience with an ICO

Canadian regulators committed to provide information and guidance to firms interested in performing an ICO using the sandbox program. Even if the sandbox allowed streamlining fundraising to the public with exemptions, timing is key for dynamic entrepreneurs. The timeline, from the first meeting with the regulator to the ICO launch, is important for startups and firms operating in the crypto space. During our interviews, we observed that the notion of time was very different depending on the interviewee we talked to. For the entrepreneur, even the sandbox process was not fast enough. Four months to get approval before raising funds was considered too long. According to Paul Allard, impak Finance CEO, the process with the financial regulator "was difficult in terms of negotiating the user experience" (CPA Ontario, 2018: 18).

The approach taken by the financial regulator was perceived as way too long for the very fast-moving world of blockchains. Describing his experience, the impak CEO mentioned having worked hand-in-hand with the regulator, in a team, to get through. Interviews conducted indicate that a common and shared objective for the firm and the regulator was to be the first Canadian-regulated ICO to be launched: "The work with the regulator was much appreciated […] the regulator guided and provided supports to the firm all throughout the process" (Interviewee #2).

Complying with regulations, the case firm got some form of credibility associated with being "Canada's First Legal ICO," as clearly mentioned on impak's website with a logo to demonstrate its "legitimacy" to the public (see Illustration 2, lower left corner), even claiming in some communications to be among the first regulated ICOs worldwide.

_____
Insert Illustration 2 here
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As mentioned, time was an element of tension between the firm and the financial regulator and can hence be considered to possibly deter firms from pursuing an interest in regulated ICOs. Literature frequently compared ICOs to crowdfunding, with the funding obtained through the latter method being more significant. Raising funds through ICOs has led to tensions between entrepreneurs, investors, and securities regulators. On this, a fintech expert at the financial regulator mentioned:

> The major risk for the regulator is the reputational risk. We don't want to be perceived as stopping innovation, yet not be perceived as giving too much flexibility to these startups. It's not a free ride, and we cannot only play the role of the police; so we have to balance, and it's not easy. The credibility of the regulator is important here. On the one side, we want to support firms wanting to do ICOs. On the other hand, we have to do some prevention and stop at the right time scams or fraud cases. We want to be friendly, but not too much. (Interviewee #5)

We now turn to the investors' experiences.

2.5.4. Investors Experiences with a Regulated ICO

We were interested in getting the perspective of those who invested in impak, and we contacted some of these investors. What attracted investors to impak was the concept of a "regulated ICO" — namely, a firm issuing cryptoassets and complying with the financial regulator:

> Over and above, it's the legitimacy since the financial regulator is behind it. (Investor; Interviewee #3)

> Yes, the risks were present [...] but it was endorsed by the regulator. So I said to myself: it's worth it [...] virtual currencies were trendy. It's approved by the regulator, so we have the chance of having a promising project. (Investor; Interviewee #7)

Motivation to invest was also based on the quality of impak Finance's team (management and board members), which includes experts in business development, and confidence that the firm has valid and solid sustainability projects and values:

> The great project of launching a new economy, we believed in it [...] we wanted to contribute to society by making a socially responsible investment [...] We invested

> in the impak ecosystem, for a virtual currency (MPK) [...] This was the raison d'être of this ICO. (Investor; Interviewee #7)

Sharing their investors' experiences, interviewees mentioned being quite nervous due to the lack of fluidity of transactions. For instance, after buying MPKs, it took time to get access to e-wallet, to be able to perform transactions: "At present, I cannot take out my MPKs" (Interviewee #7). Another key issue concerned the less-than-prompt availability of financial information, including the production of audited financial statements:

> I thought it was suspicious. I examined the financial statements and honestly it didn't look too good. I'm not sure they're going to have enough cash flow to continue unless they get another investment. So I'm wondering what's going to happen. (Interviewee #3)

This quote points to the precarious situation and delayed production of impak's financial information. Initially, the investors had confidence due to the legitimacy granted by the financial regulator, the eco-responsible values, and the management team and board. But this built legitimacy lost its appeal when the case firm encountered difficulties in providing timely financial information, such as audited financial statements, and when it posted deficits and the liquidity issue with MPKs. Impak's Facebook page was awash with investors' complaints about the way the firm is managed. For example, one investor wrote, "At the end, we funded big dreamers who took people's money to fund 1001 projects except the main project, which was to have a legal cryptocurrency that works" (C. Robert),13 and another investor, commenting about liquidity, wrote, "Currently, I don't even have the possibility to sell my MPKs" (PL Jonathan).

Hence, in a regulated ICO context, a firm may rapidly gain legitimacy vis-à-vis investors, yet may also lose it quickly. Operating within the constraints of the financial regulator brings benefits in terms of credibility, but also risks and costs. For instance, producing on-time audited financial statements may be a challenging requirement for startup firms due to their limited resources, lack of internal control in place and the difficulty of finding an auditor who can audit cryptoassets.

Although the sandbox consists of exemptions, firms issuing a regulated ICO are not discharged from providing annual audited financial statements to the regulator (Pimentel et al. 2020). The first auditor of impak Finance, for the year end April 30, 2017, was RCGT (Raymond Chabot, Grant, Thornton). But the following year, RCGT did not renew the audit mandate, as clients in the crypto space were being considered by all audit firms at that time "too risky," or "not auditable." According to impak, this was due to the lack of standards to audit blockchains firms. If we go back in time, there were a lot more uncertainties among auditors on how to perform the audit of firms operating with blockchains and dealing with significant cryptoassets. No clear guidelines existed.[14] Many Canadian firms in the crypto space faced the same issue as impak (see footnote).[15] Other auditors refused mandates in the crypto space due to a lack of training in this new technology to assess the audit risks (Richins et al. 2017; Tschakert et al. 2016). We obtained the following quote from an auditor:

> It ultimately comes down to risk […] (an audit) firm […] isn't going to do something unless they are 100% [confident] […] because the only thing worse than not doing it is doing it and ending up on the news the next morning because […]you didn't know what you were doing and you missed something. (Interview #6)

Here, the level of audit risks impacts on the auditors' ability to protect themselves against reputational risk. They are concerned about their degree of confidence, "missing something" resulting from their lack of expertise to audit transaction with cryptoassets. To find another auditor, impak contacted all audit firms in Montreal, small, medium, and large. They were all reluctant to conduct the audit due to the lack of standards, and some also due to lack of expertise. Regarding the accounting of digital currencies, the auditor has to interpret existing standards using judgment. It was a stressful situation for impak management and impak investors. One major consequence of not producing audited annual financial statements on time is a cease trade of its cryptoassets, which is unfortunately what happened. It was a very bad signal for both current investors and those the firm was seeking to solicit. Operations were frozen. KPMG ended up being the auditor for the financial statements ending April 30, 2018, and the cease trade was lifted. The issue of availability of financial information has been raised by investors:

> Honestly, I don't know how to monitor this investment, where to get relevant information […] The MPK is not visible on trading platforms, not listed on the stock market […] I ended up following my investment on social networks! (Investor; Interview #7)

This quote reminds us the warning from the CSA on the lack of reliable financial information in the crypto space, with investors having only access to information provided by the issuer.

What is interesting here is that even though impak fully cooperated and complied with the financial regulator's stringent requirements, the regulator nonetheless applied strict rules when the firm was late in submitting its financial statements. According to impak management, the cease trade on MPK nearly put an end to the firm. Having desperately looked for, and finally found, an auditor caused a significant cost to impak in terms of time, energy, stress and money. The lesson learned here is the risks involved for a firm raising funds in compliance with the financial regulator. Our case study provides a "real test" for firms in the crypto space, and for investors, highlighting the risks and benefits to raised funds through regulated ICOs.

2.5.5. Proposed Framework

Based on all the information we collected and analyzed, Figure 3 suggests a framework summarizing the risks and benefits for the blockchain firms, the investors, and the financial regulator in the contexts of an unregulated ICO and a regulated ICO.

Insert Illustration 3 here

We refer here to three key stakeholders interacting in an ICO context. These interactions are shown using bidirectional arrows. In Figure 3, we show that the blockchain firm interacts with the investors and that investors interact with the firm, regardless of whether the environment is regulated or unregulated. In a regulated environment, the firm interacts with the financial regulator and the financial regulator interacts with the firm.

Some risks and benefits had already been identified in the literature, while others, given that we investigated a regulated environment, were new findings (as a reminder, risks and benefits of unregulated ICOs have mostly been examined in prior studies, such as Howell, Niessner, and Yermack, 2019). Accordingly, in Figure 3, the risks and benefits shown in the "financial regulator" box may be considered as new since we investigated the first regulated ICO in the context of the first experience for a Canadian financial regulator. As well, we learned that if a digital crypto platform not subject to securities regulation were to fail, the financial regulator may nevertheless be blamed for not having taken jurisdiction, adding a threat to the regulator's reputation. In other words, there is always a risk that some investors may turn to the regulator in cases of financial fraud, referred to here as reputational risk. For blockchain firms in a regulated environment, we learned that they have to incur significant compliance costs, even if they have been approved under the sandbox program. While the sandbox provided some exemptions, it was not considered to be fast enough to launch an ICO. Timing to get funding is crucial in the blockchain space. As well, the production of audited financial statements to the financial regulator caused the case firm, and other firms operating with cryptoassets, major issues as a result of the auditors' refusal to perform audits due to the risks involved and lack of standards. From the study, we also learned that investors overvalued and/or misinterpreted the case firm's claim to be "Canada's First Legal ICO," as stated on its website. For many investors, impak was perceived as a different actor in the unregulated crypto space, being tagged as "legal" and thus legitimate (which we refer to as "legitimacy" in Figure 3). This "marketing tool" used by impak has had a significant impact in the investors' eyes on investing in MPKs. Information obtained from our study has helped to clarify some preconceived ideas. For instance, although the literature mentions that unregulated cryptoassets are not, in general, liquid, we learned from the financial regulator that a regulated issuer cannot guarantee that the cryptoassets issued will be more liquid.

In terms of commonalities between unregulated and regulated ICOs, a common risk, albeit higher in unregulated environments, would be cryptoassets' volatility. Risk and return come into play here. For instance, highly risky projects offered on the Internet, under the radar of the financial regulator, may lead to total loss or windfall gains. Since fake firms/projects could not exist in regulated environments, profit expectations remain "reasonable." That said, even in a regulated context, the token issued will be volatile. A common benefit could be the lower cost. Compared to an IPO, it is significantly less expensive to raise funds for an ICO. That said, as we mention in the paper, in a regulated

context the blockchain firm will incur costs such as compliance costs and audited financial statements, while in unregulated environments firms do not have to incur such costs.

We now turn to the conclusion, limitations, and future research.

2.6. Conclusion, Limitations and Future Research

This study aimed to provide a better understanding of the business and regulated environment surrounding ICOs, showing differences between unregulated and regulated ICOs. Key stakeholders identified are the firms operating in the blockchain space, the investors, and the financial regulator. To obtain deeper insight, we conducted a case study of a firm that launched an ICO: impak Finance, the first regulated ICO in Canada. Based mainly on the interviews of key respondents, we identified the main risks and benefits to performing unregulated and regulated ICOs, which we then integrated into a framework.

Our study makes a number of research and practical contributions, of which we highlighted a few. First, we documented the case of the first regulated ICO through interviews with key stakeholders involved. We are not aware of any study having done this before. The interviews conducted provided access to privileged insider information. Second, very few studies have been conducted on the impact of disruptive technologies, such as blockchains, as a financing vehicle. ICOs using blockchains may be disruptive not only from a technology standpoint but also from a financial standpoint. While the possible applications of blockchains are unknown to us to date, we do know that blockchains have the potential to challenge the traditional financial system monitored by the financial regulators. Last, the study identifies, through a framework, the risks and benefits of performing an ICO in an unregulated and regulated context, which has practical implications for firms operating in the fintech space, the investors, and the financial regulator. We trust that this framework will be useful for the stakeholders involved and future research.

The study examined two business contexts, unregulated and regulated ICOs. Deciding between these two contexts is a critical business decision for firms' management. As a reminder, the benefits of launching an unregulated ICO are numerous and very tempting: low costs, fast, no geographical limits, neither KYC nor AML qualification requirements for investors, and no reporting obligation such as audited financial statements. Too good to be true? Yes and no. While some unregulated ICOs may never face problems, others may get caught. For instance, the SEC sued the Waterloo-based messaging app Kik Interactive for having launched an unregulated ICO over C$97 million in 2017, violating securities laws. Kik argues it did not sell a *security* token but a *utility* token. The firm has been involved since 2019 in a legal battle with the SEC. In this case, there are significant risks and costs to launch an ICO in an unregulated environment.

The study's limitations need to be acknowledged. First, to document a regulated case, we focused on a single firm, which allowed for an in-depth understanding of the firm's business context but limited the generalizability of the results. That said, we documented a unique case, the first regulated ICO in Canada, which provided a better understanding of a

new phenomenon, which refers to a *paradigmatic case* (see Cooper and Morgan 2008). Second, despite the fact that we interviewed key informants, we fully acknowledge that having interviewed more investors would have been preferable, and this is a limitation of our study. We also acknowledge that our insights are generated from the views of these informants. Third, apart from firms, investors, and financial regulators, other stakeholder perspectives could have been further explored, such as those of the auditors, who have to deal with the accounting of cryptoassets. Last, the interview method allowed for an in-depth understanding of a phenomenon but has its limitations. Interviewees can speak freely, providing the opportunity to delve into otherwise hidden aspects related to ICOs. That said, more has to be done to get a broader picture of the crypto world. In the end, we do not consider that these limitations undermine our contribution or reduce the relevance of conducting field studies in such a novel domain.

For future research, it would be pertinent to expand the number of case firms involved in ICOs for investigation. If feasible, it would be interesting to include case studies of unregulated ICOs to make the distinction between regulated and unregulated ICOs. Moreover, as sandbox programs and ICOs are different from country to country, it would be relevant to investigate ICO experiences beyond the Canadian context and to then benchmark where Canada is in term of "crypto-friendliness." A promising research area is without a doubt the analysis of digital trading platforms, which is considered the weakest link for cryptoassets transactions. As a reminder, the precarious financial situation of impak is typical to the context of startup firms operating in the crypto space. As of now, impak is still in business, but investors are warned by financial analysts and regulators that investing in the crypto space is a high-risk call, so much so that these investors would qualify as venture capitalists. Future investigations could examine the challenges in cash flows that firms are facing post-ICO, as well as the profiles of investors willing to take such high levels of risk. Last, from a practical viewpoint, the accounting profession and the standard setter should continue to be proactive in accelerating the development of guidance, standards, and tools to audit cryptoassets in order to properly train the accountants and auditors of the digital age. We hope that our study will contribute to further reflections on the risks and benefits of ICOs.

TABLE 2 - PROFILES OF INTERVIEWEES

#	Position	Date	Time
1	Fintech expert	Sep. 19, 2018	77 min.
2	Top executive at the case firm	May 19, 2019	65 min.
3	Investor in the case firm	July 18, 2019	27 min.
4	Lawyer involved with fintech firms	Aug. 01, 2019	97 min.
5	Fintech expert at the financial regulator	May 29, 2019 March 30, 2020	70 min. 35 min.
6	Big Four accounting firm senior manager	Sep. 12, 2018	54 min.
7	Investor in the case firm	April 24, 2020	40 min.

FIGURE 1 DESCRIPTION OF IMPAK BUSINESS MODEL

(excerpt from impak website,
April 15, 2020)

FIGURE 2 LOGO "CANADA'S FIRST LEGAL ICO," POSTED ON THE CASE FIRM'S WEBSITE

(excerpt from impak website, April 15, 2020)

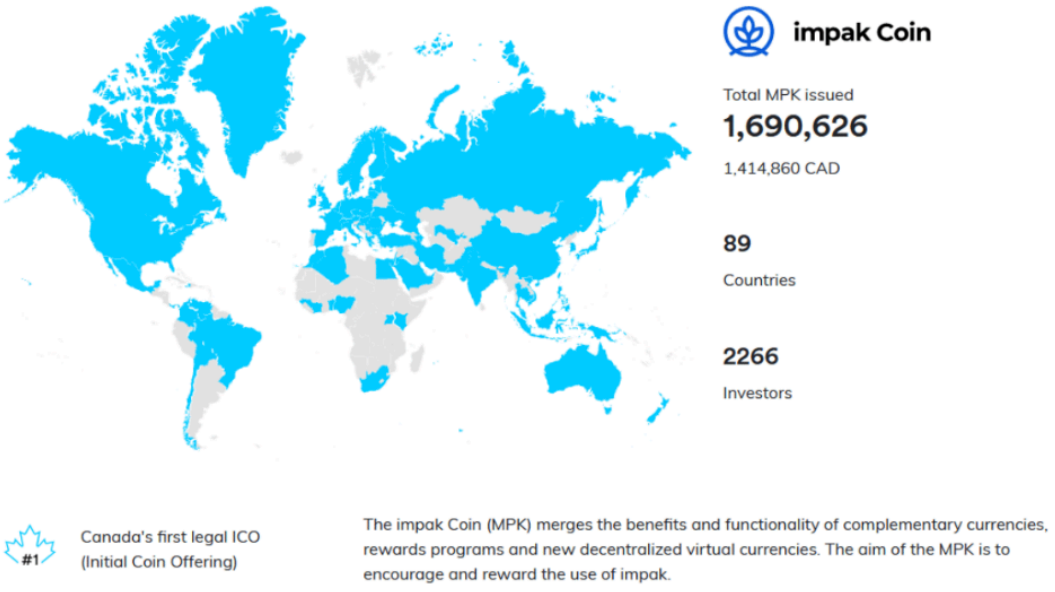
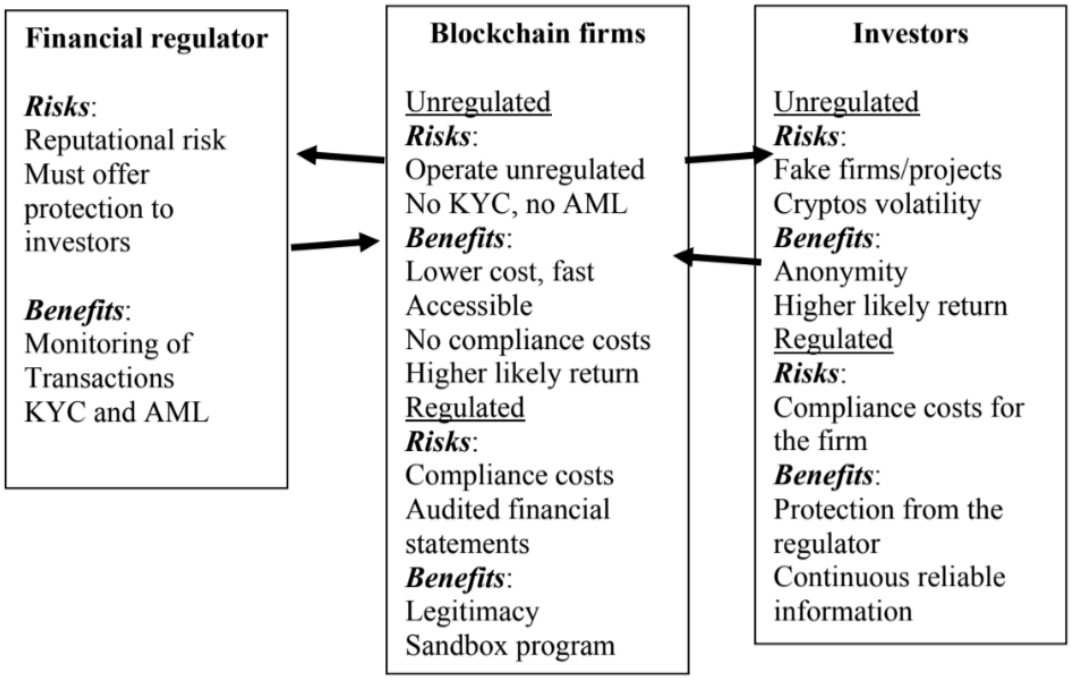


FIGURE 3 - FRAMEWORK OF RISKS AND BENEFITS FOR UNREGULATED AND REGULATED ICOS



Note: KYC means Know Your Customer; AML means Anti-Money Laundering.

Appendix. Questions list to interviewees

Financial regulator/Fintech experts: Describe your experience with ICOs, with the Sandbox? What are the risks for the financial regulator? How does the regulator protect the investors? How does the regulator protect the fintech firms? How does the financial regulator get comfort over the reliability of an audit opinion? For firms, what are the significant risks and benefits of using cryptoassets? What are the risks for a firm such as impak Finance? What are the risks for investors? Which profile of investors participate in ICOs? Which protection does the regulator provide to investors in ICOs? To what extent is the regulator willing to provide support to develop the fintech sector?

Lawyer involved with fintech firms: Describe your experience with ICOs, with the Sandbox? Explain the procedure to qualify for the Sandbox, to get regulatory approval? For firms, what are the significant risks of using cryptoassets? What are the risks for a firm such as impak Finance? What are the risks for the financial regulator? What are the risks for auditors who must issue audited financial statements? If you were given *carte blanche*, and asked to review the process leading to an ICO, what would you change? What do you think about the future of cryptoassets?

Investors: How have you heard about impak Finance? What did you understand from their business project? What were your motivations to invest in impak? Were you aware of the risks involved in buying cryptoassets? Why did you finally invest in this firm? Describe the process you went through to buy MPKs? How did you react when you learned that the financial statements would not be published on time? How do you track your investment? According to you, how is the impak project evolving? Are you satisfied with the way impak management handles the firm? What can you do with your MPKs? What will you do with your MPKs?

Auditors: Provide examples of blockchain-based projects you have provided advice on. Have you been involved in ICO-type transactions? Have you been involved with projects through the Sandbox program? Do you think it is possible to issue an unqualified audit opinion on the financial statements of a company that has a material amount of cryptoassets at this point? Why or why not? Have you issued any opinions in this space yet? Have you audited any clients that use the blockchain as part of their operations or as part of their financial reporting process? How did that complicate or facilitate the audit?

Top executive at the case firm: Please describe your professional background. Tell us the history of the impak project. Where did the idea of an ICO for impak come from? How did you hear about the Sandbox program? How were your negotiations with the financial regulator? What procedure have you set up for investors to purchase MPKs? What profile of investors were you looking for? What profile did you get? For the ICO, tell us your experience with players such as the investors, the lawyer and the auditor? You have a 2-year exemption from the financial regulator; what will happen after these 2 years? What's next for impak?

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CHAPTER 3:

Bitcoin: An Accounting Regime

3.1. Abstract

The Bitcoin blockchain is a payment system designed to disintermediate financial transactions. While many professional accounting bodies have sounded the alarm about the potential for blockchain technology to simplify accounting bookkeeping, few academic articles have been able to transcend high-level conceptual descriptions and dig deeper into the technological nuances of blockchain technology to assess whether or not, and if so, how, blockchain can undermine the accounting profession and its practices. Drawing on a netnography of the early Bitcoin community from the technology's formation in 2008 through to the disappearance of its founder in 2011, this paper aims to explore the role of accounting in the development of a new financial system. We propose that Bitcoin is more than a form of digital currency, but rather a new accounting regime that effectively takes accounting expertise away from accountants. Using sophisticated cryptography and advanced computer programming, the Bitcoin blockchain has created new interpretative schemas for measuring and recording financial transactions. Bitcoin relies on new types of experts, namely computer programmers and cryptographers, and a new form of expertise that fuses technological know-how with accounting concepts. We find that Bitcoin programmers can co-opt accounting knowledge because these concepts do not constitute a sufficiently esoteric knowledge base to protect the jurisdictional boundaries of the profession.

Keywords: Bitcoin; blockchain; accounting regime; accounting profession; expert knowledge

3.2. Introduction

In the last decade, digital currencies have emerged as the backbone of a new decentralized finance movement aimed at disintermediating financial transactions and creating a financial order free of financiers and accountants. This movement is facilitated by blockchain technology and popular cryptocurrencies like Bitcoin and Ether. While many professional accounting bodies have sounded the alarm about the emergence of blockchain technology (e.g., CPA Canada and AICPA, 2017; ICAEW, 2018), academic articles have primarily engaged with the threat of blockchain to the accounting profession on a conceptual level (e.g., Dai & Vasarhelyi, 2017; Kokina et al., 2017). Few papers have been able to transcend high-level conceptual descriptions and dig deeper into the technological nuances of blockchain technology to assess whether or not, and if so, how, blockchain can undermine the accounting profession and its practices.

This paper digs into Bitcoin's system architecture and history to explore the relationship between this technology, accountants, and accounting knowledge. We choose to study Bitcoin because it is the original cryptocurrency and first large-scale application of blockchain technology, making it something of a vanguard for the blockchain industry. Bitcoin is also an appealing choice because its system architecture is built on strong criticism of the traditional financial system (Nakamoto, 2008). More specifically, this paper aims to address two main research questions: (1) *How do accounting concepts contribute to the development of the Bitcoin blockchain* and *(2) How does Bitcoin challenge the hegemony of accountants over this accounting knowledge?*

Methodologically, our paper mobilizes a netnography of the early Bitcoin community to explore the discourse underpinning the formation of this new technology. By mining forum posts and emails between Satoshi Nakamoto (the founder of Bitcoin) and members of the Bitcoin community over the period of 2008 (when the technology was released) to 2011 (when Nakamoto disappeared), we can explore how these individuals mobilize accounting vernacular to establish a new financial order based on the tenets of decentralization, cryptography, and sophisticated computer programming. Additionally, we are able to explore how non-accountants fuse accounting language with programming code to create new ideas about how financial transactions should be recognized and processed. Altogether, this allows us to conclude that where Bitcoin displaces accountants, it makes accounting especially relevant, as accounting provides a vocabulary for Bitcoin developers to make sense of the challenges facing the development of a new financial system.

Theoretically, this analysis builds on the work of Jones and Dugdale (2001) and their concept of an "accounting regime." An accounting regime frames accounting as a technology that is at once "a system of governance (…) that is socially constructed (…) and a set of social practices that generate information" (p. 58). The concept of an accounting regime provides us with a framework to explore the ways in which accounting concepts can be used to create new interpretative schemas for understanding financial flows. We also integrate sociological theories on professional knowledge (Abbott, 1988; Freidson, 2001; Larson, 1977) to explore how accounting, as a prescribed body of knowledge and controlled by a group of experts, can be taken away from accountants, and the potential threats this can pose to the jurisdictional boundaries of the profession.

We find that Bitcoin is an accounting regime that prescribes new ways for recording and measuring transactions. It creates a new ledger for evaluating these transactions that fuse accounting concepts with technological imperatives. In fact, the ways in which Bitcoin architecture is designed are often discussed in (programming) code, as this is a language shared and understood by Bitcoin programmers. We demonstrate that this accounting regime is not owned by accountants, but rather by unelected coders who have co-opted the traditional knowledge of accountants. We argue that these non-accountants are able to appropriate accounting knowledge because it is not sufficiently "esoteric" (Larson, 1977). Where accountants are unable to make an entry into the blockchain space because of high barriers to entry in terms of knowledge acquisition and mastery (Pimentel et al., 2021), non-accountants can easily integrate and mobilize accounting ideas. While our method does not allow us to probe Bitcoin community members directly, we offer a tentative explanation for how Bitcoiners have come by appropriate accounting knowledge. Ultimately, the use of accounting knowledge by non-accountants in a system aimed at disintermediating financial transactions poses a threat to the jurisdiction of accounting professionals, as accountants are unable to protect the "cognitive exclusiveness" (Larson, 1977, p. 181) of their knowledge base.

First, we believe that one of the contributory statements of our work lies to the fact that we challenge the notion of Bitcoin as a simple payment system to demonstrate how its technological architecture is a function of its ideological and accounting aims. We mobilize Jones and Dugdale's (2001) definition of an accounting regime to demonstrate how Bitcoin developers mobilize accounting vernacular to make sense of this new financial reality. Second, we explain the incursion of non-accountants into the traditional cognitive base of accountants by exploring how Bitcoiners co-opt accounting knowledge. We explore how, if a knowledge base is not sufficiently esoteric or well-protected, a profession's jurisdiction can be threatened.

This paper is structured as follows: first, we describe how Bitcoin works to offer a basis for understanding how transactions are accounted for in the Bitcoin blockchain. Next, we unpack the theoretical background for our study, namely the concepts of an accounting regime and expert knowledge as a basis for control over a professional jurisdiction. We proceed by describing our methodology, presenting our findings, and providing a discussion of our results.

3.3. How Does Bitcoin Work?

Bitcoin was first introduced to the world in a politically agnostic whitepaper (Nakamoto, 2008) that proposed a new digital payment system. Bitcoin's founder, Satoshi Nakamoto,[3] indicated that Bitcoin was a response to the double payment problematic.

[3] "Satoshi Nakamoto" is a pseudonym designed to conceal the identity of the true inventor of Bitcoin. It is unknown whether this is one person or a group of people. Despite being a hands-on founder and catalyst for the Bitcoin project, in 2011 Nakamoto posted a single message on an online forum stating that he was moving on to other things. He then disappeared. Before doing so, he handed the reins of the Bitcoin technology over to Gavin Andresen, a collaborator and contributor, as well as to four other individuals who would then become the Bitcoin "core developers," invested in overseeing the governance of the Bitcoin blockchain (De Filippi & Loveluck, 2016).

Bitcoin "was touted by its early champions as an antidote to the inequities and corruption of the traditional financial system" (Peck, 2017). The purpose of the Bitcoin project was to create a "decentralized payment system […] based on a public transaction ledger [operating] in a distributed manner" (Garay et al., 2015, p. 281). This system purported to carry out near-instantaneous peer-to-peer payments without a financial intermediary needing to be involved, all the while engaging low transaction fees. "The technology worked on the principle that, at its foundation, money is just an accounting tool—a method for abstracting value, assigning ownership, and providing a means for transacting" (Peck, 2017, p. 29). Bitcoin effectively created an accounting tool aiming at disintermediating financial transactions by targeting the trust in central banks with the transparency of a decentralized ledger.

Bitcoin was the first large-scale application of blockchain technology, a technology "composed of a chain of data packages (blocks) where a block comprises multiple transactions (…) The blockchain is extended by each additional block and hence represents a complete ledger of the transaction history" (Nofer et al., 2017, p. 183). Each payment, transaction, or digital event represents one dataset in a block. Figure 1 illustrates the flow of a typical Bitcoin transaction. On the Bitcoin blockchain, all participants are anonymous and represented by a pre-established public address, which is a combination of numbers and letters known by all network participants without revealing the user's real identity. To send money across the network, a sender must send a cryptographically encrypted message to the recipient. Only the recipient holds the right private key to decrypt the message (Böhme et al., 2015). Once validated by the Bitcoin wallet sender, the transaction is sent to the mempool, where all valid transactions await confirmation by the Bitcoin network's miners.

In this peer-to-peer network, each network member acts as a node—a computer connected to others, following rules and sharing information—and always has a full copy of the Bitcoin ledger on their system. There is no dominant node, but rather a mutual reliance on a decentralized architecture to resist attacks on a central authority that could take down an entire network. To add a block of data to a ledger (in other words, to record a Bitcoin payment throughout the network), a "majority of nodes in the network agree by a consensus mechanism on the validity of transactions in a block and on the validity of the block itself" (Nofer et al., 2017, p. 184). A block can only be added to the chain once it has been validated. A consensus mechanism "is the process in which a majority, or in some cases all, of the network validators reach an agreement on the state of a ledger. A set of rules and procedures maintain a coherent set of facts between multiple participating nodes" (Swanson, 2015, as cited in Nofer et al., 2017, p. 184).

Bitcoin miners play an important role in this validation process. To encourage network members to participate in validating transactions, "the Bitcoin system periodically awards newly minted Bitcoin s to the user who solves a mathematical puzzle that is based on the pre-existing contents of [a] block" (Böhme et al., 2015, p. 217). Blockchain reconciles transaction recording and verification by placing both actions in the miners' hands. Miners must make sure that transactions are recorded in accordance with the consensus mechanism, even though they do not verify the substance of the transaction to determine whether it is free of fraud or error. Miners are fundamental to the recognition and timing of transaction as they ultimately decide whether or not and when a transaction will be recorded on the network.

Once a new block has been validated or "mined," it has a high chance of being finalized as the next block in the ledger. Once a block reaches finality, the transaction cannot be changed, hence the claim that blockchains are unchangeable or "immutable." Here, an important nuance needs to be made about immutability: technically, anything can be changed with the majority of nodes, including rewriting past transactions and revising the history of the blockchain. It is immutable only if the majority conform to the rule that says it should be immutable. In the next section, we will make the link between this technical background and our theoretical grounding in the construct of an accounting regime (Jones & Dugdale, 2001).

3.4. Theoretical Foundations

3.4.1. Definition of Accounting Regime

Jones and Dugdale (2001) propose the notion of an "accounting regime" as an extension of Giddens' work (1990) on the interplay between expert systems and trust. They define an accounting regime as follows:

> At core an accounting regime is composed of sets of *social practices* that generate information. This information is disembedded from local contexts to more global levels, moving through time and space, and changing meaning in this process. It is then used to act back upon the local level through processes of reembedding where again its meaning may be altered. In parallel with this, accounting practices are disembedded to become principles constructed within *accounting discourses*. (…). In local contexts accounting then constitutes, and is shaped by, *social and system relations* structuring relationships between actors and between systems. At the access points between actors and systems *accounting reflexivity* is constructed as a "mindset" that both absorbs and acts back upon accounting discourses (*italics* in original, p. 58)

As a set of social practices, accounting provides room to explore the interpersonal interactions and systems of power that generate the values embedded in accounting information. In a later section on experts and expert systems, we will discuss the role of accountants in enabling and constraining the ways in which accounting information is produced. We will now explore how the notion of an accounting regime engages with notions of disembedding (and reembedding), time-space distanciation, expert systems, and accounting as a mindset. Many of these notions are extensions of Gidden's (1990) work on modernity, and thus we refer to his ideas also in explaining the role of these concepts in understanding the interplay between Bitcoin and an "accounting regime."

3.4.2. Disembedding and Reembedding Mechanisms

Disembedding mechanisms are responsible for lifting social relations from their local context and reembedding them into present time and space (Giddens, 1990, p.18). These

disembedding mechanisms exist in two types: symbolic tokens and expert systems. Together, they are referred to as abstract systems. We will examine each of these in turn.

Unerman and O'Dwyer (2004) describe symbolic tokens as "mechanisms which can store and transmit to other people some sort of value, thereby enabling this value to be transported across both time and space." These are fundamental to the disembedding of transactions because they allow Giddens to use the example of money as a symbolic token. For him, "the symbolism of money derives from its social circulation and the trust invested in it that is necessary to its circulation" (Gilbert, 2005, p. 364; see also Zelilzer, 2017). It is not the intrinsic value of money that makes it distinct, but the value ascribed to it by the individuals who trade it across time and space (Giddens, 1990, p. 24; Unerman and O'Dwyer, 2004). Such is the case with Bitcoin, as the digital currency's valuation is entirely disconnected from any government support or physical form, which challenges the traditional way of conducting financial transactions.

Expert systems (e.g., Busco, 2009; Englund & Gerdin, 2014; Englund et al., 2011; Griffith, 2020; Hyvönen et al., 2006; Jeacle & Carter, 2011; Jones & Dugdale, 2002; Moilanen, 2008; Seal et al., 2004; Smith-Lacroix et al., 2012; Unerman & O'Dwyer, 2004) consist of "systems of technical accomplishment or professional expertise that organize large areas of the material and social environments in which we live today. […] An expert system […] provid[es] 'guarantees' of expectations" (Giddens, 1990, p. 27) that allow non-experts to trust abstract systems when these lay users lack specialized knowledge in a particular area. As non-experts engage with expert systems, they gain basic familiarity with the concepts, systems, and routines of these systems in order to obtain at least a conversant level of knowledge. However, this does not eliminate the need for expert systems; rather, laypeople still rely on the deep-seated knowledge of experts (Giddens, 1990).

Previous research has demonstrated how accounting, especially auditing, is an expert system that allows individuals to rely on economic information (Hyvönen et al., 2006; Jeacle & Carter, 2011; Jones & Dugdale, 2001) or investor data (Unerman & O'Dwyer, 2004). Smith-Lacroix et al. (2012) mobilize the concept of the accounting regime to examine how auditors and firms responded to fair value approaches to accounting. They find that a new accounting regime centred on fair value accounting "makes it increasingly hard for auditors to feel and actually be in control of their own expertise" (2012). As such, implementing a new accounting regime changes the importance of certain spheres of knowledge and establishes new social practices between and among participants in the regime, in this case, auditors and fair value specialists. Similarly, Griffith (2020) examines the interplay between auditors and fair value specialists. She observes that "institutional pressures in the fair value environment unevenly impact auditors and specialists, causing tension between auditors' needs for ontological security and jurisdictional claims" (p. 270).

Again, the implementation of a new accounting regime centred on fair value challenges the auditor's pre-existing notions about how audits should be conducted and the sphere of an auditor's expertise. Moilanen (2008) explores the notion an accounting regime in the context of the implementation of a new management control system in the Baltic and Russian subsidiaries of a Western parent company. The author extends the "concept of an accounting regime by showing how the power of accounting can be formed on the local level" (p. 252) and can be used to link social systems. Together, this research suggests that

accounting regimes have the power to create new social practices and interpretative schemas that make possible the disembedding and reembedding of accounting information.

Previous research has suggested that because of Bitcoin's design as a public decentralized ledger, "at a certain level of abstraction, blockchains are autonomous, self-referential accounting systems" (Hayes, 2019, p. 15). However, the broader implications for Bitcoin as an accounting regime have not yet been investigated. This is important because the technology requires new forms of knowledge (programming code) and necessitates new experts (Walch, 2019). It is not clear if these forms of expertise might create new accounting routines or change existing approaches to accounting for transactions.

3.4.3. Time-Space Distanciation

Time-space distanciation "is a key characteristic of modernity whereby our daily experience of life is significantly affected by many actions and events which took place in the past (over potentially long time periods) and in many other places" (Unerman & O'Dwyer, 2004, p. 973). In traditional societies, an individual was only able to experience events they could observe themselves without imagining a separation of time and space. The actions of distant actors had little or no impact on this person; in fact, the individual may have very well been ignorant of far-away civilizations or practices. Today, calendars, clocks, and timetables allow for the standardization of time such that time can be "disembedded," through the process of "lifting out social relations from local contexts and their restructuring across almost indefinite spans of time–space" (Giddens, 1990, p. 21).

In late modernity, the Internet has provided the ultimate tool to deconstruct and reconstruct time and space, bringing together people from around the world—either synchronously or asynchronously. Jeacle and Carter (2011) describe how Tripadvisor allows users to provide reviews or issue ratings of hotels, for instance, which can then be consumed or viewed by other community members at a later time or place. Of interest for this paper is the time-space distanciation involved in Bitcoin and online payments. For one, Bitcoin disentangles the act of spending money (time) from its physical form (space). Zook (2020) describes how forms of digital money like cryptocurrencies result in a "compression of time and space through technology. (…) The ability of technology to compress time-space, however, brings with it new challenges, particularly regarding the accuracy and reliability of transactions with spatially or socially distant counterparts. (…) Historically, kinship or social ties ameliorated this trust at a distance. The need for trust is arguably even more pronounced with digital money and currencies since actors in an exchange are often unknown to each other" (pp. 152-153). Digital currencies like Bitcoin represents a further disembedding of financial flows compared to fiat currencies because Bitcoin has no physical form. Rather, it exists entirely in digital form on ledgers that span the (virtual) globe. Bitcoin seems to challenge this notion of time-space distanciation.

3.4.4. Reliance on Experts in Expert Systems

Accounting regimes depend on the strength of the trust in systems where (accounting) expertise can present a guarantee in the face of risks arising from modernity. "The construction of such regimes relies upon the creation of networks that bind actors and

intermediaries. These networks are formed by translations that – when strong – maintain and change them but that, when weak or broken – can precipitate their collapse" (Jones & Dugdale, 2001, p. 58). Thus, accounting regimes depend on trust in experts. Potential erosion of this trust explains the fact that accounting regimes are temporary, partial, and fragile, but no less powerful.

In the accounting domain, these systems that have been organized are professions. Traditionally, professions have existed because they hold control over a specific body of knowledge. This expertise has translated into rewards, prestige, and even state-sanctioned protection as state actors perceive the quality of services offered by professionals to be superior to those offered by laypeople (Abbott, 1988). More specifically, professions are believed to gain control over a body of knowledge when this corpus is seen as uncertain (and therefore requiring a high level of expertise and judgement; Jamous and Peliolle 1970). Jamous and Peliolle (1970) propose that the level of uncertainty inherent in an occupation can be modelled by the ratio of indeterminacy to technicality of its knowledge. They describe professions as:

> *occupations (…) whose indetermination/technicality ratio, intrinsic to the systems of production, is generally high. [In this case, technical refers to the] means that can be mastered and communicated in the form of rules [and indetermination refers to those] means that escape rules and, at a given historical moment, are attributed to the virtualities of the producer (112).*

In other words, professions have value because they exercise substantial judgement in the understanding of a certain body of knowledge, a value that cannot be separated from the professionals themselves. Building on Jamous and Peilolle's (1970) work, Larson (1977) argues that as a profession matures, its knowledge becomes standardized and codified. There will also remain a portion of knowledge that "cannot be taught" (Larson, 1977, p. 41), the area that requires discretion and judgement, the exercise of which is linked to the professionals themselves. Maintaining a high level of mystique or secrecy over a profession's body of knowledge can allow a profession to protect its cognitive basis. The esoteric quality of this knowledge is associated with the exercise of power and creates distance between the professional and their client through a process of mystification (Friedson, 2001).

Larson (1977) explains that to maintain professional status and autonomy, professionals must engage in a strategy of affirming the esoteric basis of their knowledge in order to avoid routinization of their practice and thus loss of market control. "The presence of a lay public is what distinguishes modern professional expertise from other forms of scarce and esoteric knowledge" (Larson, 1977, p. 37). Willmott (1986) observes that accountancy possesses a public image that, in stressing its technical and esoteric qualities, underplays the social and political formation of its practices and standards. Other studies on the historical foundation of the accounting profession (e.g., Dezalay, 1995; Richardson, 1989) stress how the profession has traditionally gained professional monopoly through its ability to maintain claim to "'pure' accounting knowledge" (Walker, 1991, p. 85).

Through their claims to expertise, esoteric knowledge, and strategies of political legitimation, professionals gain state-sanctioned autonomy, the right to self-regulation, and the ability to determine the work of others (Friedson, 2001). Through this process, a profession becomes concerned with the "production of producers" (Larson, 1977), or with the standardized processes for training and credentialing new professionals. "The key to professional status within Larson's framework is not the discretion available in professional knowledge but the ability of the profession to control that knowledge" (Richardson, 1988, p. 385).

The processes through which professionals reinforce their knowledge claims form the basis for the boundaries of professional jurisdiction (Abbott, 1988). Jurisdictional boundaries frame the field of work in which a profession's expertise is regarded as legitimate. Digitalization provides an opportunity to challenge the boundaries of accounting knowledge (Knudsen, 2020). In a study on the impact of digitalization on auditors, Köktener and Tunçalp (2021) find that "digitalization impacts critical activities and jurisdictions of auditors in diagnosis and treatment phases" (p. 349) of audit issues, effectively changing the relationship between auditors and other groups within the firm.

Similarly, Moll and Yigitbasioglu (2019) argue that cloud technology, big data, blockchain, and artificial intelligence have the possibility to disrupt the traditional purview of the accounting profession by demanding a skill set that is currently not possessed by accountants. In other words, digitalization demands mastery of an uncertain body of knowledge in an area currently not under the purview of accountants. Pimentel et al. (2022) document the incursion of non-auditors into the audit area in the blockchain space. This leads us to wonder whether, as a "self-referential accounting system" (Hayes 2019, p. 15), Bitcoin challenges the place of accountants in the blockchain space.

3.4.5. Accounting as a Mindset

Accounting regimes are deeply embedded in their ideological and political environments. From a political standpoint, accounting can be seen "as a technology, a way of intervening, a device for acting upon activities, individuals and objects in such a way that the world may be transformed (Miller, 1994, p. 2) that draws upon particular value claims to legitimate its authority" (Jones & Dugdale 2001, p. 38). From an ideological standpoint, an accounting regime can also be described as "a distinctive body of knowledge providing "discursive representations and vocabularies" (Miller, 1994, p. 3) that inform, and are informed by, actors' perceptions of the world" (Jones & Dugdale, 2001, p. 38). Thus, the ways in which actors within an accounting regime see the world can have important implications for how the system is devised. As described in Section, the creation of Bitcoin involved a new set of actors, namely computer programmers who bring their sets of logics and ideologies to accounting (Dodd, 2018).

3.5. Methodology

On October 31, 2008, Satoshi Nakamoto released the Bitcoin whitepaper to the public via a mailing list of cryptographers. Over the period from 2008 to 2011, Nakamoto maintained frequent email correspondence with this mailing list and actively engaged with

supporters (and critics) of the Bitcoin project on online I. These electronic communications (both Nakamoto's messages and their replies) have been archived on the website of the Satoshi Nakamoto Institute (n.d.).

Netnography was first proposed by Kozinets (2002; see also Kozinets, 2010, 2015) as a research method to study online communities, or to conduct what Hine (2000) described as a "virtual ethnography." For Kozinets (2002), "'[n]etnography', or ethnography on the Internet, is a new qualitative research methodology that adapts ethnographic research techniques to study the cultures and communities that are emerging through computer-mediated communications" (p. 62). This approach consists of observing an online community over a reasonable time frame, with an aim of understanding the inherent relationships at play (Jeacle, 2021; Kozinets, 2015). Netnography was originally developed for marketing academics (Kozinets, 2002) but has since been applied in accounting (e.g., Aleksandrov et al., 2018; Bialecki et al., 2017; Guo, 2018; Jeacle, 2017; Jeacle and Carter, 2011; Miley and Read, 2012). The COVID-19 pandemic has also opened up new opportunities for conducting netnographic accounting research (e.g., Finau & Scobie, 2021; La Torre et al., 2021).

Given that the Bitcoin project was born and exists online, we sought to use a netnographic approach to study the creation of a new payment system (or, given Bitcoin's supporters, a new financial order). As we are studying the creation of Bitcoin, our focus is on the period of Nakamoto's involvement in the project, or the period from 2008 to his disappearance in 2011, as shown in emails and posts archived on the Satoshi Nakamoto Institute's website (n.d.). Additionally, since we are approaching the online artifacts of this community more than a decade after they were posted, we are conducting what Costello et al. (2017) refer to as "passive netnography." This passive approach is a limitation of our study, as we are unable to engage with and ask questions of community members since their identities are concealed by online aliases. Additionally, much has evolved in the Bitcoin space since its initial creation over a decade over. Despite these constraints, we believe that our dataset offers the opportunity to observe the creation of a new accounting system in an online venue.

To collect our data, we downloaded and analyzed one whitepaper, 34 emails and 543 forum posts from the Satoshi Nakamoto Institute's website (the totality of the records on the site), for a total dataset of 578 documents. These emails and posts included both the initial message by a poster and the replies by community members. Netnographic data analysis can occur simultaneously with the data collection process (Jeacle, 2021). As such, the researcher must engage in a continuous iterative process, weaving between field data, literature, and interpretation. Given our relatively small dataset, we were able to qualitatively read and analyze all the emails and forum posts. A smaller sample under analysis offers the advantage of a more humanistic interpretation (Jeacle, 2021).

Our data analysis evolved in three phases. First, the authors read the posts, emails, and whitepaper, generating a coding schema of 19 categories aimed at unpacking the role of accounting in this new financial order. In the second step, a research assistant used our coding schema to code the data in NVivo. Then, the two authors each individually coded the data again in NVivo. Next, we compared results across the three iterations of coding, and found that they converged with less than a 5% difference; thus, we were confident about our data analysis. However, Kozinets (2002) warns the netizen not to sacrifice contextual richness to create coded categories. The data should be placed and understood

within their context. Therefore, in our third step, we reviewed our coded categories and the raw data. At this point, the notion of an accounting regime and the use of accounting knowledge by Bitcoiners became salient. We proceeded to iteratively cycle between the theory, transcripts, and codes until we were able to make sense of our findings (Boyatzis, 1998).

3.6. Findings

3.6.1. Bitcoin as a Set of Social Practices

As described above, the purpose of the Bitcoin project was to create a new decentralized payment system. Bitcoin prescribes social interactions on two levels: on-chain and off-chain. On-chain interactions refer to the decisions on software updates and infrastructure that are embedded into blockchain code and that can be voted on by blockchain participants by virtue of the amount of computational power a member provides to the network. This process is referred to as "algorithmic governance" (De Filippi & Loveluck, 2016). Off-chain interactions refer to the human systems of governance that oversee the system. On-chain governance reflects the fact that the recording of each transaction is based on a consensus mechanism that dictates how miners can review and approve a transaction for recording on the blockchain.

People spend computer power creating a pool of coins to use as money. Each coin is a proof-of-work meeting whatever criteria were in effect for money at the time it was created. The time of creation (and therefore the criteria) is checkable later because people can see the emergence of this particular coin in the transaction chain and track it through all its "consensus view" spends. [White Paper, October 31, 2008]

Yet the actual development of the Bitcoin blockchain and its subsequent governance is very much the outcome of human interaction. As our netnography evidences, the process of developing this new system is the outcome of years of back-and-forth discussions between the systems' developers and its founder, Satoshi Nakamoto. In fact, the conversations on the message board review a fundamental unease amongst Bitcoin developers over the level of centralization of power in the hands of the technology's founder, Nakamoto. In one discussion, developers discuss how Bitcoin's development is constrained by the Nakamoto's iron-grip over the technology:

We need to get Satoshi's approval if something goes into the main Bitcoin client. (…) We could create a patch that would put hooks into the Bitcoin software to permit these kind of changes, but it could also be for naught if Satoshi rejects that patch.

Since this is also a major architectural change to the software, it seems highly unlikely that it would get accepted unless we can demonstrate a clear need for this idea or show some huge benefits that would help Bitcoin be adopted as a currency. It is also a whole bunch of software development that depends on just one person accepting that change on essentially a whim.

In short, if we decide to put this into Bitcoin, Satoshi is the gatekeeper. [Forum post, August 11, 2010]

As Parkin (2019) explains, "the overall political framework for altering the Bitcoin code is described as senatorial governance: a (de)centralized model of bureaucratic parties who compete to change the monetary policy (codified rules) of the protocol. This model shows how Bitcoin is not an autonomous system but is assembled and maintained via human discretion" (p. 463). These human interactions are infused with values and ideologies that dictate how the system will be designed (and eventually operate). An exchange between Nakamoto and a community remember reveal the role of ideology in developing this system:

[Describing the ideology behind the Bitcoin whitepaper]'
It's very attractive to the libertarian viewpoint if we can explain it properly'. I'm better with code than with words though (Satoshi Nakamoto)

No, it is very attractive to the libertarian if we can design a mechanism that will scale to the point of providing the benefits of rapidly irreversible payment, immune to political interference, over the internet, to very large numbers of people. You have an outline and proposal for such a design, which is a big step forward, but the devil is in the little details. (Community member)
[Email thread, November 16, 2008]

As such, Bitcoin is more than a piece of code, but is both the product of, and represents an ongoing set of, social practices driven by ideological and programming rules. As we will evidence in the following sections, these rules and ideas drive the accounting for transactions on the blockchain.

3.6.2. Mobilizing Accounting Vernacular

In the following sections, we explore how programmers mobilized accounting language to describe the concepts they were encountering as part of their task of developing a new financial system. A first step in determining how Bitcoin transactions would be presented on the ledger was constructing accounts that could hold. These accounts are used to keep track of the flow of Bitcoin across users in the network.

Your 'wallet' is more like your own personal bank. It contains many different accounts (in Bitcoin these are called Addresses). Each Address has a balance associated with it, how much money is in it. Your Wallet balance is the sum of all the balances of the Addresses in your wallet. When you perform a transaction, it empties enough Addresses to make up the required output amount, but since it has to completely empty each Address there is often money left over in this case 'he 'change' is returned to you at a new Address. [Forum post, August 11, 2010]

When describing how transactions would be recorded within these accounts, developers use accounting language like "debits" and "credits."

When a user is logged in to their account, [they can see] the BITCOIN address they can send to add funds. (…) You use [the programming function] get received by label <username> with the username as the label to get the "credit" amount of the account. You need to keep a "debit" amount in your database. The current balance of the account is (credit - debit). When the user spends money, you increase debit. [Forum post, July 16, 2010]

Referring to the ins and outs of transactions within Bitcoin wallets as credits and debits became part of the vernacular on the message boards. As such, the use of accounts, debits, and credits eventually became the basic form for how transactions would be captured in the architecture of the Bitcoin blockchain. Beyond this basic determination, the Bitcoin community also had to decide when and at what value to measure flows of the cryptocurrency. These discussions fused a mixture of economic concepts (like money supply or inflation), accounting concepts (like timing of recognition, measurement, and valuation, all of which are discussed above), and programming logic. The conversations were interspersed with segments of code attempting to produce the rules for how transactions would be recorded. For example, in one exchange, a programmer discusses the use of debits and credits and shows how this could be realized in code.

[Responding to a change in the programming code for how transactions would be listed in the BITCOIN ledger]
Using the key name "class" will cause problems for, at least, JavaScript, and probably other languages where "class" is a reserved word. "type" or "variety" or some other synonym will cause fewer problems later.

Or, maybe better, get rid of that field and just report credits as positive numbers and debits as negative. (…)

Since each entry refers to a transaction, I'd suggest adding a "tx_id" SHA256 hex-encoded transaction iI(...)

Code to get that would look something like:
Code:

```
uint256 tx_hash = transaction.GetHash();
string tx_id = tx_hash.GetHex();
 mapJSONResponse.push_back(Pair("tx_id", tx_id));
```

[Forum post, July 30, 2010]

Programmers recognize that they are developing a new specification for recording transactions. While "no authoritative formal specification [exists], the original Bitcoin white paper provides a good overview of Bitcoin's design philosophy, but many important technical details are omitted or outdated. The [Bitcoin Core source code] is considered the de facto specification [for how Bitcoin works], with further knowledge scattered across a series of 'Bitcoin Improvement Proposals' (BIPs), forum postings, online wiki articles, the developer mailing list, and logged [Internet Relay Chat] discussions" (Bonneau et al., 2015,

p. 105). The rules and standards for recording transactions embedded in the Bitcoin source code comprise a "distinctive body of knowledge providing 'discursive representations and vocabularies' (Miller, 1994, p. 3) that inform, and are informed by, actors' perceptions of the world," (Jones & Dugdale, 2001, p. 38), or in essence form the basis for what Jones and Dugdale refer to as an accounting regime.

In the following sections, we explore specifically how Bitcoiners mobilized the accounting concepts of transaction measurement and valuation, recognition, measurement, and profitability in the design of a new payment system.

3.6.3. Bitcoin Standard for Transaction Measurement and Valuation

At the time the Bitcoin source code was conceived, a key design step was deciding how Bitcoin would measure transactions. An initial debate was what the standard would be for capturing numbers in this accounting code, either a floating-point type or integer basis (GWN, 2018). Concerns were raised regarding implementing the correct standard for measuring transactions in such a way that the system would not produce rounding errors between different representations or versions of the software. The latter could result in simultaneous versions of different values of the ledger, referred to as different "forks." Unlike traditional accounting systems, which only capture transactions to the two decimal points, original developers had to "define" the measurement of Bitcoin transaction both economically and in terms of code. Math errors could also mean that miners would be unable to solve the cryptographic puzzles fundamental to block mining and transaction validation, or would earn the wrong reward when doing so.

One example of such a bug occurred on August 25, 2010, when a developer found that an error in the code resulted in incorrect transaction measurement:

Seems a block at height 74638 has exploited a bug in the net. It uses an integer overflow [programming function] to make a negative total transacoIn. (...) We need a fix asap [Forum post, August 25, 2010]

A discussion ensued where developers discussed this coding issue (the use of an integer overflow function[4]) and how to address it. In this discussion, the developers questioned whether to invalidate transactions captured on the blockchain that were incorrectly "measured" due to the bug. There are discussions about which version of reality would be valid, as transactions were carried out according to the rules but did not reflect the intended spirit of the transactions. The group came to the consensus that transactions measured erroneously due to the bug would be considered invalid and would have to be eliminated, as they were incorrect in principle. This exchange shows how, much like accounting rules, computer code is malleable and subject to judgement. Much like accounting standard setters who revise accounting standards that no longer meet user needs, the developers had to revise the rules (code) to address the substance of economic transactions.

[4] Integer overflow basically means that you submit a couple of values that are really big so that when they are added together, they "wrap" back to zero (e.g., 9999 + 1 = 0000 when you only have four integer places) or they go to a negative number when negative numbers are encoded as the largest integers in the range.

The ability to adapt to an uncertain cognitive base, or to address ambiguous issues about when and at what value to recognize transactions, reveals that the programmers can exercise professional judgement over transaction recognition and measurement. Larson (1977) argues that the degree to which a profession can maintain hegemony over professional judgement effectively determines its ability to maintain and protect its professional boundaries. In this case, we see Bitcoiners able to address the complexity of an accounting transaction, effectively making an incursion into an area customarily reserved for accountants.

Beyond determining the standard for measuring individual transactions, the code helps in establishing the valuation of the cryptocurrency. As a way of creating scarcity, the supply of Bitcoin that can ever be "minted" is limited to 21 million units.

Total circulation will be 21,000,000'coins. It'll be distributed to network nodes when they make blocks, with the amount cut in half every 4 years.

first 4 years: 10,500,000 coins
next 4 years: 5,250,000 coins
next 4 years: 2,625,000 coins
next 4 years: 1,312,500Iins
etc...

When that runs out, the system can support transaction fees if needed. It's based on open market competition, and there will probably always be nodes willing to process transactions for free. [Email, January 8, 2009]

Amongst the developers, there was concern about how the limited supply would impact the valuation of Bitcoin, including on the ability to control prices during periods of rapid deflation or inflation in the absence of a central bank or centralized trust figure charged with protecting the cryptocurrency's value.

Indeed there is nobody to act as central bank or federal reserve to adjust the money supply as the population of users grows. That would have required a trusted party to determine the value, because I don't know a way for software to know the real world value of things. If there was some clever way, or if we wanted to trust someone to actively manage the money supply to peg it to something, the rules could have been programmed for that.

In this sense, it's more typical of a precious metal. Instead of the supply changing to keep the value the same, the supply is predetermined and the value changes. As the number of users grows, the value per coin increases. It has the potential for a positive feedback loop; as users increase, the value goes up, which could attract more users to take advantage of the increasing value.
[Forum post, February 18, 2009]

The above post reflects how the code is central in defining how transactions will be valued. Throughout the forum thread, comparisons are made to existing economic practices, like the valuation of precious metals or government activities aimed at

controlling the money supply. New practices for accounting for transactions on the Bitcoin blockchain are positioned as an evolution of existing accounting practices. Yet the purveyors of these ideas are prepared to mobilize ideas outside their field of expertise. In one post, a community member admits that "*he is not an economist and this is going to take some hard economic theory,*" [Forum post, December 6, 2010] but goes on to accurately mobilize economic concepts. We find that developers in the space are capable of mobilizing accounting and economic vocabulary from outside their sphere of expertise to describe the Bitcoin project.

Broadbent (1998) describes how accounting logic imbues current accounting practices with a specific set of assumptions. These assumptions intertwine with an "economic logic" and "provides the technology, through double entry book-keeping and the profit measures of 'conventional accounting' to operationalize economic thought" (p. 272). Although these developers are not accountants, we find that in designing this payment system, appeals are made to economic logic (for instance, profit maximization, concerns over money supply, etc.) and there is a feedback loop between the technological architecture and the operationalization of measures to achieve the desired economic aims.

Conventional accounting is concerned with reproducing existing routines and following standards for transaction recognition and measurement. Heinzelmann (2017) extends this definition to consider how "accounting logic defines the underlying design principles of accounting systems characterized by historical contingency at which an accounting logic becomes prevalent in the context of designing and using accounting systems" (p. 165). These developers are unconstrained by historical contingency, and existing accounting logic. While they use language like "value" and "profit," the conversation is centred around how these transactions will be coded or how the code must be written to achieve a certain reality. Although the developers are discussing accounting issues like measurement, they are effectively replacing "accounting logic" normally used to frame financial transactions with "algorithmic logic" (Mirkowska & Salwicki, 1987) by designing financial transactions in terms of computer code written by non-accountants. This logic reconstructs social relationships into programs and "data into a desired output based on specified calculations" (Gillespie, 2014, p. 167).

3.6.4. Bitcoin Standard for Transaction Recognition

When and how transactions should be recognized was also an important topic for developers. The moment when a transaction is confirmed and recognized on the blockchain (or the timing of transaction recognition) is a concept referred to as finality and is subject to much debate within the blockchain community. Finality refers to the time when it becomes infeasible to remove a block that has previously been appended to the blockchain (Anceaume et al., 2012). In this example, a developer discusses finality in the context of when a transaction can be realized:

[Discussing two possible programming functions that could be embedded in the code to determine when a transaction is final, listreceivedbyaddress or listtransaction']
I think it's helpful to compare current website behavior under mainline Bitcoin, with listtransactions. Let us call this the "confirmation point". (…)

Bitcoinmarket and mtgox [two popular Bitcoin exchanges at the time] and other sites seem to consider 6 confirmations their "confirmation point", the moment at which a transaction may be considered "safe." If a past transaction becomes invalid and disappears, the website cannot avoid potential loss, because the user has already received their PayPal-USD. Same for a web store or brick-and-mortar store. There is a confirmation point at which the customer receives goods. If a TX [transaction] becomes invalid after that, the store takes an unavoidable loss, because the customer is already gone with the purchased goods. (…)

Whether it is listreceivedbyaddress or listtransactions, you still have a binary confirmation point, a moment in time, at which the transaction crosses the "approved by store" level of confidence. At that confirmation point, the customer leaves with purchased goods, and store takes a loss regardless of further block chain or [transaction] behavior. (…)

Transactions can and will be replaced after the binary "confirmation point." All users of Bitcoin *must figure this into their business plans, just like they account for credit card chargeback risk or shoplifting risk.* [Forum post, Dec 8, 2010]

Transaction recognition is based on a probabilistic determination, or the likelihood that the chain or "version of reality" that a Bitcoin is recorded on will be the accepted one, as several parallel chains may exist at the same time. With "Bitcoin, it is usually assumed that a transaction is considered as accepted when about six consecutive blocks [after the particular transaction under consideration has been] accepted, because [there is] a high probability (but not certainty) this chain containing the transaction" (Hyla & Pejaś, 2020, p. 2) will be the approved version of reality. From an accounting perspective, this means that even though two parties may contract to exchange value, the Bitcoin blockchain may or may not approve this transaction. Instead, the timing may be delayed or the transaction entirely reversed. As described by the developer in the above forum post, participants in the Bitcoin blockchain would need to provide for (in accounting terms) returns for the possibility that a transaction is never finalized by miners. Notions of cut-off or recognition become tied to the code and behaviour of miners and not solely to the financial intentions of transacting parties.

When these transactions do get reported on the Bitcoin blockchain, cryptography is used to record the transactions through a technique called "hashing" (Bonneau et al., 2015). Bitcoin uses the SHA-256 hashing protocol, which converts each transaction on the Bitcoin blockchain onto a 256-character string known as a Hash-ID. When one party sends Bitcoin to another, that transaction is written to the blockchain ledger in the form of a hash or an encoded message that includes information on the value of Bitcoin transacted and the public keys or identities of both the sender and recipient. The hash is used as a serial number for the transaction, but the entire transaction is also written alongside the hash. Bitcoin proposes its own ways of recording transactions to the ledger, driven by technological imperatives.

These examples demonstrate how, as an accounting regime, Bitcoin creates new social practices through the reliance on miners to validate transactions and accept them (or not). The Bitcoin blockchain makes accounting logic and concepts relevant by putting these

concepts in the service of non-accountants who have their own ideology and technological aims.

3.6.5. Existence on the Bitcoin Blockchain

In the original Bitcoin whitepaper, Nakamoto emphasized how the Bitcoin blockchain proposed a solution to the "double spend" problem, or the possibility that digital cash would be spent twice if there were no way of keeping track of whether each unit of currency had been used before.

The problem of course is the payee can't verify that one of the owners did not double-spend the coin. A common solution is to introduce a trusted central authority, or mint, that checks every transaction for double spending. After each transaction, the coin must be returned to the mint to issue a new coin, and only coins issued directly from the mint are trusted not to be double-spent. The problem with this solution is that the fate of the entire money system depends on the company running the mint, with every transaction having to go through them, just like a bank.

We need a way for the payee to know that the previous owners did not sign any earlier transactions. (…) The only way to confirm the absence of a transaction is to be aware of all transactions. In the mint based model, the mint was aware of all transactions and decided which arrived first. To accomplish this without a trusted party, transactions must be publicly announced, and we need a system for participants to agree on a single history of the order in which they were received. The payee needs proof that at the time of each transaction, the majority of nodes agreed it was the first received. [Bitcoin whitepaper]

The issue relates to ensuring that the cryptocurrency for the attempted transaction actually exists. The problem is solved using timestamps.

The solution we propose begins with a timestamp server. A timestamp server works by taking a hash of a block of items to be timestamped and widely publishing the hash, such as in a newspaper or Usenet post. The timestamp proves that the data must have existed at the time, obviously, in order to get into the hash. Each timestamp includes the previous timestamp in its hash, forming a chain, with each additional timestamp reinforcing the ones before it. [Bitcoin whitepaper]

Generating blocks serves (…) critical but independent functions in the Bitcoin system. It permanently records valid transactions in a roughly chronological order. [Forum post, August 6th, 2010]

The Bitcoin blockchain is designed as a ledger that shows a chronologically organized record of all the transactions ever carried out across the network. The system ensures that, prior to approving a transaction on the blockchain, miners validate the transaction by verifying that a unique identifier associated to that Bitcoin (a hash) has not previously been used on the blockchain. By verifying the existence of Bitcoin, miners essentially "audit" each transaction. In this way, the Bitcoin blockchain is described as

"self-verifying" because its architecture requires each transaction to be verified before being carried out. When designing this architecture, Nakamoto explicitly chose to design a system that did not rely on a central trusted party, but rather reflected an ethos of decentralization, replacing trust with transparency. Effectively, the act of verification "is undertaken not by humans issuing bills of exchange" (Maurer et al., 2013, pp. 269-70), but is materialized through hashes and algorithms that are put into the hands of miners.

3.6.5. Evaluating the Profitability of Bitcoin Mining

The discussion over the viability of the Bitcoin architecture is often framed in terms of the "profitability" of Bitcoin mining:

[As a rebuttal to the argument that there will always be miners (which the poster refers to as minters) willing to work for low returns] The problem with your analysis is that you assume that all for-profit minters will have the same profit margin. They won't. Among other things, larger minters will have economies of scale in their favour, making them more profitable. In addition, as Bitcoin grows, people will develop dedicated hardware that maximizes the khash/dollar spent [their return on investment]. In addition, people will tune the software in more and more precise ways to squeeze slightly more khash/second out of the same hardware. The people who invest a large fixed cost to do that will receive a correspondingly lower variable cost per Bitcoin minted in return, so they'll be able to mint at price levels that would drive others out. Finally, at the point that this becomes an issue, everyone will be including transaction fees with their transactions to incentivize minting. [Forum post, August 14, 2010]

In the above discussion, the developer appeals to fixed costs and specialization as ways to increase returns on Bitcoin mining. Transaction fees are often seen as a lever that could be used to entice miners if Bitcoin were to become scarce and therefore no longer offer a sufficient return on investment to miners:

Currently, paying a fee is controlled manually with the -paytxfee switch [the programming function which determines the transaction fee allocated to a miner]. It would be very easy to make the software automatically check the size of recent blocks to see if it should pay a fee. We're so far from reaching the threshold, we don't need that yet. It's a good idea to see how things go with controlling it manually first anyway. (…) Keeping the threshold lower would help limit the amount of wasted disk space in that event (Forum post, September 8th, 2010).

In this post, the developer describes the need for profitability, but ultimately ties it back to an issue of system architecture or disk space. We see this trade-off often in the posts where developers balance technological and economic concerns. We also see miners performing detailed calculations (similar to those of a management accountant) to determine the actual profitability of mining:

[Discussing a news article on the cost of mining Bitcoin] The article is all about the cost of the hardware, neglecting the more significant cost: electricity. Once you're above

baseline power of 11 kWh/day (as any geek is), Southern California utilities get about $0.13/kwh marginal, with taxes, distribution, etc. The 24-core beast [the mining hardware] built in the article probably draws some serious current. Hard to guess how much, but I'd guess about 500W? Anyone know? This will add 360kW/h a month to your electric bill, which will easily drive you into the next pricing tier, or maybe two tiers higher. Now your marginal power can be $0.18 kW/hr. Yikes. That Bitcoin miner would be about $2/day to run, or $788 a year, which means you've never matched the hardware cost of the system in two or three years. If you have to actively cool the room with the computer, at least during the daytime, double it again (Forum Post, September 1st, 2010).

This example shows how a miner evaluates the cost of the resources needed to make his "product," which is the validation of Bitcoin transactions. He also estimates the number of years before he will get a return on his investment in the processors allowing him to validate the transactions. In fact, two resources are essential: the energy required to run the processor and the processor itself. These calculations are normally the purview of accountants.

Together, these examples show how Bitcoin prescribes its own set of rules for the measurement and recognition of payments based on technological factors, instead of the ones prescribed by accounting standards. This system is more than a simple piece of software: it constitutes an accounting regime in that it is "composed of a set of social practices that generate information" (Jones & Dugdale, 2001, p. 58). This process is not meant to be agnostic: accounting information is embedded with the norms and values it absorbs from the social practices it was born of. The very utilization of Bitcoin as a means of payment is a political act (Golumbia, 2016) reflecting an appreciation of the cypherpunk ethos embedded in the technology's foundation. Not only does the Bitcoin blockchain produces a record of transactions, it also creates new relationship patterns through which accounting transactions are captured (Boland, 1993), which are schemas out of accountants' control.

Traditionally, accounting systems provide a transaction record through the lens of accounting standards and economic value in the sense of the well-established financial order. The novelty of Bitcoin is in the fact that economic transactions are now digitized and formed with the help of a programming code. This generates a new language through which economic value is measured and, in fact, created. While the accounting ledger becomes the output of this data capture, computer code becomes the lens through which transactions are legitimated and rendered into being (Boland, 1993; Macintosh, 1994). The discourses embedded in the Bitcoin ecosystem actively promote a unique vision for the world. Pimentel et al. (2021) highlight the distance between the blockchain ecosystem and auditing field, as well as their different views on accounting. What matters is the recognition that, in so doing, the Bitcoin source code effectively produces an accounting ledger with its own set of rules and embedded values existing outside the purview of accountants.

Gillespie (2014) warns us against allowing technological determinism to justify a reductionist approach and advises us to understand the impact of algorithmic logics. "Sociological analysis must not conceive of algorithms as abstract, technical achievements, but must unpack the warm human and institutional choices that lie behind these cold mechanisms. [The author] suspect[s] that a more fruitful approach [would be] to see how

these tools are called into being by, enlisted as part of, and negotiated around collective efforts to know and be known" (p. 169). This approach emphasizes the role of human actors in designing and managing algorithms, while passing on their values to the code.

This analysis of accounting existence, recognition, measurement, and cost-benefit evidences the reappropriation of expert knowledge "by lay agents as part of their routine dealings with abstract systems" (Giddens, 1990, p. 144). Usually, these concepts should be programmed or developed by accountants. Here, though, they're programmed and developed by Bitcoin developers, and it's doubtful that they have a degree or training in accounting. This means that as non-experts engage with expert systems, they gain basic familiarity with the concepts, systems, and routines of these systems to obtain at least a conversant level of knowledge. However, this does not eliminate the need for expert systems—rather, laypeople still rely on the deep-seated knowledge of experts (Giddens, 1990).

3.7. Discussion and Conclusion

Our netnography of the early Bitcoin community has evidenced the role of accounting in defining a new cadre of rules around transaction recording, measurement, and validation for digital payments. We have also examined how a group of cypherpunks and libertarians (Dodd, 2018) intent on reorganizing the financial order and disintermediating accountants altogether would come to appropriate accounting knowledge. While our historical approach does not allow us to question the early Bitcoin designers in real time, the data have allowed us to analyze and explore the social practices underpinning the development of this new payment system to explore the discourse and ideologies embedded in the negotiations around the design of this new system.

While we believe that our study makes several contributions to the academic literature on accounting and blockchain, we wish to highlight two primary contributions here. The first is that we challenge the notion of Bitcoin as a mere payment system and, rather, position Bitcoin as an accounting regime (Jones & Dugdale, 2001). This positioning recognizes the fundamental role of accounting knowledge in providing a vocabulary and set of constructs for non-accountants to use to make sense of financial flows. This allows us to extend previous research on accounting regimes (Moilanen, 2008; Smith-Lacroix et al., 2012) to understand how accounting shapes systems of governance in digital environments, as well as how the values imbued in the accounting discourse shape social practices.

Second, we demonstrate how Bitcoin creates a new cadre of experts capable of mobilizing accounting knowledge in a way that displaces accountants. The development of the Bitcoin blockchain depends on technological experts like software developers, who develop and support the code, and miners, who convert transactions into accounting records. These experts rely on abstract knowledge based on computer programming, information security, and cryptography. This trade is possible because the Bitcoin system necessitates a new form of expert knowledge that fuses together accounting, computer programming, and cryptography.

Pimentel et al. (2021) demonstrate how the absence of deep technological knowledge keeps auditors and accountants from engaging in this area. Auditors who do try often find themselves outclassed by cryptographers and programmers because of their lack

of technological expertise (Pimentel et al., 2022). Yet our netnography demonstrates that programmers rather effectively mobilize accounting concepts. The ability for programmers to marry accounting and programming techniques allows them to effectively create an accounting regime. Kurunmäki (2004) explains that "abstract knowledge is held to provide the key to winning jurisdictional disputes and surviving the unending competitive game" (p. 327). We find that programmers are able to co-opt the accounting knowledge and thereby make an incursion into an accounting regime, an arena that would normally be the purview of accountants. An important finding for this study, and one that has also been noted in other blockchain projects (Pimentel et al., 2022; Fortin, 2022), is the facility with which non-accountants appropriate accounting knowledge.

These studies, however, do not observe accountants as easily absorbing and deploying technological knowledge—a fact that Pimentel et al. (2022) find is a barrier to auditor expansion into the blockchain field. Larson (1977) proposes that much of a profession's value derives from its ability to maintain "cognitive exclusiveness" (181) over a defined body of knowledge. She explains that "the more esoteric the body of knowledge and the more it approaches a unique paradigm" (Larson, 1977, p. 47), the more likely that a profession will be able to exercise control over this sphere of knowledge. Fournier (2002) points out that "the authority of the professions relies on the creation of boundaries between themselves and the client or lay person. An indispensable feature of professional autonomy and authority is the corresponding passivity and dependence of the lay person" (p. 74).

An implicit question in our study is understanding how Bitcoin developers appropriated accounting knowledge. While a limitation of our study is that we were unable to question community members directly due to the amount of time that has passed since the formation of Bitcoin and the anonymity of community members, extant literature points to several pathways through which accounting knowledge has become accessible to non-specialists.

First, Mazza and Alvarez (2000*)* describe how management concepts have become part of popular discourse. They explain that "managerialist discourse (has come to apply) to all sorts of organized activity and tends to be abstracted from the technical details of any specific activity. And it can be applied essentially anywhere" (Alvarez et al., 2005, p. 135). This popularization of management includes the increased accessibility of core accounting concepts as a body of knowledge. In contrast, information technology topics like programming or cryptography are seen as difficult and having a high barrier to accessibility. Pimentel et al. (2021) find that a lack of competence in technological topics is a barrier for accountants wishing to enter this space.

Second, Pimentel et al. (2022) describe how blockchainers become educated about new topics through trial and error. As no codified body of knowledge exists, blockchainers are forced to learn as they go, often trying out new types of code outside their sphere of expertise. Levy (1984) describes the desire to tinker and learn as fundamental to the hacker ethos, an ideology common to the Bitcoin sphere. As one hacker editorial explains, "we believe in freedom of speech, the right to explore and learn by doing" (2600, 1998-1999, p. 4).

The combination of the accessibility of accounting knowledge and the willingness of blockchainers to experiment with ideas outside their sphere provides one clue into how Bitcoin developers might be willing to wrestle with accounting knowledge and be in a position to develop new hybrid knowledge that would be outside the grasp of accountants.

To further probe this issue, future studies could explore the pathways through which accounting concepts are diffused and learned within the blockchain ecosystem.

Regardless of how Bitcoiners come to assimilate accounting knowledge, the inability of accountants to maintain control over their sphere of professional knowledge has implications for their professional jurisdiction. "In claiming jurisdiction, a profession asks society to recognize its cognitive structure through exclusive rights; jurisdiction has not only a culture, but also a social structure" (Abbott, 1988, p. 59). At the heart of Abbott's thesis is the fact that the concept of the professional group is not static; new professions develop and old ones diminish in status and even disappear, reflecting the fact that jurisdictional claims can strengthen or weaken over time. With Bitcoin, we see that these boundaries have been weakened by the easily replicable cognitive basis of accounting. Future studies could explore other areas where blockchainers are making incursions into the accounting space (for instance, the use of security auditors to validate blockchain code; Pimentel et al. 2022) to explore the responses of the accounting profession in protecting jurisdiction.

As accounting researchers, we are alarmed by the potential for accounting to cede its traditional cognitive base to outsiders and hope to draw accountants' attention to this phenomenon. Thus far, the notions appropriated by developers are still fairly basic, yet this does not diminish the threat to accountants' jurisdiction. Rather, this evidences that, for professional accountants to remain relevant to the Bitcoin ecosystem, they must not only to improve their technological competence, although it is an important first step (Pimentel et al., 2021; Pimentel et al., 2022) but, more importantly, accountants must demonstrate the relevance of more esoteric forms of accounting expertise (those outside the grasp of Bitcoiners) to the Bitcoin space. This could include showcasing the ways in which accountants understand the risks associated with large-scale transactions or their ability to verify transactions not just for compliance with a consensus mechanism but for the transactions' substance as well. It will therefore be important to equip accountants with the right skills so that they can engage with Bitcoin, cryptocurrencies, and blockchain more broadly.

Accountants will not be able to reappropriate their place in the blockchain field unless they possess at least a passing fluency in computer code (Pimentel et al., 2022). The impact for the accounting profession until now has been on bookkeeping and recording data, but with the evolution of blockchain that we are looking at, soon accountants will have to be interested in blockchain in order to ensure the rigour of transactions when it comes to using these data for financial statements, for example. This will require a certain level of upskilling and continuing professional education (Moll & Yigitbasioglu, 2019, Qasim & Kharbat, 2020; Zhang et al., 2020).

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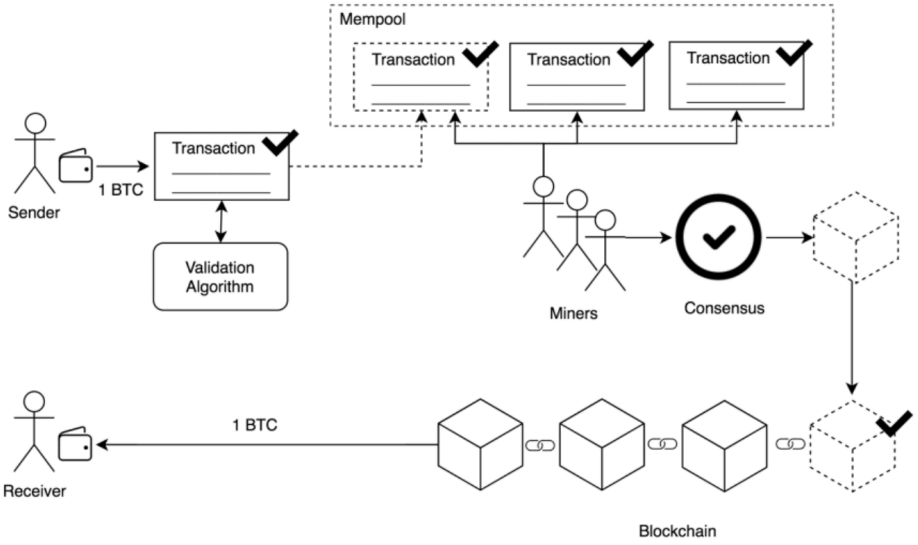
FIGURE 3 - EXAMPLE OF A BITCOIN TRANSACTION FLOW



(Castro, 2018)

*BTC: Bitcoin

CHAPITRE 4

Towards a Single Trust:

Blockchain Early Adopters and the Impact on Accounting and Accountants

4.1. Abstract

Blockchain is a decentralized, distributed accounting and data storage technology (Fu & Zhu, 2019) and a triple-entry accounting system. Very few studies investigate the blockchain, especially its private or hybrid versions. Drawing on a qualitative field study involving 28 interviews with CEOs, entrepreneurs, managers, CPAs, and computer specialists from companies that are considered pioneers in using or implementing blockchain, I report two main findings. First, I illustrate how triple-entry accounting, which is intrinsic to blockchains, modifies and simplifies the processing of accounting operations. Second, participants in the blockchain network operate with a single ledger, driving a single version of reality that creates a consensus and generating real-time information. Hence, blockchain provides the technology to implement the theoretical idea of triple-entry accounting, a reality different from Ijiri's 1986 vision, thus opening a new mindset with respect to accounting information. My findings raise some questions regarding the future role of accountants as internal control experts.

Key words: triple-entry accounting, blockchain, accounting process, impact for accounting, changes for accountants.

4.2. INTRODUCTION

There is nothing so useless as doing efficiently that which should not be done at all.
– Dr. Peter F. Drucker

Since its first application as Bitcoin, blockchain technology has been used in a myriad of other ways. Proclaimed as a game changer, blockchain is expected to revolutionize the way transactions are seen and performed and supply chains are managed. Indeed, large companies across a variety of industries have already begun exploring its potential. For example, Walmart is currently exploring blockchain to track food for improved safety[5] and tech giant IBM has invested more than $200 million in blockchain research. Blockchain "refers to a growing list of digital records of transactions organized into blocks that are linked together by cryptography" (AICPA, 2020, p. 2). Blockchain, which is also referred to as a distributed ledger technology, enables trackable, transparent, and secure information and transactions without any controlling intermediary (Stein Smith, 2019). Transactions and information are simultaneously recorded and synchronized within the network.

With this paper, I aim to understand how the advent and implementation of permissioned blockchains[6] transform accounting practices. As Bonsón and Bednárová (2019) note, "after analyzing the characteristics of blockchain architecture, private blockchain architecture seems to be an interesting tool for accounting, as it might offer solutions for better auditability, automated control, and reliability of data" (p. 736). Dai and Vasarhelyi (2017) argue that blockchain plays the role of an accounting system that "distributes the power of transaction verification, storage, and management to a group of computers in order to prevent any unauthorized data changes" (p. 6). Up until now, the bulk of academic research focused on these potential changes and tended to be rather conceptual. Only a limited number of studies look at the changes occurring within organizations. The specific type of blockchain I am studying introduces the notion of triple-entry accounting, which can disrupt business processes. Therefore, it is necessary to understand the impact of blockchain on business processes. This is thoroughly explored in some of the recent accounting information systems literature (Albizri & Appelbaum, 2021).

[5] https://digital.hbs.edu/platform-rctom/submission/walmart-and-block-chain-it-takes-two-to-mango/

[6] To avoid confusion concerning distributed ledger, blockchain technology, and permissioned blockchain, I use the term blockchain in this paper to refer specifically to permissioned blockchain (private or hybrid blockchain). "A permissioned blockchain is […]: only members approved members (peers) can join the network. Each peer belongs to one organization, and the group of all organizations participating in the network is called a consortium." (Calderón & Stratopoulos, 2020, p.309-310). Hybrid blockchain can define as "supply chain systems will be formed through integrations of blockchain into current systems, and a hybrid system with public on-chain data and private off-chain data will be used." (Bellucci et al., 2022, p.138).

In recent years, there have been significant developments in all areas of accounting influenced by new technologies, such as blockchain, which introduces a new way to store accounting information. Blockchain challenges an old accounting system that has not been changed for a long time: double-entry accounting. As demonstrated by Cai (2021) and supported by Maiti et al. (2021), blockchain leads to a new form of accounting recording, triple-entry accounting. Triple-entry accounting is an enhancement to the traditional double-entry system in which all accounting entries involving outside parties are cryptographically sealed using the blockchain and linked by a transaction within a third-party entity in a common ledger. The concept of triple-entry accounting first emerged with Ijiri (1986), who proposed a conceptual idea based on physics to integrate the notion of time in financial statements to reduce the desire of top management to manage a company in the short term. More than twenty years later, this idea of triple-entry accounting appears with Grigg (2005), who proposes cryptographic signatures and a model that is more similar to what we see now with blockchain. With the emergence of blockchain, it seems that triple-entry accounting resurfaced with concrete applications. In 2016, Deloitte published a short document about the potential of blockchain, including how triple-entry accounting can be a game changer (2016). Cai (2021) explored blockchain applications based on this triple-entry accounting framework. This context led me to the following research question: (1) *How does blockchain permit triple-entry accounting? (2)How does blockchain impact and change accounting operations?*

Building on a qualitative research method, I conducted 28 semi-structured interviews with early adopters, i.e., blockchain experts, accountants, and chief executive officers (CEOs) who chose to implement blockchain technology within their organizations. More specifically, I explore how an organization's system can be reconfigured to adapt to new accounting practices, generating a new way of collecting, storing, processing, and communicating information. My analysis reveals two broad insights. Firstly, it highlights the simplification of accounting operations with triple-entry accounting, which offers a higher degree of transparency. Secondly, and most importantly, it illustrates how a single version of reality, with a single ledger for all blockchain network participants, tends to decrease transaction costs and improve relations with suppliers. Such observations lead us to explore the changing role of accountants, who can no longer be considered the gatekeepers of financial reporting.

This paper makes three main contributions. Firstly, it adds accounting and empirical dimension to prior research on blockchains to obtain insights. For instance, Coyne and McMickle (2017) did not "investigat[e] the problems with accounting ledgers that might need resolving or the potential for modifications to accounting and automation that would make the blockchain more useful without changing the blockchain itself" (p. 111). This paper presents a similar analysis but with the smart contract, blockchain, and triple-entry accounting. Secondly, the findings reported in the paper suggest that blockchain is interrelated to the idea of triple-entry accounting, and thus I discuss Ijiri's (1988) framework and Grigg's (2005) triple-entry accounting. I contribute to the understanding of triple-entry accounting, which is still nascent and under-studied. Cai (2021) started a conversation about the similarity of Grigg paper (2005) and triple-entry accounting. Here,

the paper develops the concept of triple-entry accounting with several concrete applications. I look into Ijiri (1986) and Grigg (2005) to provide a comparison analysis of the development and evolution of the triple-entry accounting system. Thirdly, the paper addresses in a practical way how blockchain and accounting operations can be coordinated with a common ledger to record transactions. More specifically, I propose flow charts of the transaction process that show the before and after of the arrival of blockchain technology, which represents a comparison with double- and triple-entry accounting and could be useful for organizations that want to use this emerging technology.

4.2. OVERVIEW

4.2.1. Triple-entry accounting: the unique feature of Blockchain

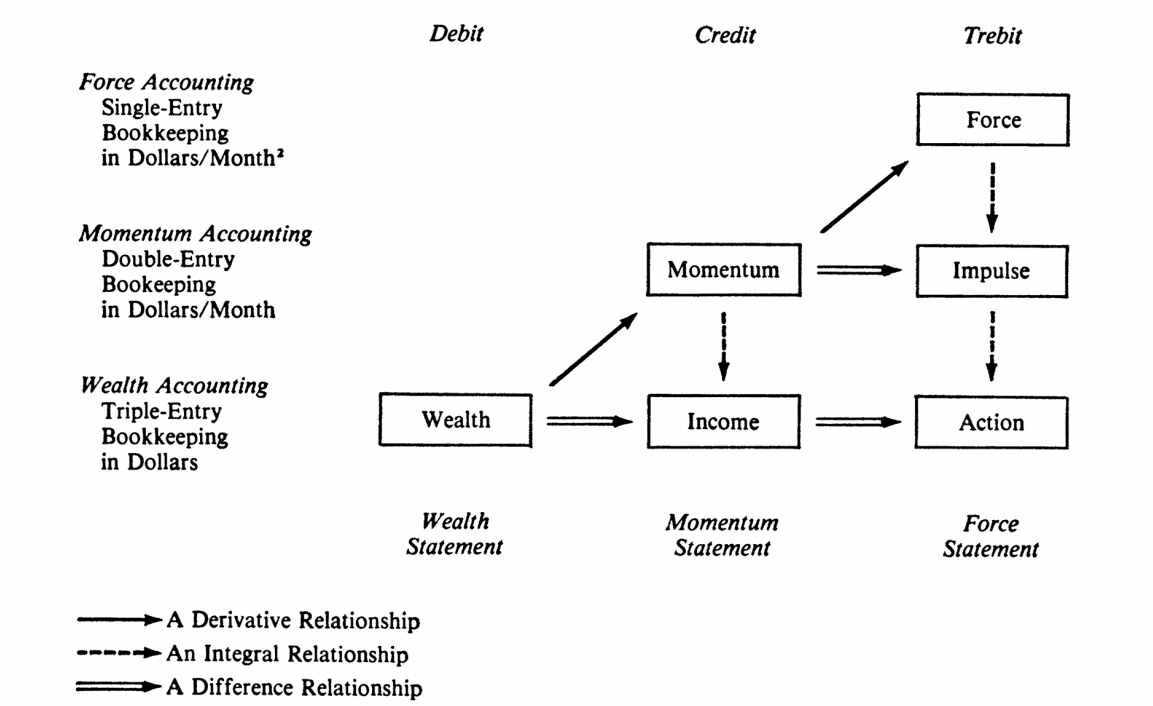
One of the unique features that is integrated and made possible by blockchain is triple-entry accounting. Its underlying idea and framework predate the emergence of blockchain. The term "triple-entry bookkeeping" first appears in a conceptual paper written by Yuji Ijiri in 1982. Grigg (2005) further develops the concept, which constitutes, with Ijiri's, the only two concepts of triple-entry accounting proposed so far.

4.2.2. Ijiri's triple-entry bookkeeping framework

After a long investigation of mathematical axioms in accounting and financial accounting from a systemic perspective, Ijiri develops triple-entry bookkeeping, also referred to as "momentum accounting." Its logic is based on the concepts of momentum and force borrowed from physics, more precisely kinetics, which studies motion in relation to its causes (Blommaert, 1995). Double-entry accounting was created to explain the change in stock accounts and is identified with flow accounts (Ijiri, 1986; Melse, 2008). The objective is to extend the commonly practiced two-layer or "double-entry" accounting to a three-layer one to facilitate decision-making by managers (Ijiri, 1986).

Ijiri's framework strives to integrate concepts in management accounting and financial accounting to explain changes in *flow* accounts (1986), one of the major challenges in accounting. The framework is built on three "new" accounting concepts, with each having its own measurement unit: wealth (in dollars), momentum (in dollars per month), and force (in dollars per month per month). It aims to reduce the information time gap and positively impact strategic decision-making (Ijiri, 1986; Carlin, 2019; Cai, 2021). Each rate is a representation of a change in duration of the rate equal to the amount of change. The conventional accounting identity or double-entry accounting in which debit equals credit now endorses a third dimension, in which trebit equals debit equals credit.

FIGURE 4 - FRAMEWORK FOR TRIPLE-ENTRY BOOKKEEPING FROM IJIRI (1986, P. 749)



The concept of momentum is defined as the "the rate at which wealth is changing," or the rate at which income is being earned. Based on mass and velocity, income is measured by dollars per month. For example, to illustrate the concept, an investment of $10,000 yielding interest at the rate of 1% per month has a momentum of $100 per month. If the momentum is stable, it will, by the end of the year, result in an income of $100 per month for 12 months and a total income of $1 200. "Because momentum may be defined and measured at any single point in time, it is conceivable to prepare a 'balance sheet' in which all revenues and expenses are treated as stock account and measured in momentum" (Ijiri, 1986, p. 747). The fact that momentum can change over time refers to the force concept, which is to say the acceleration time. Translated into investments, the same example could become the inflationary rate referring to the concept of force. Finally, the last concept is impulse, in which momentum and force share the same unit, both measured in dollars per month. Because the income results from a stable momentum, these two conditions satisfy the Newtonian mechanics requirement of impulsion.

Ijiri (1988) further develops and contextualizes the momentum framework he had exposed in 1986. Ijiri (1986) concludes by stating that "[i]n this way, the extension of double-entry bookkeeping to triple-entry bookkeeping is carried out under a disciplined framework of measurements, which hopefully will direct management's attention and sensitivity to factors at the level deeper than the level of wealth and income that has been traditionally dealt with the double-entre accounting" (p. 756). Ijiri addresses this short-term income

incentive issue: managerial goals are based on income, and top management remuneration is too often and wrongly based on its increase in the short term. With a rate considering the change in incentives, as with the concept of momentum, we can see the actions taken indicating the measure of long-term performance (Ijiri, 1988). While conceptually the triple-entry framework offers an interesting solution to the delay in processing accounting information, the technology available in 1986 did not allow a concrete application (Carlin, 2019). Unlike Cai (2021), I use Ijiri's conceptual framework to understand the changes blockchain brings more than thirty years later.

4.2.3. Triple-entry accounting from Grigg (2005)

Grigg (2005) and Ijiri both have one point in common in their articles and research project: criticizing double-entry accounting, which is inefficient in practice. Both authors propose very different models but have the same objective: to obtain accounting information faster for better decision-making. Grigg (2005) reuses the term "triple-entry accounting" in a totally different way, defining it as "pairs of double entries connected by the central list of receipts; three entries for each transaction. Not only is each accounting agent led to keep three entries, the natural roles of a transaction are also of three parties, leading to three-by-three entries" (p. 6).

Such triple-entry accounting is based on digital signature and cash (Grigg, 2005). For instance, Grigg (2005) notes that paper invoices could be lost or withheld, and we should therefore stress the principle that the entry itself is the transaction. "This results in three active agents who are charged with securing the signed entry as their most important record of transaction" (p. 9). One of the difficulties identified by Grigg (2005) has to do with the software used in a triple-entry system, which would be less convenient than the software used in double-entry bookkeeping. Blockchain technology plays an important role in overcoming this obstacle, as it allows the application of advanced triple-entry accounting systems.

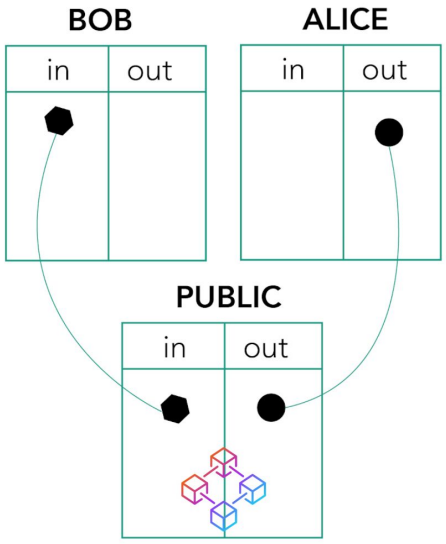
4.2.4. Triple-entry accounting literature

Blockchain enables a triple-entry ledger system that offers transparency to its network participants by replacing the human verification process of transactions with a cryptographic process (Dai & Vasarhelyi, 2017; O'Leary, 2017; Schimtz & Leoni, 2019; Belucci et al., 2022; Fortin & Pimentel, 2022). Unlike Grigg's (2005) model, blockchain does not simply add a third ledger to the traditional double-entry accounting approach, but a shared ledger (Schimtz & Leoni, 2019). Rather than recording transactions separately into different ledgers (Company A's ledger and Company B's ledger), which the traditional double-entry bookkeeping does, the blockchain records accounting entries (or any event or piece of information, regardless of its format) in a common ledger, and places it next to accounting information in a chronological and real-time scheme. All entries are available to all participants of the blockchain network (ICAEW, 2018; Tan & Low, 2017).

Moreover, all network participants enjoy constant access to the same set of shared ledger records; any single change to the ledger (e.g., transfer of assets to another network participant) is visible to all network members (ACCA, 2017). Changes can only be made if all rules dictated by the consensual protocol are followed. The consensus protocol takes

the form of cryptographic mathematical algorithms and requires the approval of the network participants for the change to be effective. Without such a consensus, the network automatically rejects the ledger entry (Coyne & McMickle, 2017; Dai & Vasarhelyi, 2017; Kozlowski, 2018; Schimtz & Leoni, 2019).

FIGURE 5 - SIMPLE EXAMPLE OF TRIPLE-ENTRY ACCOUNTING TRANSACTION [7]



Let us recall the nuance differentiating the type of blockchain investigated in this paper from others: the blockchain of interest in this paper is the so-called permissioned and hybrid blockchain. As part of the triple-entry accounting system, public and permissionless blockchains are visible and accessible to anyone who wishes to consult them. Private and permissioned blockchains are rather similar to traditional transaction ledgers in which only authorized users can view the content (Coyne & McMickle, 2017; Yermack, 2017). For this type of blockchain, external auditors must be granted access to perform audits (O'Leary, 2017). This paper focuses on triple-entry accounting within the organization, especially day-to-day operations such as management accounting, and thus excludes auditing. Hence, the following research question: *how does blockchain permit triple-entry accounting?*

4.2.5. Smart contracts

When studying blockchain's business application, mention must be made of smart contracts, which were created in 1994 by Nick Szabo.[8] Although not required for distributed ledgers, the smart contract finds its use within blockchain, similarly to triple-

[7] Figure is from: https://blog.gilded.finance/the-accounting-innovation-nobody-is-talking-about-triple-entry/

[8] Szabo, N. (1997). *Formalizing and securing relationships on public networks*. First Monday.

entry accounting: “a smart contract is an event-driven computer program, with state, which runs on the blockchains, and which can take custody over assets on that ledger” (Brown, 2015). The smart contract’s main purpose is to automate the execution of contracts between parties. Smart contracts can be incorporated into the blockchain and performed if certain conditions are met, depending on what the initial settings are, without need fort trusted intermediaries to participate in the process of verifying and executing (Kokina et al., 2017). As an example, CPA Canada (2016) states that smart contracts can represent the terms and conditions of legal contracts.

From an accounting perspective, the smart contract provides smart controls held in computer programs operating on the blockchain. These smart controls automatically control the business processes in the face of predetermined rules (Dai & Vasarhelyi, 2017). Thus, smart contracts provide an additional layer of protection for both parties involved in a transaction (Coyne & McMickle, 2017), offer endless possibilities due to their flexibility (Pimentel & Boulianne, 2020), and help generate transactions, which can be subsequently distributed to every peer in the channel (Calderón & Stratopoulos, 2020). With smart contracts, blockchain is more than a simple ledger with recorded information: it is a “living” ledger (Cai, 2021). The smart contract based on predetermined program codes can send information, record it, and carry through transactions with tokens, the system’s unit (see Cai, 2021, for accounting examples of smart contracts’ uses).

4.3. METHODS

I conducted 28 interviews within nine different early-adopter organizations that implemented blockchain, as well as three blockchain platform providers that work with several customers. The focus was placed on talking to CEOs, Information technology (IT) irectors, blockchain experts, and CPAs who would soon implement or had already implemented blockchain technology. The initial objective of this interview process was to generate a purposeful sampling of blockchain users’ organizations considered to be early adopters in their specific fields, “offer[ing] useful manifestations of the phenomenon of interest” (Patton, 1990, p. 40). Reliance on a qualitative study allows for the identification of concrete applications of distributed ledgers, as well as managerial experiences in this regard (Brilliantova & Thurner, 2019; Pimentel et al., 2021; Helliar et al., 2020), and for in-depth insights into the impact of blockchain, which includes its implications for accounting (Schmitz & Leoni, 2019).

4.3.1. Data collection

Following Lincoln and Guba’s (1985) and Patton’s (1990) guidelines on purposeful sampling, “information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling” (Patton, 1990, p.169). With this perspective, I investigated newspapers and the Internet to find cases of organizations that used blockchains. To find the purposeful sampling, I contacted CEOs or top management through LinkedIn to recruit those early adopters of blockchain. In my first interview with each company, I aimed to both create a bond of trust with the managers about my study’s motivation and to validate the relevance

of the firm's projects for the study. Through this initial meeting, I also engaged in data collection, namely collecting documents produced by the organization regarding the implementation of blockchain, as well as relevant white papers and administrative documents. This documentation was used to corroborate the interviewees' sharing and to validate its alignment. I also examined publicly accessible documentation on the case firms to better understand the firms and their projects. Such documentation consisted in internal documents, media articles, press releases, conferences attendance, presentations, web sites, and reports.

Since the interviews took place during the pandemic, all were conducted online through either Zoom or Teams video chats. Much information and many presentations were shared through these channels. The average time of each interview was 40 minutes. All but three of the interviews were recorded and then professionally transcribed. During the three interviews that were not recorded, I actively took notes. All interviews were conducted between June 2020 and January 2021. Confidentiality was ensured so that interviewees could freely speak their minds and share the most accurate information possible.

Most interviewees (19) work for organizations that implemented or were in the process of implementing blockchain. One interviewee is employed by a company where the blockchain project was aborted and was no longer part of the organization's mission. Since his experience offers unique insights, I have retained it in my interview sample. Six interviewees have experience with accounting and blockchain from former jobs, and three IT experts are consultants supporting organizations during the implementation process (see *Table 3* for details on interviews).

TABLE 3 - DETAILS OF INTERVIEWS

	Interviewee's position	**Industry**	**Categories of organizations**	**Interview date**	**Interview length**
1	Executive director	Agriculture 1 (beef)	Early adopter	2020/06/21	33 minutes
2	IT expert and director	Copyright 1 (book)	Blockchain provider	2020/06/01	27 minutes
3	Project director	Copyright 2 (textbook)	Early adopter	2020/06/23	41 minutes
4	General director	Copyright 1 (book)	Blockchain platform provider	2020/06/01	27 minutes
5	Executive director	Agriculture (beef)	Early adopter	2020/06/30	32 minutes
6	Co-founder	Agriculture 2	Early adopter	2020/07/31	32 minutes
7	Co-founder	Supply chain association	Blockchain expert	2020/07/31	37 minutes
8	Project director	Copyright 2 (textbook)	Early adopter	2020/08/03	32 minutes
9	Executive director	Copyright 2 (textbook)	Early adopter	2020/08/06	27 minutes

10	CEO	Gaming industry and technology	Early adopter	2020/08/11	45 minutes
11	Sales and marketing coordinator	Blockchain platform services	Blockchain platform provider	2020/08/12	59 minutes
12	Founder	Transport	Early adopter	2020/08/13	39 minutes
13	Blockchain developer	Copyright 1 (book)	Blockchain platform provider	2020/08/14	39 minutes
14	Senior consultant in methodology and practice in computer architecture	Financial services	Blockchain expert	2020/08/18	50 minutes
15	Founder	Financial technologies	Early adopter	2020/08/31	44 minutes
16	CPA	Accounting (Masters student)	Small audit firm	2020/09/01	18 minutes
17	CPA	Accounting	Small audit firm	2020/09/03	27 minutes
18	CPA	Accounting	Small audit firm	2020/09/04	24 minutes
19	CPA	Accounting	Consultant accounting/technology	2020/09/10	35 minutes
20	Founder	Art industry	Blockchain expert	2020/09/11	75 minutes
21	IT – Blockchain developer	Blockchain development	Blockchain expert	2020/09/15	55 minutes
22	CPA	Mining	Public company	2020/09/14	34 minutes
23	CPA	Accounting	Private company	2020/09/16	22 minutes
24	CPA	Accounting	Medium audit firm	2020/09/17	26 minutes
25	Senior technical manager, R&D	Aerospace	Early adopter	2020/09/25	32 minutes
26	Head of data governance and project office	Broadcaster	Early adopter	2020/11/20	46 minutes
27	Director of technology and innovation	Maritime Transportation	Early adopter	2020/12/03	51 minutes
28	Business development executive	Blockchain platform technology	Blockchain platform provider	2021/01/15	100 minutes

4.3.2. Data analysis

From the professionally transcribed interviews and interview notes, including my logbook, I selected the most impactful and unique parts to demonstrate the novelty in blockchain, as well as its impact for accounting. In this initial stage, "the researcher concentrates on the parts of the data they find most surprising or salient" (Grodal et al., 2021, p. 597). The injunction is to remain sensitive to changes blockchain generates on accounting systems, accounting operations, and financial information. During the data analysis phase, several

iterations between data, emerging themes, related literature, and broader social theory were conducted with the aim of deepening our understanding of the impact and accounting changes in terms of transaction initiation, data entry, and transaction operations.

The first analysis was manually carried out by identifying all passages that were relevant to accounting and blockchain's impact. A limited number (8) of transcripts were read three times to ensure that the essence of the interviews was accurately captured. This process lead to the identification of broad areas of thematic interest around blockchain, such as the project's description, its visibility, a cost-benefit analysis, the blockchain property, and digitalization, to name the most important codes in NVivo. Then, a largely inductive coding process was conducted by a skilled single coder (Campbell et al., 2013), generating major thematic areas around accounting changes. However, the outcome of a such process was still primarily descriptive. I then proceeded to a more conceptual, second-order data analysis.

The second data analysis was conducted using NVivo, where all interviews were coded with their previously associated themes. Since this study is exploratory, the first coding resulted in several themes (*see appendix - codebook*). In a second coding, we focused on the changes that blockchain brings to early adopters, such as their motivation, data automation, transaction traceability. The second round of coding aimed to analyze in detail the accounting impact, and not only the blockchain technology. Administrative documentation was also coded then. This second analysis was carried out iteratively, starting from the data, moving on to blockchain literature and then to broader theoretical studies such as triple-entry accounting and business process management, and then circling back again while thoroughly validating emerging findings and determining how best to interpret them (Gioia et al., 2013). A limited number of interview quotes were coded more than once because they resonated with more than one identified theme. With several iterations between what I found throughout the literature and what my data reveal, I selected the most impactful quotes. Finally, several back-and-forths between the literature, the data, and the different blockchain applications are performed.

4.5. RESULTS AND DISCUSSION

4.5.1. Digitalization and simplification of accounting operations

My results suggest that the implementation of blockchain simplifies the administrative process and managing documentation. The evidence I gathered also points towards an acceleration of the invoicing process, payment through the Internet of Things (IoT), and smart contracts. I examine the chronologically recorded events, whose proof is available in real time for all network participants. Blockchain may allow such changes to processes and workflows in the supply chain.

To illustrate this new workflow, I use the concrete example of the delivery process Interviewee 11 shared with me. *Table 1*[9] shows the operation and documentation without blockchain and illustrates the new way through which transactions are being processed with blockchain's implementation. The changes this example points to have been very

[9] Figure 1: from Interview 11. Past or prior to blockchain workflow and blockchain workflow.

lightly explored by literature. Figure 1 recaps the workflow prior to the use of distributed ledgers for a shipment of merchandise from Company A to Company B's, warehouse as well as the invoicing process.

TABLE 4 - COMPARISON OF SITUATIONS PRIOR TO BLOCKCHAIN AND AFTER ITS IMPLEMENTATION AND IOT DEVICES FOR A DELIVERY

Steps	**Past workflow**	**New blockchain workflow**
1	Shipment details confirmed for the bill of lading (tender process)	Shipment details confirmed for the bill of lading (tender process)
2	Transportation of goods and delivered	Transportation of goods and delivered
3	Tender accepted OR rejected	Carrier's agreement to shipment details and proof of delivery via IoT
4	Rejection reason OR acceptance proof	No action
5	Auditor notified of accessorial charges	No action
6	Invoice generated	No action
7	Invoice issued	Accessorial charges added and invoice issued
8	Comparison of invoice with what was expected	No action
9	Validate match OR raise dispute	No action
10	Manual reconciliation	No action
11	Payment of invoice	Payment of invoice

Figure 1 illustrates the simplification of the business process through blockchain. What is really at play here is that when Company B needs goods to be picked up from or delivered

to Company A, it issues a tender or electronic instruction stating its needs to the transportation company. That request would be based upon the contract Company B has with that carrier. In the original contract with Company A, the transporter states specific requirements for delivery, such as the number of kilometres covered, the origin and destination pairs (ODP), the cost, and any specific fees, as well as the type of delivery truck needed. The contract provides an ideal, pitfall-free situation for the order's delivery.

Once it is processed, the delivery can run up against many obstacles that may be related to weather, traffic, or construction. All of these can change the original contract and add fees that the carrier may later claim. Once Company A reaches Company B's store, the carrier may have to wait for up to three hours before unloading its merchandise. Once again, this creates additional charges. It is very common in the industry to encounter known fixed charges at the beginning of the process or tender, right before several variable events, or charges occur throughout the delivery.

By the time the goods are delivered, and the invoice generated (Steps 6 and 7 in the example), the disconnect between what Company B expects to pay and the amount Company A is charging on its invoice has grown noticeably. At this point, both companies compare the delivery process they each recall, which is often different and mismatching. The situation creates disputes, as well as multiple back and forth emails and calls aiming to reach an agreement. The process is manual and relies on the agent's memory to proceed with a manual reconciliation. A payment will eventually be made.

> *So, as you can imagine, that is super manual. You are relying on people's memory, and it amounts to some significant dollars, financially, because of the variances that these types of charges can create. So, it's got this whole manual reconciliation and eventually the invoice is paid. (Interviewee 11)*

With blockchain, the integration of smart contracts allows the changes and validations to the contract's clauses to be performed electronically, reducing human error and chances of missing or sidestepping any system procedure. Circumvention or shortcuts are no longer possible.

The event recording applies to consumer goods delivery with the GPS tracking of blockchain delivery. This information is accessible to all stakeholders and avoids any confusion around delivery delays, waiting times, temperature, and so on.

> *So, there could easily be—you know, a couple of weeks that would go by before an invoice was generated, so that creates even more time and distance between the actual delivery event, which is why it would be hard for people to remember—hey, what happened when you dropped off that, you know, that load at that store?*
>
> *And so now, on our platform, because all of this information has been agreed to upfront, it exists between all parties. We use the IoT data as the justification … I call it the silent third participant in the workflow. It's there. It can be easily referenced by both parties. The invoice is basically generated once the goods are delivered. (Interviewee 11)*

When Company B needs merchandise and Company A automatically initiates the delivery, the invoice is triggered and recorded in the blockchain platform. All the known information, including the line haul rate, the fuel charges, the number of kilometres agreed upon, or any additional stops, are on the invoice. Only then may the transportation of goods occur.

> *What is unique now is [that] we're using IoT data, so the data information about the GPS location, the temperature data on the truck, the whereabouts; we're now using that information. We pull it into our platform, and now we can answer the questions around: yes, there were extra miles, or yes, we can validate that wait time was three hours, because we can see that in the GPS information. (Interview 11)*

In this example from a large retailer, the company managed to streamline its business process. Blockchain reshapes the organization's work practices and the way information flows.

With the last quote, we notice how blockchain is not relevant by itself, but rather in hybrid relation with other technologies such as smart contracts, IoT, and GPS. Using IT enhances the new and redesigned process' efficiency. As in the last case, IoT helps in solving problems by continually tracking shipments and collecting data. Note that through this supply chain exchange, IoT and GPS allow the digitization of information and data. Blockchain, on the other hand, ensures the reliability of information with encrypted data. Thus, the blockchain allows for the integration of other IT and provides a solution to the digitization obstacle.

Blockchain drives digitalization and engages in a hybrid approach. Paired with another system, it is more efficient in integrating new technologies on all fronts. Blockchain coordinates parallel functions during the process rather than afterwards (Hammer, 1990). Such coordination between information and movement in the supply chain accelerates data processing and reduces costs.

4.5.2. Streamlined billing and receipt settlement

With blockchain, precise events are captured and their history reconstructed. As mentioned by Interviewee 27, blockchain allows the capture of events in real time with tangible evidence, which is different than before. To illustrate these continuous events, here are several explanations and experiences of such events at play in various industries.

> *So, all these events are recorded in the blockchain and we are able to reconstruct the performance history of each container transit that passes through us. And that's the value. (Interview 27)*

Blockchain technology redesigns processes, accounts payables being one of the most affected ones, generating new rules and a process without invoices. These ideas are not new: Hammer (1990) connects the concept with the empirical case of the Ford company and pinpoints the need to, first and foremost, prevent mismatches in accounts payable. Interestingly, 30 years later, the topic is still relevant.

Figure 2 and *Figure 3* respectively show double-entry accounting and triple-entry accounting payable processes. *Figure 2* presents the classic double-entry accounting. The system results in a duplicated effort by both organizations to capture the same information, wasting time and resources in doing so. A transaction has been shared with me through interviews, which I then generalized. The flowchart presents a material purchase transaction based on an annual purchase contract between Companies A and B. There are several steps and exchanges of documentation between the two companies. There is also a delay between each step of the process, as well as several manual steps (see the figure's legend), such as invoice validation, payment, and the matching process between different supporting documents. There are weaknesses in the process, notably a loss of documentation, wrong documents, and negotiation or disputes between invoice and payment.

Figure 3 graphically simplifies the process to highlight the differences between traditional and blockchain systems. From the get-go, the agreement between the two parties is encoded in a smart contract, with all the business rules of the contract. This first step impacts the whole process because as soon as an order is placed with the supplier, an invoice is automatically co-created and made available in real time. This invoice is automatically updated for everyone in real time, skipping several validation and reconciliation steps between different copies of the process that happen with double-entry (see *Figure 2*). The delivery is captured by the IoT updating the information in an oracle[10] linked to the smart contract. The process is the same for the reception, and so the documentation serving as supporting documents is posted and reproduced for all members of the network to approve. Once approval is gained by all members of the network, each document is cryptographically coded following this specific network's rules, which differ from those of other networks. The blockchain then updates the information through a process of triple-entry accounting and the register is simultaneously updated for all participants of the network. Ultimately, the block information is assigned to a unique hash and the new block is added.

[10] Oracle are like IoT, a technology to help to use blockchain including a cloud service, an on-premises edition, and a SaaS application for supply chain, as example.

TABLE 5 - DOUBLE-ENTRY PURCHASING PROCESS AND ACCOUNT PAYABLE

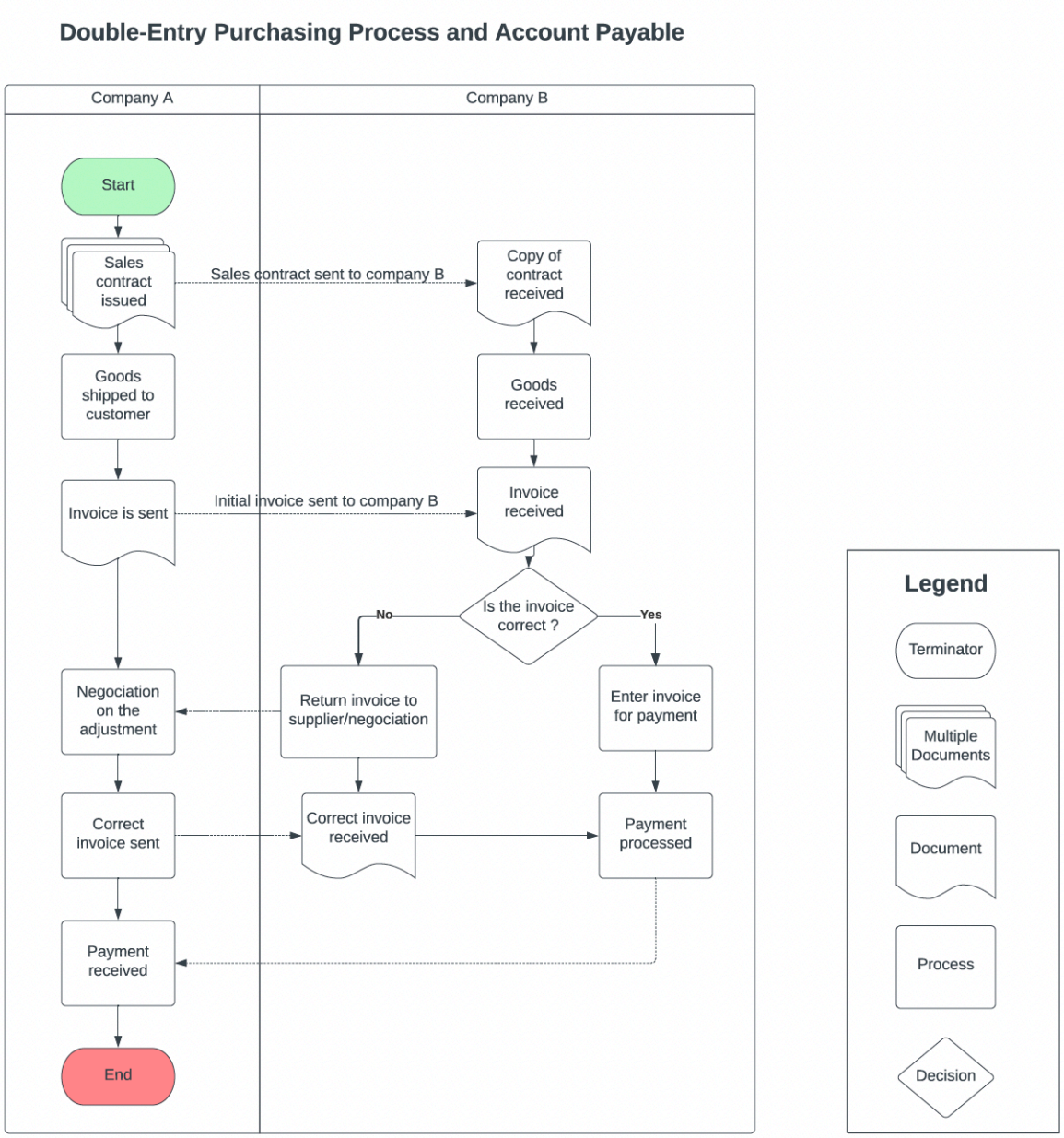
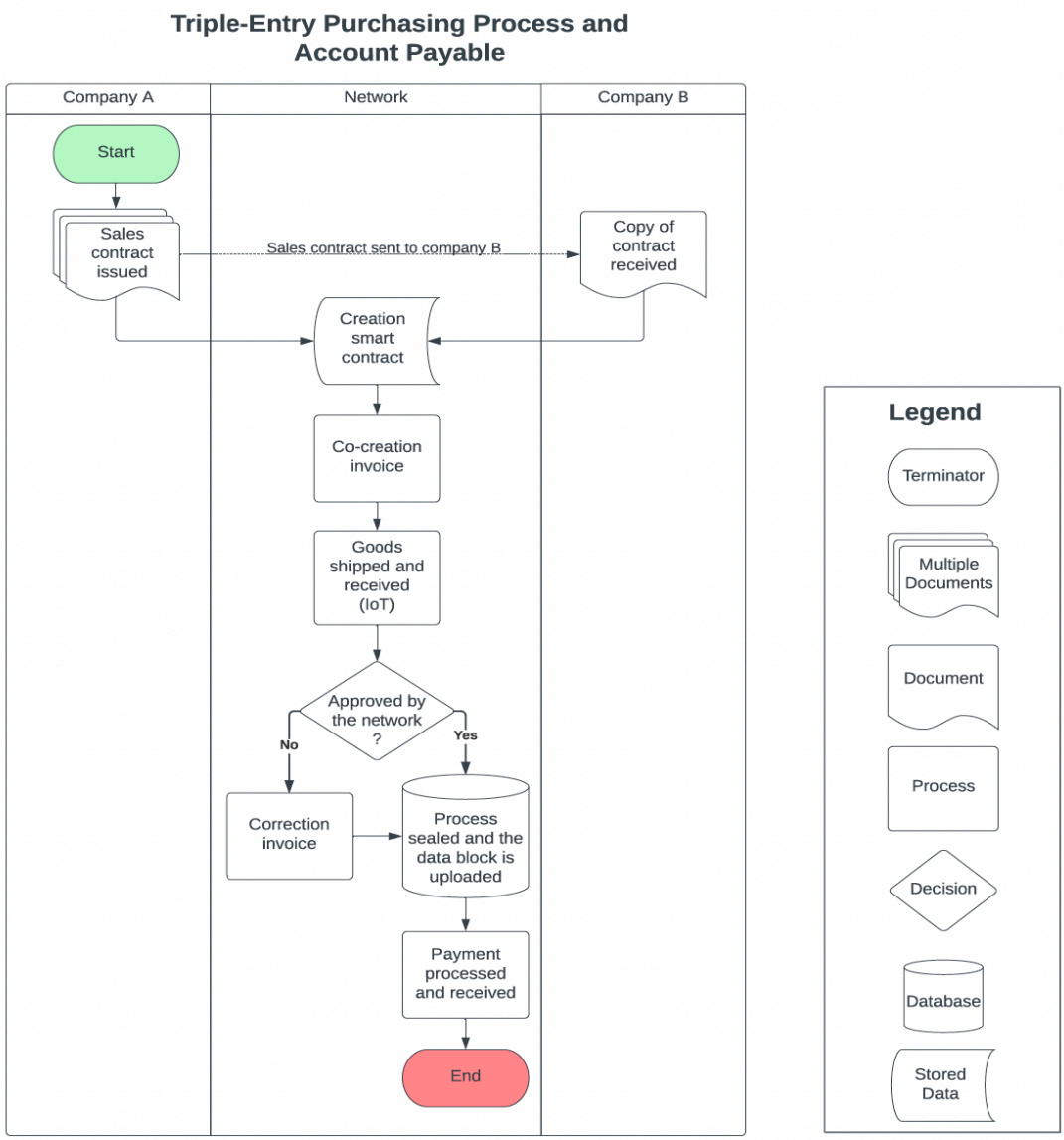


TABLE 6 - TRIPLE-ENTRY PURCHASING PROCESS AND ACCOUNT PAYABLE



This account payable is an example of many accounting processes automated by encoding business rules and agreements into smart contracts. Those with IoT technologies registered in a distributed ledger show a higher degree of information coordination and accelerate the processing of all operations. They also simplify the various processes around documentation and vouchers on top of considerably reducing the accounting costs of follow-up and reconciliation.

> *The error threshold for each transaction went from $10 per invoice to $0 per invoice. And the timeline to agree on and approve carrier invoices that formerly varied from six to eight weeks, but often extended over many months, went to less than one week. After approximately six months of national deployment, the platform has successfully processed over 200,000 invoices totaling payments in the hundreds of millions of dollars (business case documentation from Interview 11).*

4.5.3. A single version of the truth

In this section, I present one of the most important changes blockchain brings to accounting: a single version of a shared ledger to record all transactions.

The maritime industry, an important industry impacted by supply chain management, illustrates this innovative change. Through an example of the maritime transportation of goods, which can go through several ports, the course of a transaction is contextualized:

> *So, there's a lot of unloading and loading that takes place. It's not just point A and point B. Sometimes it's point A to point B and then from point B to point C. So, until that container gets to its final destination country, it goes through the import process. It gets sent to a warehouse or a deconsolidation centre and the goods get taken out of that container, and then that container then ends up going back into a pool somewhere. And it's now idle, ready for it to be used somewhere else. (Interview 28)*

Interviewee 28 explains how blockchain allows the recording of various events in a continuous way throughout the shipment and delivery of all sorts of consumer goods.

> *We're tracking 121 different milestone events. And we're working directly with the source to pull all those milestone events. So, if it's the trucking company, we want to know what the trucking company is doing. If it's the terminal operator that loads and unloads the containers, then we want to know from that. If it's the customs agency that's clearing that container, we want to know when it's going to be cleared and all of that. (Interview 28)*

Interviewee 11 explains that with the tracking of events allowed by blockchain, the different perceptions by the different parties involved in a transaction vanish. Where there were previously and frequently two different versions of the same delivery, a negotiation must now happen between the two parties to produce a single invoice reflecting reality (for example, a delivery). With blockchain, all parties involved in the transaction share the same reality:

> *You know, the carriers will have their version of what they said happened, the company will have their version of what they thought happened, and both organizations end up being in disagreement over what we call a single source of truth, that when you implement a distributed ledger technology like ours, all of a sudden puts everybody on the same page. (Interview 11)*

The digitization enforced by blockchain adds a new layer of information: the continuous recording of events, also referred to as the events log. This new possibility improves the information available to organizations, as well as the quality of this information. In the past, the accounting system used vouchers to recreate a transaction history. These

documents are used to prove the existence of an event or a business transaction requiring accounting treatment. With blockchain and its new level of information, the entire event can now be traced in real time, as it unfolds. This event tracking becomes proof of the transaction's existence. As mentioned by Interviewee 11, this continuous and real-time monitoring of events creates a single version of reality and of the truth for all of the network's users.

> *And in particular, at the level of reporting, we will probably find that some of the reporting that we currently do is no longer necessary. Because since you have continuous transactions, you can have a historical report that will just tell you: this is what happened this year—or this is what happened the last three days, or this is what happened the last three seconds. (Interview 21)*

Dai and Vasarhelyi (2017) anticipate this very innovation as they argue that " b y encoding the third accounting entry into blockchain, a transparent, cryptographically secure, and self-verifying accounting information system can be generated, which could facilitate reliable data sharing between business parties and continuous reporting for shareholders" (p. 10). My results are partially aligned with the potential transformation Dai and Vasarhelyi speak of, but also complemented with additional dimensions: continuous and chronological entries, improved invoicing processes, faster payment, one version of reality, and visibility for all the network's participants. The fact that two organizations or more share a ledger allows them to receive the same information, reality, and transactions, making it so that all parties are on the same page. This shared process avoids any negotiation situations or email exchanges, while speeding up the payment of invoices. Each participant or organization in the network has the same version of the ledger, which we refer to as the distributed consensus, where each network user maintains an identical copy of the blockchain, which is constantly being synchronized.

> *So the big difference between a blockchain program versus another is that these databases are all aligned with one company, unlike a blockchain project, as far an IT infrastructure is concerned, it gives you an opportunity to distribute the ledger across organizations between participating organizations. (Interview 25)*

Blockchain submits its common ledger for all participants of the network, which creates a single version of their reality and a consensus about the information. Having a single ledger for all participants in the network is also new: the seller, the buyer, and the bank have the same information registered in the same way. In the past, with an enterprise resource planning (ERP) system or accounting system, the processing was separate and left one of the three parties of a transaction in the dark or blind. Now, with the blockchain, all three (although a network can include hundreds of participants) parties will have the same information at the same time. There are no longer blind parties, as there were in previous transactions.

4.5.4. Challenges faced with blockchain

In the preceding section, the experience from Interviewee 11, who works with one of the largest international organizations in North America that implemented blockchain as an

early adopter, is relevant. The implementation created substantial resource savings, but the situation isn't the same for all the organizations I interviewed. These organizations face different challenges. Some share the view that financing is not easy to get; such difficulty is frequently stated throughout the literature on any new technological project. However, from this exploration of early adopters, there are specific problems I identified from the interviewees: knowledge, missing case studies and information, network creation, and scalability.

The human factor also requires understanding blockchain technology itself. As a nascent technology, blockchain is not yet well known or understood, and few people have implemented or had experience with the technology.

> *So, in my opinion, this is the step that needs to be taken, this step of popularization to the general public to have mass support. (Interview 14)*

> *What we struggle with, from a commercial aspect, is the individual knowledge that is necessary in order to envision these different workflows and to have all of the business expertise to define the business requirements for the solution that needs to get built. (Interview 11)*

One challenge encountered is the choice of technology itself. The limited number of case studies does not allow companies to identify best practices of the technology, since it is too nascent. Developing the technology in-house requires very specific coding knowledge that is limited on the market, so companies have turned to other organizations that offer blockchain that is scalable to their reality. Interviewee #6 discussed a project with me, explaining how the choice of technology was difficult and slowed down the pace of the project.

Another challenge is the creation of the network itself. To get organizations on board with the blockchain platform is a challenge for several reasons: fear, misunderstanding the technology, and migration to a new system.

> *And so, the challenge of a blockchain network like this, in particular, the biggest challenge that we've faced is you have to get, and you have to develop the ecosystem. It only works if multiple parties truly decide to come together and work together. So that's a critical aspect of it. (Interview 28)*

> *For the rest of us, it brings the … difficulty that [Agriculture Company] will work with a slaughterhouse and then if the slaughterhouse decides that it doesn't want to do it anymore or that it doesn't want to do it, well you're out of the chain and you've just lost the fundamental link, there. (Interview 5)*

> *I think, so the challenge is that, and which I would say they're still working towards it, is the idea of increasing the ecosystems of... Continuing to expand the ecosystem. So because it is a team sport, the more and more number of people join of varying kinds of compagnies and understand the value and the benefit of the shared ledger, there would be a magnifying advantage of that. So, it will amplify the value more. (Interview 25)*

One of the important differences is the ownership of the information and the functioning of the information exchange. Sharing information on a network isn't common for organizations. This system architecture is not common for private company.

> *To change the perspective that, "Hey, some things are useful to be shared across." So which means that including sellers, they should be feeling comfortable about some of the data sets, some of the data parameters about a particular part, they should be comfortable about sharing it across. Repair histories, and things like that. That itself was a challenge to begin with, I would say. (Interview 25)*

Not all players in an ecosystem or network like sharing information. Interviewee 26 shared with me a situation they encountered when evaluating the possibility of using blockchain. In their situation, the project was halted because the governmental mission of the organization was not aligned with the development of a technology.

> *And the producers resisted or used it as excuses. They all saw the point of it, how it could possibly allow—even better negotiation of the licence agreement and everything else. However, the current system is within its limits and favours them on some things, the flow that there is today allows me to cheat, and transparency would take away that ability. And the risk they anticipated was a loss of revenue because of the efficiency of the system. […]*
>
> *So the fact that the systems are separate and the different funding bodies don't talk to each other means that they are able to navigate and basically optimize their budgets on production today, which the transparency and the decentralized database takes away from that possibility. (Interview 26)*

Thus, in this passage, blockchain would have allowed different organizations across Canada to share information and correct a limitation in their industry. Producers objected because they could no longer request double or triple funding from different levels of government (such as provincial and federal, in Canada).

In the next quote, Interviewee 11 explains for their users, how to deal with the other participants in the network when a company implemented and used blockchain. Also, it provides an example how the company is trying to find different methods to achieve it.

> *So, it becomes—a lot of people, I think, struggle with—when it comes to deployment, how am I going to accommodate the vast range of technical capabilities in this ecosystem of third parties, to be able to deploy something like blockchain technology? And so, what we've realized is that there needs to be multiple methods with which organizations can share information that can accommodate their different technical capabilities. (Interview 11)*

Finally, a more general challenge already identified is the possibility of scalability from the blockchain platform.

From a technological standpoint, our biggest challenge will be to adapt the various components of our blockchain technology to the needs of this new product. In developing our other solution, [blockchain platform provider], we strategically developed the components to be reusable and adaptable to other situations, but now we will have to demonstrate that we have met our technical specifications and that they were well planned. (Interview 8)

Many of the challenges explained here are predictable, given that I have studied the early adopters of a recent technology. What seems to be specific, and essential, to blockchain is reaching an adequate number of players and for those players to actively participate in the network. The real challenge lies with this component: to share a common ledger, key participants must agree to share their information and use the technology.

4.6. DISCUSSION

4.6.1. Rethinking triple-entry accounting

The previous section shows, for the first time, the blockchain flow of operations by early adopters and looks at how triple-entry accounting takes place in a concrete way. In this section, I come back to the two initial frameworks of triple-entry accounting to analyze how the blockchain version of triple-entry accounting intersects with the visions of Ijiri (1986) and Grigg (2005). Even though some concepts are similar in both models, they differ in their applications and in the nature of the problems to be solved.

Ijiri's goal was to create a unit of measurement to validate the time of income acceleration for a business. With different momentum and force rates, the unit could measure the increase of income for a period, for example a month. In blockchain, tokens automatize the repartition between accounts, the attribution of costs, and profit at each transaction.

Such a rate notion does not yet exist for blockchain, but it may be just around the corner. Below, Interviewee 10 explains how to program each account in the accounting charts to determine the profit to be transferred to the investors for each transaction. Moreover, he explains how this works with blockchain, making the similarity with the rate of momentum striking:

And once you've paid all your costs—normally, what you say: well, it's pretty standard, you've got your tapline, you take out your costs; then you've got your gross profit. You pay your taxes, et cetera, and finally you have your net profit.

But the difference here is that the net profit goes where? The net profit normally goes to the investors because that's how it's always worked. The middle of a company that makes profits, is that the profits go to the investors.

But here, the token holders, the people who hold your token, actually, it's not—they don't have equity. ***Equity is another dimension.*** *They just have a financial right to future revenue.*

And so when you buy a token, you're not going to say, hm. I'm going to wait for—next quarter they're going to review their results and ***maybe I'm going to get a dividend.***

> ***That's not it at all.***
>
> *And now, we're going to say: in fact, every dollar that comes in, you, by owning a token,* ***you're going to get a micro portion of it****.*
>
> *And so, in fact, since your return to investors is already realized by the equivalent of a return to investors …. (Interview 10)*

The difference is that tokens permit a real-time preprogrammed distribution of money between accounts, something that Ijiri never thought of, which is not surprising given the technology available in 1986. In some way, the concepts of rate and repartition with blockchain intersect Ijiri's framework. Even though the explanation provided by Interviewee 10 was not yet applicable at the time of the interview, the ideology is still quite like Ijiri's and remains one of the first concrete applications of his idea. Even though the blockchain is not an application of the ratio as described and imagined by Ijiri, the idea of creating a distribution of costs to obtain better information is common. Further development of the notion would thus be relevant.

Despite the similarities between blockchain and the accounting momentum framework, they also differ in some aspects. The first difference is with regards to the financial statements presentation. Ijiri (1986; 1988) proposes an additional dimension with the force statement, as well as a third part in a debit and credit: the *trebit*. With blockchain, the presentation of the financial statements remains unchanged, but neither notion is possible given the architecture of blockchain technology. Instead of adding a layer, blockchain provides a common ledger for network participants to simplify debit and credit accounting for both companies at the same time. For an illustration of this idea, see the comparison I made in *Figures 2 and 3*.

The problem with the triple-entry accounting, as pointed out by Ijiri, lies in the short-term vision of managers and executive management. Blockchain solves this issue with the recording of transactions. With smart contracts and pre-programmed transactions, it is now possible to distribute costs to various centres. We imagine this distribution as such:

> *And in fact, what's happening with tokens is that every financial flow that exists within your organization, it can be directed immediately to its cost centre. In fact, I can immediately match revenues with costs in an automated way. (Interview 10)*

Ijiri's proposition of triple-entry accounting was meant for the bookkeeping of one organization or company of a centralized context. In the end, we didn't need a concept from physics to create triple-entry accounting, but rather the right technology to enable it. So Ijiri's proposal was a start, but his framework was too advanced and needlessly conceptual.

Now, let us examine Grigg's vision (2005). There is no doubt that his vision is well aligned with what we find with blockchain. Cai (2021) adeptly points out the similitudes between actual blockchain triple-entry accounting and Grigg's (2005) vision. The cryptographic

signature, the digital cash, the notion that the receipt is the transaction, and the third ledger for recording transactions intersect with the blockchain applications.

The limitation of Grigg (2005) was that he proposed an advanced conceptual idea of triple-entry accounting, but it was not viable at the time because of the right technology to apply the cryptographic signature and triple ledger did not yet exist. Without going into depth on the seven steps that Grigg (2005) suggests, the real difference is the local entry storage: for him, we should use different ledgers. The innovation with blockchain is the idea of a distributed and decentralized ledger, which implies only one ledger for all the participants and not a different ledger per participant. Blockchain architecture permits triple-entry accounting to be applicable, now. With blockchain, it is a totally different mindset. It creates a single ledger for all participants of a network. The tiple-entry is thus the recording of transactions for everyone simultaneously. This important and unique change is developed in the next section.

4.6.2. New technology, new mindset

Blockchain installs a different mindset, a process regulated by new rules (Hammer, 1990) and a new creative way of operating business transactions.

> *Yes, so we're having to sort of figure things out in a new way. (Interview 6)*

My interviews suggest that blockchain opens the possibility of organizing data and processes differently. However, as the literature review show, the concept of triple-entry accounting existed long before the arrival of blockchain. The same goes for smart contracts in respect to IoT. Blockchain technology now makes possible the realization of these theoretical ideas. The architecture of the blockchain, the cryptographic process, allows triple-entry accounting and its characteristics, thus creating a new mindset on data management. It would have been much simpler and more economical to integrate this architecture into a company's existing information system, such as an ERP, for example. My observation is that information systems are already stuck in a straitjacket and a vision so anchored that only a new technology could have innovated and proposed a different architecture.

4.6.3. The former role of accountants as gatekeepers

Given the recent development of new expertise in various fields, a question arises: what is the new role of accountants? Accountants have the role as gatekeepers with the topic of sustainability. " G atekeeping is considered a form of brokerage, i.e., a process by which intermediary actors facilitate transactions between other actors lacking access to or trust in another" (Marsden, 1982, p. 2020, in Schaltegger & Zvezdov, 2015, p. 341). While the initial intent is to investigate the role of accountants in blockchain implementation, there was no accountant active in any of the organizations I met. I had to expand my interview sample and include six accountants to benefit from their insights on their role. Since blockchain is relatively new, I needed to generate my own results, just like Schaltegger & Zvezdov did in 2015. My main conclusion is that accountants play the role of gatekeepers of financial information.

Overall, I observed that accountants experience a loss of power when reports are generated in a format adapted to certain readers, sharing a specific truth, and disclosing information for and on a specific period, since these are all actions in which accountants can no longer generate modifications.

> *Especially in accounting—then my blockchain client was very hard to wake up after eight months, because when it came time for the end of the fiscal year, they wanted to redesign their financial statements. I said: no, you can't. I said: you will not have any ability to do reclassification of information. Because again, I don't want to be mean to accounting, but accounting is not a science. Accounting is a swamp of information manipulation to play with the limit of accounting standards. (Interview 10)*

With blockchain, information is available in real time, therefore eradicating the gap between actual transactions and the publication of financial statements. While delays in the publication of financial statements previously varied between from one and six months after the year's end, blockchain eradicated these delays. With accountants now designing accounting information systems, provided information cannot be "fudged" as it was in the past, nor used as an income smoothing. Interviewee 10 points to this fact. The information is "frozen," protected and secured in a block, and requires a consensus of the entire network to be modified. This new level of control, where information is frozen once approved, impacts the power accountants and managers have in modifying the results. Moreover, since the information is transmitted directly to the network's participants, there is no longer a need for a gatekeeper. It is therefore of utmost importance to investigate the role accountants play in the new technological realm of blockchain.

> *It was just designing an environment and thinking about all the different risk factors that could come to our new type of business and try to put controls in place to mitigate them. (Interview 22)*

I believe that accountants, should they be granted the proper training and understanding of blockchain, will make for the next generation of tech consultants. Up until now, accountants have been responsible for internal controls and mitigation of risks, and it represents a real opportunity for accountants to be relevant in the blockchain world.

4.7. CONCLUSION

This study reports my in-depth examination of the changes in the business process after the implementation of the accounting transaction that is blockchain. Based on the 28 interviews with managers and professionals working in firms that are early adopters of the technology, I explored the impact of and changes generated by this technology. While most of the extant literature is rather conceptual and descriptive, I chose a qualitative and interview-based approach to draw awareness to several important aspects regarding the future of accounting that were previously neglected.

Through blockchain, IoT, and smart contracts, I showed how operations have been simplified. I also compared double-entry accounting process with the triple-entry process made possible through blockchain technology. In doing so, I revealed an important element of blockchain: the recording of events common to all participants of a given transaction creates a single version of truth and reality. Blockchain permits an events log, which was not possible before, and creates the perfect technology for triple-entry accounting to be applicable. Nevertheless, several challenges and risks are present, and we must remain on the lookout for them in order to make triple-entry viable. Furthermore, and importantly, a single record in a single register completely transforms the way accounting books are kept in businesses. This new system reduces costs and improves relationships with suppliers by avoiding negotiations or disputes over payment. I believe that accountants, should they be granted the proper training and understanding of blockchain, will make for the next generation of tech consultants. Up until now, accountants have been responsible for internal controls and mitigation of risks.

The study has its limitations. I chose to focus on a selected set of organizations active in a few industries that may or may not be leaders in blockchain technology implementation. Further studies in different locations would help in determining the extent to which my conclusions can be generalized. In the same way, further research could investigate cases where permissioned blockchain is integrated to enterprises and seems to impact business processes, reengineering them. It would be interesting to analyze risk management by considering the impact of continuous auditing, which blockchain permits. My study being exploratory, further research on the matter would deepen our understanding of the transformation and impact that triple-entry accounting with blockchain has on the technology of the accounting profession. I anticipated important changes in the way of using, interpreting, and receiving (accounting) information into organizations that will, in turn, create new way for organizations to manage this information. An observation of information management study will be essential.

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Appendix – Codebook

PROJET BLOCKCHAIN CODES

Nom	Description	Fichiers	Références
Après ça ils n'ont jamais voulu règlementer et obliger les déclarations. Ça devient un positionnement commercial.		1	1
Blockchain Project	Description du contexte de l'étude	14	81
Contenu WhitePaper		2	5
Cost-Benefit Analysis		5	17
Advantages - Game changer		17	53
Challenges		19	63
Implementation time		11	32
Improvments		4	5
CPA Role		9	24
Audit		1	1
Changements Comptables		2	3
Impact for accounting		4	7
Knowledge		14	63
Critic of Private Blockchain Usage		2	3
Crypto		6	21
De-humanisation		1	4
Decentralisation		5	19
Decision Making		3	3
Development Blockchain	Maturity of the technology	3	5
Distributed information		2	2
Efficiency -Payment process		2	12
Errors and correction in		1	1

Nom	Description	Fichiers	Références
the blockchain			
Ethique and Behavior		0	0
Ethical sourcing		3	4
Fraud		1	1
How convince implementation		0	0
Information - Governance	Information Owner	5	10
Partie Prenante - Blockchain	Qui sont les joueurs ?	3	8
Inter-Organization		0	0
Eco-Sytems		3	10
Network		8	18
Relations between Participants		4	10
Internal Controls		6	13
Access		4	7
Privacy		1	1
Interoperabilité		3	3
Isomorphism		1	1
Legitimiser l'utilisation blockchain		11	33
Make it Visible		4	8
Immutability		1	1
More information		12	40
Ownership-Provenance-Origin		6	7
Power of information		4	8
Tension sharing Information		1	3
Tention Sentitive Information		0	0
Modernity		0	0
Abstract systems		0	0
Reflexivity		0	0

Nom	Description	Fichiers	Références
Separation of time and space		0	0
Single Truth		2	2
Symbolic tokens		1	7
Trust Notion		9	23
Motivation for blockchain uses		1	1
Complexity		6	14
Facility for operations (users)		10	22
Magnitude (power) of blockchain		8	18
Problem to solve		18	69
Regulated Context		3	4
Technologic Gap		7	13
New Responsability for User		3	3
New way to organize		0	0
Off-chain		1	1
Orchestration - New order of Accounting information or Operations		0	0
Automatization		13	46
Dashboard		4	14
Optimization of a process		7	17
Reconciliation		3	8
Validation		1	1
Platform _ Fournisseur Plateforme	IBM HyperLedger Ethereum	10	19
Proof of ...	Proof of stake Proof of Work Par example - processus de validation de transactions	3	4
Property of Blockchain		1	1
Anonymity		2	2
Immuability		6	7

Nom	Description	Fichiers	Références
Traceability		15	30
Traçability		4	6
Transparence		3	10
Real-time transactions		4	10
Regulator or Tax authorities		3	11
Risk Management		6	16
Mitigation of Risks		6	22
Reducing Risks		4	13
Security Information		7	16
Standardization process with blockchain		1	2
Team	Composante de l’équipe	5	9

Chapter 5 – Conclusion

The objective of my thesis is to deepen the understanding of blockchain technology for the accounting profession and, more generally, accounting by the information processed and used. I have also identified a significant lack of field study to reach this understanding, so the three chapters of my thesis are three different data samples that study three different generations of blockchain.

Chapter 2 is a case study that explores the risks and benefits of ICOs for the stakeholders of a cryptocurrency issuance in a regulated context. The stakeholders identified are the company, the regulator, and the investors. In this case study, I note that accounting firms are not equipped to issue an option on the financial statements of this type of project and company, a rather abnormal situation. Based on prior research and interviews of key respondents, I developed a framework identifying the main risks and benefits of performing an ICO for key stakeholders.

Chapter 3 is a study of the history of Bitcoin. I find that Bitcoin is an accounting regime that prescribes new ways for recording and measuring transactions. It creates a new ledger for evaluating these transactions that fuse accounting concepts with technological imperatives. In fact, the ways in which Bitcoin architecture is designed are often discussed in (programming) code, as this is a language shared and understood by Bitcoin programmers. I demonstrate that this accounting regime is not owned by accountants, but rather by unelected coders who have co-opted the traditional knowledge of accountants. I argue that these non-accountants can appropriate accounting knowledge because it is not sufficiently "esoteric" (Larson, 1977).

Chapter 4 explores the adoption of blockchain in early adopters enterprises to understand the accounting changes. To analyze these changes, I use Ijiri's and Grigg's frameworks of triple-entry accounting to study what changes blockchain's triple-entry accounting system has brought. In this chapter, I illustrate how a single version of reality, with a single ledger for all blockchain network participants, tends to decrease transaction costs and improve relations with suppliers. Such observations lead me to explore the changing role of accountants, who can no longer be considered the gatekeepers of financial reporting.

5.1. Contributions to ICO and accounting firms

My study makes several research and practical contributions. First, I document the case of the first Canadian-regulated ICO through the examination of interviews with key stakeholders. The interviews provided access to privileged insider information. Calls for conducting qualitative research to get insights on motivations to launch ICOs, and to invest in ICOs, have been made (Fisch, 2019; Schmitz & Leoni, 2019).

Second, very few studies have been conducted on the impact of disruptive technologies, such as blockchains, utilized as financing vehicles. ICOs using blockchains may be disruptive not only from a technology standpoint, but also from a financial standpoint.

While the possible applications of blockchains are unknown to me to date, I do know that blockchains have the potential to challenge the traditional financial system monitored by financial regulators. Prior research paid little attention to ICOs.

Last, the study identifies, through a framework, the risks and benefits of performing an ICO in both unregulated and regulated contexts, which have practical implications for those involved in the fintech space. I am not aware of studies integrating the three stakeholders discussed—namely, the firm launching an ICO, the investors, and the financial regulator. I trust that this framework will be useful for future research, for firms operating in the crypto space, and for financial regulators.

5.2. Contributions to accounting regime

My thesis also contributes to the sociology literature, more precisely, to the accounting regime concept. First, I believe that one of the contributory statements of my work lies to the fact that I challenge the notion of Bitcoin as a simple payment system to demonstrate how its technological architecture is a function of its ideological and accounting aims. I mobilize Jones and Dugdale's (2001) definition of an accounting regime to demonstrate how Bitcoin developers mobilize accounting vernacular to make sense of this new financial reality.

Second, I explain the incursion of non-accountants into the traditional cognitive base of accountants by exploring how Bitcoiners co-opt accounting knowledge. I explore how, if a knowledge base is not sufficiently esoteric or well-protected, a profession's jurisdiction can be threatened. Theoretically, this analysis builds on the work of Jones and Dugdale (2001) and their concept of an "accounting regime." An accounting regime frames accounting as a technology that is at once "a system of governance (…) that is socially constructed (…) and a set of social practices that generate information" (p. 58). The concept of an accounting regime provides us with a framework to explore the ways in which accounting concepts can be used to create new interpretative schemas for understanding financial flows.

I also integrate sociological theories on professional knowledge (Larson, 1977; Abbott, 1988; Freidson, 2001) to explore how accounting, as a prescribed body of knowledge controlled by a group of experts, can be taken away from accountants, and the potential threats this can pose to the jurisdictional boundaries of the profession.

5.3. Contributions to triple-entry accounting

This paper makes three main contributions. First, it adds accounting and empirical dimensions to prior research on blockchains and to understanding the magnitude of the changes that blockchain brings to business, and more specifically to the discipline of accounting and its profession. For instance, Coyne and McMickle (2017) did not "investigat[e] the problems with accounting ledgers that might need resolving or the potential for modifications to accounting and automation that would make the blockchain more useful without changing the blockchain itself" (p. 111). This paper presents a similar analysis, but with the smart contract, blockchain, and triple-entry accounting.

Second, the findings reported in this paper suggest that blockchain is interrelated with the idea of triple-entry accounting, and thus I discuss Ijiri's (1986) framework and Grigg's (2005) triple-entry accounting. I contribute to the understanding triple-entry accounting, which is still nascent and under-studied. Cai (2021) started a conversation about the similarity of Grigg's paper (2005) and triple-entry accounting. Here, my paper develops the concept of triple-entry accounting with several concrete applications. I mobilise Ijiri (1986) and Grigg (2005) to provide a more complete analysis of the development of the triple-entry accounting system.

Third, this paper addresses, in a practical way, how blockchain and accounting operations can be coordinated with a common ledger to record transactions. More specifically, I propose flow charts of the transaction process before and after of the arrival of blockchain technology, which represent a comparison with double- and triple-entry accounting and could be useful for organizations that want to use this emerging technology.

5.4. Concluding thoughts

In conclusion, I am convinced that my dissertation contributes to the understanding of an emerging new technology that disrupts routines, processes, information processing, and the register, a central tool of the accounting profession. My three studies inform, both theoretically and practically, what blockchain will change for the accounting profession, as well as blockchain's limitations and challenges. In future research, I encourage further investigation into what companies are developing with blockchain, as well as deepening the understanding of changes in information processing for management accounting.

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