Innovation Within Networks – Patent Strategies for Blockchain Technology

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Abstract

Purpose - Understanding a technology's patent landscape, including patent strategies, helps organizations position themselves regarding their innovation and provides insight about a technology's future direction. This research aims to provide an overview of blockchain technology patenting trends and outlines an exploratory framework of patenting strategies for blockchain.

Design/Methodology/Approach – A total of 3,234 registered patents are analyzed to determine the geographical distribution and identify key actors patenting around the globe. In addition, an empirical study consisting of multiple case studies in the form of ten in-depth interviews with owners/managers of organizations based in North America was conducted to understand organizations' strategies for patenting blockchain technology.

Findings – Several novel insights regarding the strategies used for blockchain technology patenting. For example, the existence of strong anti-patent sentiment which results in a lack of patenting by start-up organizations or has led to a form of open source patenting strategy. Larger organizations appear to be patenting defensively, and small-to-medium organizations are primarily patenting to defend their competitive advantage.

Practical Implications - Start-up organizations harbouring anti-patent sentiment should consider the open source patenting strategy to ensure that the collaborative innovation network can continue. They should also consider collaborating with other actors within the network to have a competitive position in the market.

Originality/Value – To the authors' knowledge, this paper is the first to conduct an empirical study with organizations currently using blockchain technology to understand patenting strategies used for blockchain.

Keywords: Patenting Strategy, Blockchain Technology, Case Study, Patent Analysis, Clustering.

[1] Last Updated December 12th 2019. For more information, consult:

1. Introduction

Over recent years, blockchain technology has been an active area of research in both academia and industry. Blockchains are an innovative and disruptive technology with the potential to impact many industries including; healthcare (Griggs et al., 2018), real-estate (Mashatan and Roberts, 2017), governance and citizen engagement (Hanifatunnisa and Rahardjo, 2017), education (Sharples and Domingue, 2016), economic transactions (Wang and Kogan, 2018), logistics/supply chain (Gao el al., 2018) energy (Liang et al., 2018) and, many more (Shen and Pena-Mora, 2018; Casino et al., 2019). The National Institute of Standards and Technology define blockchains as; tamper evident and resistant digitalized ledgers implemented in a distributed network, without a central repository or authority (Yaga et al., 2018).

The concept of a blockchain, although still immature, is not new. It was first conceptualized in 2008 by Satoshi Nakamoto in his seminal work titled; *Bitcoin A Peer-to-Peer Electronic Cash System.* Indeed, blockchain technology started with the cryptocurrency; Bitcoin. Nakamoto (2008) describes the Bitcoin blockchain as a peer-to-peer network for direct transactions using a distributed timestamp server that generates computational proofs of transactions in chronological order. In short, Nakamoto's Bitcoin blockchain is a method of transacting digital currency (cryptocurrencies) among a network of peers. The network can take several forms, comprising of individuals or B2B organizations. Overall, Nakamoto's Bitcoin combines several existing technological components such as, cryptography (digital signatures and hash functions), networks, data structures, a distributed consensus mechanism, and a programming language to create a new form of technology (Narayanan et al. 2016).

Overtime, Bitcoin gained significant value, although experiencing drastic fluctuations due to several factors (Sovbetov, 2018). The value fluctuations and what some would refer to as bubbles, resulted in waves of public, organizational, and academic interest. Nakamoto's Bitcoin inspired others to consider the technology and over the next several years numerous blockchains were developed; each providing a slightly different function. Alternative digital currencies, known as altcoins, were soon created to capture a portion of the cryptocurrency market (Cheah, and Fry, 2015). Two early and predominant altcoin examples are Ripple (Ripple, 2019) and Litecoin (Litecoin, 2019) launched in 2011 and 2012 respectively. In 2014, one of the most notable blockchain developments was made; the Ethereum blockchain, described by (Buterin, 2018).

Ethereum has a built in Turing-complete programming language which allows users to write applications and smart contracts (Buterin, 2018). Ethereum drastically expanded perceptions of the possible when using blockchain technology and sparked an entire new line of thinking. This new era of thought continues today, as does blockchain technology development.

Blockchain technology is an innovation with significant potential to impact Business-to Business (B2B) networks. Impacts can take three main forms; the creation of new B2B networks, the re-structuring of B2B networks, and the enhancement of existing B2B networks. Blockchains allow for peer-to-peer transactions to be conducted in a trustless B2B network (Lacity, 2018), which allows for the creation of new B2B networks. For example, Kang et al. (2017) describe how a consortium blockchain provides increased transaction security without the reliance on a trusted third party, enabling a new peer-to-peer network for electricity trading. With the ability to conduct direct peer-to-peer transactions, blockchains also allow for existing B2B networks to be re-structured through the disintermediation of third-party intermediaries (Hughes et al., 2019). Dobrovnik et al. (2018) studied the impact of blockchain technology for logistics and noted third-party intermediaries are no longer needed to verify the transfer of ownership for goods within a supply chain. This radically changes the structure of existing supply chain networks. When it comes to B2B network enhancement blockchains are tamper-evident data structures which creates immutable data (Narayanan et al., 2016; Hughes et al., 2019). This enhances the quality of data within B2B networks. Also, blockchains can provide transparency which facilitates increased trust among actors within networks. Finally, a blockchain can improve efficiency, lowers costs, and even provide automation capabilities (Narayanan et al., 2016; Hughes et al., 2019), all of which improve the functioning of B2B networks.

Today, blockchain technology is capturing the attention of managers and policy makers around the world. In 2016, the blockchain market was estimated to be worth 210.2 million and is predicted to be worth 2.31 billion by 2021 (Statista, 2016) and 7.59 billion by 2024 (Grand View Research, 2018). In addition, a recent PwC survey, of 600 executives geographically distributed around the globe, shows that 84% of organizations are involved, in one way or another, with blockchain technology (PwC, 2018). With such high levels of interest, a large projected growth rate, and vast impacts on business networks, there is a need to examine innovation trends for blockchain technology.

One proxy for innovation and economic activity is patent data (Wang et al., (2019); Acs et al., 2002). A patent gives the inventors the *right*, for a limited period, to exclude others from using their invention, which has its boundaries defined by the written claims in the patent document (Somaya, 2012). However, over time, organizations began to conceptualize the patenting process as a strategic endeavor with the potential to achieve more than exclusion. This resulted in the development and use of patent strategies to be used in congruence with organizations business motivations (Somaya, 2012).

Technology-driven organizations need to find novel and innovative strategic approaches for emerging technologies based on their capabilities. Understanding the patent landscape, including patent strategies, can help organizations position themselves regarding their blockchain technology innovation and provide insight about the technology's future direction. As such, this research aims to provide an overview of blockchain technology patenting trends to understand the patenting landscape and outline an exploratory framework of blockchain technology patenting strategies.

The following section reviews the relevant literature regarding the use of patents as a tool for analysis and patent strategies. This is followed by an overview of the research methodology, analysis, and results. The paper concludes with a discussion of the results, managerial implications, theoretical implications, limitations, and future research.

2. Literature Review

The following literature review discusses how patents can be used as a tool for analysis and reviews previous literature on patents as a strategic tool for organizations.

2.1. Patent as a Tool for Technology Analysis

The original purpose of patenting was to foster innovation and economic development by preserving incentives to make and commercialize inventions (Somaya, 2012; Mazzoleni and Nelson, 1998). As Macdonald (2004) puts it, the aim of a patent is to be a means to an end, with the end being further innovation. Patents encourage innovation which, in turn, is supposed to produce more innovation (Macdonald, 2004). Analyzing the historical data of patent applicants, citation information of patents, portfolio of assignees, and international patent classifications can develop research and development as well as market strategies (Jun et al., 2012). In addition, a

patent analysis can be used to compare the strategic industry positioning between countries. By analyzing patent counts or the number of applicants from different countries, researchers can quickly distinguish which countries are leading innovation in different areas of technology (Albino et al., 2014). Similarly, organizations can use patent analyses to position themselves strategically in their industry. In the literature, different patent analysis approaches have been used to find the correlation between the value of patents, e.g., backward citation (Reitzig, 2004), forward citation (Fallah et al., 2009), word clustering (Dehghani and Dangelico, 2018), and text mining (Tseng et al., 2007).

Word clustering is an approach for text-based data (Dehghani and Dangelico, 2018) and categorizes technologies that share similar characteristics ( ). Technological trends and associations can be discovered by analyzing these word clusters (Motohashi and Tomozawa, 2016). This helps the decision-making process for technology analysts. In addition, Tseng et al. (2007) noted that text mining is useful for patent data and used text mining in their patent analysis. Indeed, there are many examples of using patent data to study the development trends of technological innovations (Jeong et al., 2015).

2.2. Patent Strategy

As the patenting process evolved and industries changed, managers began to realize that patents have strategic value. Somaya (2012) described a framework of *patent strategies* to organize the fragmented literature. One of the strategies he describes is the *proprietary strategy* which dictates patents be used as an isolation mechanism to shield an organization's competitive advantage from imitation. When using this strategy, the firm is attempting to obtain an exclusive position in the industry and make use of the technology themselves. Afuah (1999) discusses a similar strategy known as *blocking*. The idea is that if a firm has unique capabilities at each stage of their value chain, they can use patents strategically to keep competitors out of the market. Blind et al. (2006) call this type of strategy an *offensive blockade*; patenting to prevent other firms from using the technology in the same or similar field. Rivette and Kline (2000) present two similar forms of proprietary strategies; *clustering* and *bracketing*. A clustering strategy is using multiple patents on a single product which effectively builds a patent wall to keep competitors out. A bracketing strategy is when one does not have the patent on the invention, but patents everything around it to keep competitors from using it and out of the market. *Pre-emptive patenting* and *patent*

fencing are two additional strategies geared toward keeping a market exclusive. Cohen et al. (2000) describe patent fencing as a similar strategy to clustering; patenting around a core patent (patenting substitutes) to prevent competitors from entering the market. Preemptive patenting is defined as patenting substitute technologies before competitors, to prevent market entry (Ceccagnoli, 2009).

A second strategy from Somaya's (2012) framework is the *defensive* strategy where patents are filed to avoid a competitive disadvantage. This type is to defend against the patents of others (to avoid litigation, being forced to license, or being blocked) so the organization can operate freely. Blind et al. (2006) describe a similar strategy labeled a *defensive blockade*; when firms patent to prevent their own room to maneuver from being eroded from other's patents. Ziedonis (2004) describes an *aggressive* patenting strategy (filing many patents for a larger portfolio) as a mechanism to avoid being fenced in or held up (forced to pay license fees) by competitors. Hall and Ziedonis (2001) found that large-scale manufacturers are engaged in portfolio races to amass large portfolios of patents. These organizations are ramping up their patenting as a form of defense (e.g., to ensure the freedom to operate) and to assist in the winning of favorable terms in negotiations with other firms (Hall and Ziedonis, 2001). Somaya (2012) discusses portfolios further, claiming that the defensive patent strategy can be reflected by the term *portfolio patenting*, which he describes as building large defensive portfolios of patents to avoid being held up (Somaya, 2012).

The third strategy from Somaya's (2012) framework is known as the *leveraging strategy*. A leveraging strategy is when an organization patents to pursue direct (licensing revenue) or indirect (greater power in negotiations) profit opportunities. Some organizations do not intend to produce the technology that underlies their patents but intend to use the patents strategically to make money from royalty payments or damage awards. These actors are referred to as patent sharks or trolls by Reitzig et al. (2007). *Royalty stacking* is a strategy like clustering, in the sense that there are multiple patents on a single product, but the goal is not to exclude competitors, it is to force organizations to bear multiple royalty payments (Lemley and Shapiro, 2007). Strategies are certainly employed for financial gain but receiving royalty payments is not the only strategic motivator. Similarly, small firms or start-up organizations may patent in hopes of signaling their technologically innovative capabilities to investors to secure funding (Veer and Jell, 2012).

Although previous studies have identified several patent strategies (Somaya, 2012) for different products or industries, there is a lack of empirical studies identifying the patent strategies for blockchain technology. In fact, there is a general lack of knowledge about the blockchain innovation landscape and strategic motivation of blockchain technology patenting for different organizational environments, industry classifications, and business sizes. Second, much of the existing literature reviews patent strategies retrospectively; that is, they analyze what patent strategies have been used in the past. This research takes the stance of analyzing the application of patent strategies for an emerging technology in the early stages of maturity; making this research especially timely. Third, to the best of our knowledge, there has not been any patent analysis conducted for blockchain technology. Finally, this study is one of the first to employ multiple methods to analyze innovation trends for blockchain technology.

3. Research Methodology

The methodology used in this research is twofold. First, patent data is analyzed to determine the number of blockchain technology patents, how they are distributed geographically, and identify the key actors patenting around the globe. Second, the results of multiple case studies, consisting of in-depth interviews with owners/managers of organizations based in North America, are discussed to gain insight into organizations' strategies for patenting blockchain technology.

3.1. Patent Analyses

To analyze the development trends for blockchain patenting, data was collected from Clarivate Analytics. Since the first patent for blockchain technology was registered in 2012, we searched for patents between 2012 and 2018. The patent search ended on December 31st, 2018 giving us a 6-year span of data. To search for patents, different combinations of keywords were used that were most likely to be related to blockchain technology such as "Blockchain", "Cryptocurrency", "Bitcoin", "Distributed Ledger Technology", "Ethereum", "Hyperledger", "Smart Contract". To choose the most relevant keywords, we carefully reviewed the previous scientific literature, in particular, the study by Miau and Yang (2018). Keywords were searched in the patent document, specifically the patent title and abstract. The search process identified a total of 3,234 granted patents.

3.2. Empirical Study

To gain a deeper understanding of the strategic motivations behind the blockchain patenting, we conducted an empirical study (Yin, 2011). An exploratory multiple case-study research design, in the form of semi-structured interviews, was chosen to collect the empirical data. This method was selected to enhance the external validity (Voss, 2010) and because multiple cases were available (Stake, 1995). The cases were selected to be a representative sample of organizations operating in the North American blockchain technology space. A review of our patent analysis (Section 4, Figure 2) revealed that North America holds over 25% of the world's patents for blockchain technology, making it a hub for blockchain innovation and a reasonable choice for sample selection. The application of blockchain technology is not limited to a single industry or organization type which stipulates the need for a heterogeneous sample. The selection of a heterogeneous sample is aligned with the theoretical replication approach (Yin, 1994) which aims to examine differing practices, in this case patenting, according to organization type and other characteristics such as industry.

Organizations were chosen to be aligned with the objectives of this study, to be representative of the North American population, and to maximize the amount of information obtained. In total, we were able to conduct interviews with 16 organizations. However, several cases had no patents nor were involved with patenting in the blockchain space and were removed from the sample. This resulted in a final sample of 10 cases with organizations who had filed or were already granted blockchain patents. These 10 cases are representative of nine unique organizations and close to 200 blockchain patents that are either fully registered or filed. Table 1 outlines the details of each case.

	Organization Type	Industry	Interviewee Position	Establishment Date	Annual Revenue (Millions)	Number of Employees	Number of Blockchain Patents Registered or Filed
	Small - Medium Organization	Technology Identity Management	Technical Subject Matter Expert and Executive	2008	>10	50 – 249	4
2	Large Organization	Financial	Senior Management and Executive	1855	>10	>1000	11
	Start-up	Financial	Technical Subject Matter Expert	2017	<1	1 – 49	35
4	Start-up	Technology	Technical Subject Matter Expert and Executive	2017	<1	1 – 49	2

5	Small - Medium Organization	Technology	Partner (Lawyer)	1967	>10	50 – 249	
6	Start-up	Technology Healthcare	Executive	2017	<1	1 – 49	1
7	Start-up	Technology	Technical Subject Matter Expert and Executive	2018	<1	1 – 49	
8	Start-up	Technology Human Resources	Executive	2017	<1	1 – 49	2
9	Small - Medium Organization	Technology	Partner (Lawyer)	2011	1 – 5	1 – 49	
10	Large Organization	Financial	Executive	1855	>10	>1000	11

Table 1 - Interviewee Details

4. Analysis and Results

The following section presents the results of the patent analysis and empirical study. It includes results from the descriptive analytics, cluster analysis and cross-case analysis.

4.1. Descriptive Analysis

Figure 1 illustrates the number of patents per year between 2012-2018. The graph illustrates an exponential increase in the number of patent registration for blockchain technology over the 6 years. In the period between 2012-2016, patent applications were conservative with less than 500 filings. In contrast, the period between 2017 and 2018 shows a very sharp rise in the number of blockchain patent applications with 2,388 (74%) recorded by the end of 2018. Having 74% of the total blockchain patents filed between 2017 and 2018 shows this technology is beginning to gain significant interest and patents are just starting to amass.

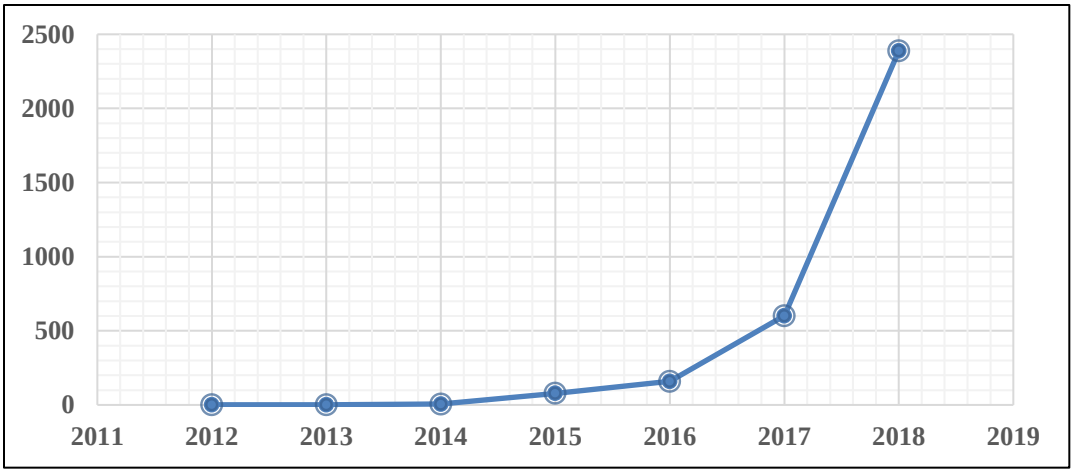

Figure 1 - Distribution of Patent Filings Between 2012-2018

The geographic distribution of patents for blockchain technology is reported in Figure 2. China is the dominant country, contributing to 34% of patent registration and the United States is in second place with 25% of the share of the world's patents for blockchain technology. What is interesting is that two recent studies, one which analyzed patent data for the Internet-of-Things (IoT) (Ardito et al., 2018) and the other patent data for smart wearable technologies (Dehghani and Dangelico, 2018; Dehghani and Dangelico, 2017), found a similar distribution of registered patents. This speaks to a trend that emerging technologies seem to be patented most frequently in either Asia or North America.

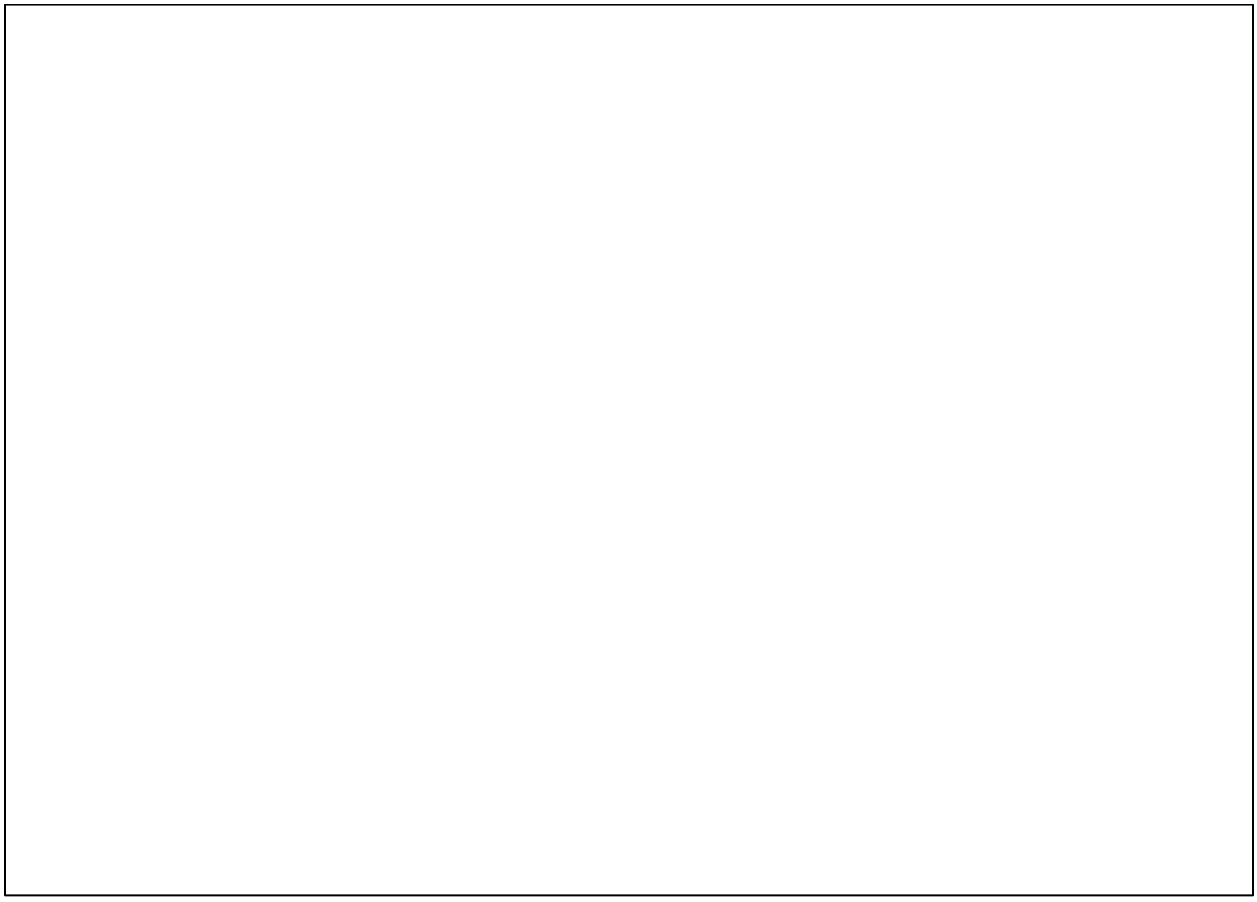

Figure 2 - Geographical Distribution of Patents Registered

Figure 3 lists the top organizations in terms of number of registered patents for blockchain technology. According to the data, there are two leading organizations, Nchain Holding Ltd with 303 patents and MasterCard Inc with 151. Similarly, IBM has a leading assignee with 141 patents, which places them in third position. The data shows that large technology providers, financial organizations, and blockchain startups are the predominant blockchain patentors. One consulting firm and one electronic-commerce provider were also in the top 10.

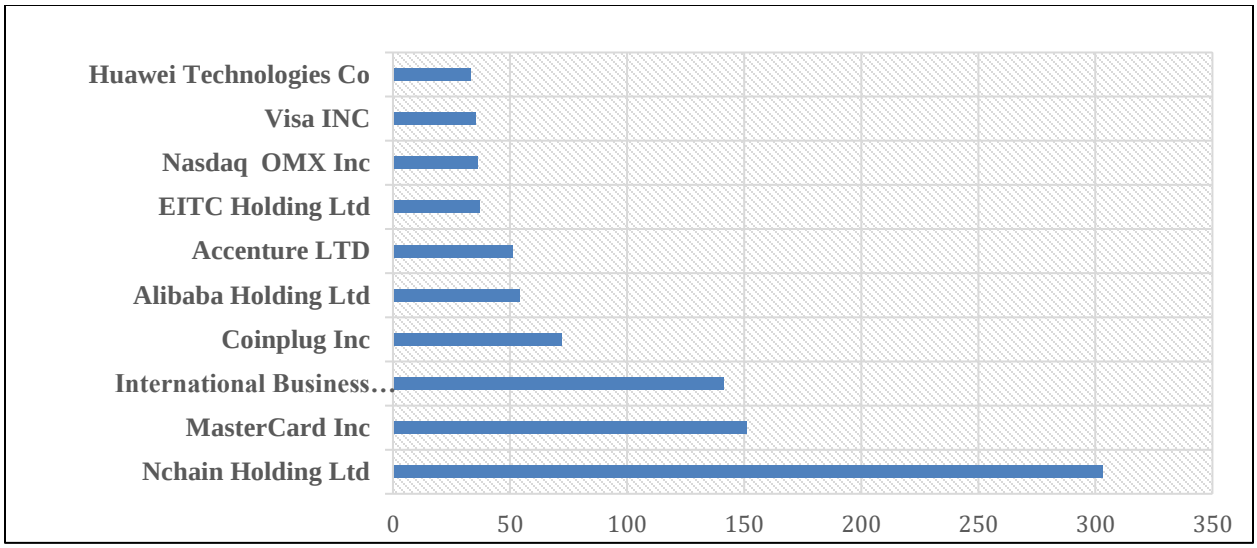

Figure 3 - Top 10 Organizations in Terms of Number of Registered Patents

4.2. Clustering

VOSviewer software (Waltman et al., 2010) was used to construct and visualize patents keyword networks, since it has already been validated in previous technological studies (Leydesdorff, 2015). Text-mining techniques were employed first to transform the raw data into a structured data set using document parsing and term extraction methods. Titles and abstract descriptions of all patents were chosen to search for and build comprehensive clustering results. In total, 64,711 terms were recognized, with 5068 meeting the threshold based on the software's calculation. Then, clustering was employed to identify words with similar characteristics enabling us to highlight patent trends for blockchain technology. The keyword co-occurrence network is shaped when the keywords become visible in the published patents and co-appear, forming a link to the related blockchain patents.

Figure 4 illustrates the most frequent word stems and most associated word-stem pairs. Each word stem reflects a specific theme from the text. If a word stem, recognized with a given theme, had a high frequency with its associated word stem, the more important the theme.

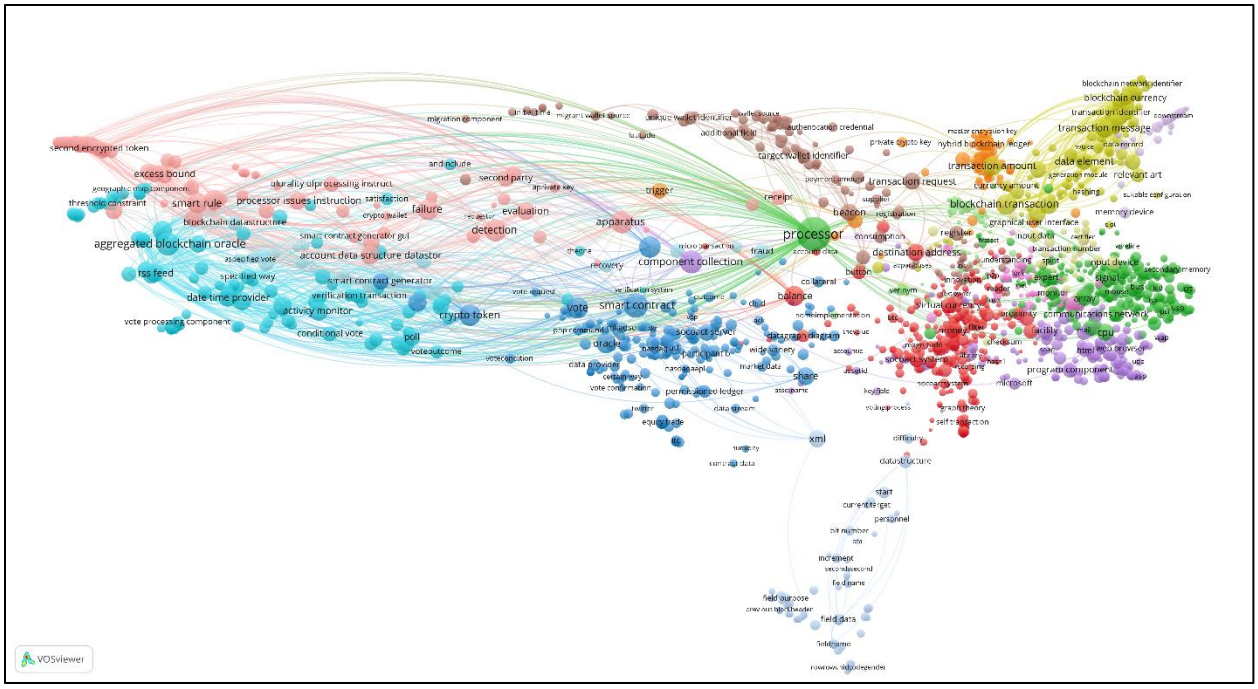

Figure 4 - Six Main Word Clusters

The interpretation of the results based on the high frequency words in each cluster and their relevancy score to other words within the network is provided in Table 2. Two researchers provided interpretations of the clusters independently and found very similar findings. Any differences were reconciled, producing synthesized results. In addition, a blockchain expert verified the interpretations, enhancing the validity further.

Cluster	Cluster Key Terms	Interpretation
1	**Processor** **CPU** **Signal** **Micro Trusted Network** **Secondary Memory** **Peripheral Device** **Network Interface** **Input device**	This Cluster shows several patents focused on optimizing the connection between devices and a blockchain network. Several terms indicate patenting on a form of mining rig or mining network.
2	**Virtual Currency** **Money** **Socoact System** **NFC (Near-Field Communication)** **Destination Address** **Self-Transaction** **Graph Theory** **Blockchain Recording** **Bluetooth**	The Socoact System is a voting system patented by Fidelity Investments. This Cluster signifies a system which operates with transactions as votes. This cluster may also indicate a simplified method of conducting financial transactions with a cellular device. The terms signify that users of this system conduct transactions or cast votes by tapping their phone on or by creating a Bluetooth connection with a receiving device.
3	**Smart Contract** **Crypto Token** **Vote** **Twitter** **Permissioned Ledger Share** **Electronic Wallet**	This Cluster is indicative of a voting system. This voting system includes access management components. With terms like ‘permissioned ledger share’ it appears this voting system can segregate users. For example, with a voting system it would make sense to analyze votes based on state or province. It

	Socoact Server **Oracle** **Vote Confirmation** **Participants**	would also make sense to have the voting system permissioned, as only certain individuals can vote for a given election.
4	**Aggregated Blockchain** **Vote Processing Component** **Conditional Vote** **Poll** **Vote Outcome** **Data Time Provider** **Verification Transaction**	This Cluster indicates a voting system. The key terms seem to be variable names for a voting system. The key terms also imply the possibility of integrating multiple blockchains into one combined chain and ensuring one vote per person.
5	**Beacon** **Transaction request** **Target wallet identifier** **Authentication credential** **Unique wallet identifier** **Wallet source** **Mitigation component**	This Cluster is about a form of wallet backup or wallet management use case. The terms also show the possibility of efficiently connecting digital wallets. Additionally, the terms also indicate a form of private-permissioned blockchain.
6	**Hyper blockchain ledger** **Peer system** **Data repository** **Conventional blockchain ledger** **Connected device** **Master encryption key**	These terms speak to the basic components of a blockchain. The Hyperledger is an open source collaborative global blockchain platform. The term master encryption key infers confidentiality, meaning this Cluster indicates information security for blockchain technology.

Table 2 - Cluster Interpretations

4.3. Cross-case Analysis

To collect data for each case, one-to-one interviews were conducted. Consistent with Tomasin et al. (2013) methodology, a recording device and a transcription application (Otter.ai) were used. The transcribed data was compared to the audio record to ensure its accuracy; any discrepancies were resolved. Then, the transcribed interviews were analyzed to determine the strategic motivations behind each organization's patenting behaviour. The textual data from each interview was read multiple times to identify which of Somaya's (2012) patent strategy categories accurately reflect each case. As each case was read, key arguments reflecting the organizations strategic motivations were noted and added to the margins of the interview transcription. Two different researchers performed the above analysis independently and both found very similar results. This provides reproducibility reliability as described by Krippendorff (2004). Interviewee names and their respective organizations have been kept anonymous to preserve confidentiality, as some view this topic as highly sensitive. Yin (2017) described a compromise when anonymity must be maintained for case studies. Rather than presenting a series of case studies analyzing individual organizations, a cross-case analysis was performed. This allows for a synthesis of cases and comparisons across cases Yin (2017).

4.3.1. Defensive Strategy

The empirical study has revealed that several organizations are patenting blockchain technology in a defensive manner. According to Somaya (2012) a defensive strategy is when patents are filed to avoid a competitive disadvantage and defend against the patents of others. In short, an organization employing a defensive patenting strategy wants to maintain their freedom to operate (Somaya, 2012). For example, one blockchain patent expert (Case 3) from the financial industry mentioned:

> "the financial institutions are filing a little more deliberately because what they're doing is they're looking at what are the vulnerable technologies or vulnerable businesses that blockchain could disrupt and they are filing head of that, right just as a purely defensive manner, just to make sure that they can still maintain some position within the space"

The use of a defensive strategy was further evidenced by a patent expert, highly experienced with blockchain patents (Case 5). When asked why organizations are filing blockchain technology patents, their response was:

> "So, there are some companies, especially big financial institutions that I am sure have gotten into the space because they are worried that their competition is building a patent war chest and they don't want to be left holding the bag"

In other words, some organizations are patenting blockchain technology in fear of being out patented by competitors and excluded from the space. Overall, 40% of the cases mentioned a form of defensive strategy (see Table 3).

4.3.2. Proprietary Strategy

Based on the empirical results, the proprietary strategy was the most widely used among our sample. The proprietary strategy is used as an isolation mechanism to shield an organization's competitive advantage from imitation and obtain an exclusive position in the industry (Somaya, 2012). It is the strategy most aligned with the traditional reasoning for organizational patenting. This strategy is clearly articulated by several cases. For example, Case 8 stated:

"We're looking to file patents to be able to protect our market… Our strategy is offensive and competitive, where we're looking to block out competition, and to use the patent"

A second example comes from Case 4:

"We filed the patent because this is our core IP. This is the value that we can provide to the wider economy and we'd like to be able to capture that value… What we do want to control is the ability of other players to fork our technology or to set up competing networks, which do not enable us to actually capture value"

Organizations interviewed clearly believe the space is highly competitive and in response, want to protect their innovations from competitors. In total, 80% of the cases claimed they were patenting blockchain technology using a form of the proprietary strategy.

4.3.3. Leveraging Strategy

Several organizations are employing a leveraging strategy. With the leveraging strategy, organizations are looking to pursue direct or indirect profit opportunities (Somaya, 2012). Direct profit opportunities could be in the form of licensing revenue or infringement lawsuits while indirect profit opportunities could be greater power when bargaining or gaining capital through investments (Somaya, 2012; Veer and Jell 2012). Case 6 declared they were filing their blockchain patent, in part, to capture the attention of investors:

"The reason, we would pursue either course is one it gives us competitive advantage, two it facilitates fundraising from investors and three it gives us competitive advantage… as part of the investor conversations, very quickly it will come up, what IP [intellectual property] do you have and how do you protect that IP. Personally, my preferred answer is being first to market and growing the market quickly. I value that more than patents, however many investors will place a priority on IP and IP protection within the company that they invest in"

This shows that Case 6 is aware investors are looking for an organization's IP and they plan to leverage their IP to capture their interest. Case 10 was also motivated to leverage their patents; however, they were not definitive regarding the precise nature of their leveraging.

"The whole intent with filing a patent is to capture and crystallize our innovation insight, so that we create a patent currency, how we choose to use that patent currency in the future, patents last 20 years, I don't

know right now, there's no intent of that. But 10 years from now, there might be”

Indeed, the empirical study showed that leveraging patents is a popular strategy among North American organizations. Altogether, 60% of the cases cited a form of leveraging strategy. Table 3 summarizes the cases.

Case	Patent Registered	Position of the Organization in Blockchain Technology	Time to Patent (Years)	Time to Patent	Recruiting Inventors	External collaboration	External /Competitive Pressure	Patent Strategy	Organization s Patent Barriers or Concerns
1	Yes	Strong	3	3 Years	No	Yes	Yes	Proprietary	Patent Search. Patent Infringement. Existing Patents. Licensing Rights.
2	Yes	Strong	2	2 Years	Yes	Yes	Yes	Defensive and Proprietary	Industry's Patent Trolls.
3	Yes	Strong	2.5	2.5 Years	N/a	No	Yes	Leveraging and Defensive	Market Immaturity. Existing Patents. Licensing Rights.
4	Yes	Moderate	N/a	N/a	Yes	Yes	Yes	Proprietary and Leveraging	Filing Costs.
5	No	Moderate	N/a	N/a	N/a	No	Yes	Proprietary, Leveraging and Defensive	Existing Patents. Licensing Rights. Rigorous Examination Process.
6	Yes	Moderate	N/a	N/a	Yes	Yes	Yes	Proprietary and Leveraging	Patent Search Availability. Existing Patents. Licensing Rights.
7	Yes	Strong	2	2 Years	Yes	No	Yes	Proprietary	Public Disclosure.
8	Yes	Moderate	1.5	1.5 Years	Yes	No	Yes	Proprietary	Existing Patents. Licensing Rights. Public Disclosure.
9	No	Moderate	2	2 Years	N/a	Yes	Yes	Proprietary and Leveraging	Drafting of Blockchain Patents.
10	Yes	Strong	3	3 Years	No	Yes	Yes	Leveraging and Defensive	Patenting Software.

Table 3 - Patent Strategy Summary

5. Discussion

This research has revealed two main points of discussion. The first revolves around the results of the cluster analysis and the second is regarding the empirical study.

5.1.Cluster Discussion

The six clusters show that blockchain patenting is occurring on three main verticals; the core components of a blockchain, blockchain technology use cases (voting and/or transaction system), and blockchain technology improvements (wallet management and confidentiality). Patenting on the core components of a blockchain is indicated by Cluster 6. This cluster shows

some entities (individuals or organizations) are patenting their novel orchestrations of a blockchain solution. This could present a challenge for blockchain technology, as future innovations may be stifled by these patents. Individuals or organizations holding these patents could attempt to prevent others from using the needed orchestrations, use cases, or components and control the development of the technology. However, blockchain technology is still immature and likely to change, making these patents less powerful than the holding organizations believe them to be.

The other two verticals, patents on use cases and improvements, show that innovation is taking place that can push the development of blockchain technology forwards. Clusters 2 - 4 show that innovators are working toward a blockchain based voting system or a simplified method of conducting blockchain based transactions. Either of these use cases, if implemented properly, should provide enhanced validity for blockchain technology and push both its development and adoption. Having a successful use case sets a positive example for consumers and has the potential to increase interest. The transparent and immutable nature of blockchain technology can have positive implications on consumer confidence/trust in the voting process. In addition, simplifying a blockchain based transaction system can make the technology available to a wider audience. Clusters 1 and 5 signify that patenting activity is also taking place on specific blockchain improvements. For example, Cluster 5 speaks to a wallet management or wallet back up use case. Innovation in this area makes blockchain technology more secure and user-friendly, facilitating increased trust and allowing the technology to be used by a wider network of people. In addition, the more secure and trustworthy blockchain technology is perceived, the more likely to be used by organizations to strengthen their B2B networks.

One note is that whether these verticals are a challenge or benefit to blockchain technology depends on how specific the patents were written and the strategic orientation of the organization. Broad patents would make it difficult for future entities to innovate and potentially force these entities into licensing agreements. Narrow patents should prove to be less of a challenge, as blockchain technology is immature, and innovation can occur around them. In either case, an organization may choose to allow others to use the patent, facilitating an open source environment, or they may lock it down for themselves.

In sum, the results of our cluster analysis show that positive innovation is taking place for blockchain technology, however this depends on the specifics of the patent and how it is

used.

5.2. Empirical Discussion

The empirical study has revealed several novel insights about the strategic motivations of North American organizations patenting blockchain technology. The results show organizations are using all three-core patent strategies. This demonstrates no single strategy is dominating blockchain patenting. The proprietary strategy was the most predominant; being mentioned in 80% of the cases. Organizations perceive the blockchain technology space to be highly competitive, as all 10 cases indicated they feel time pressure to be the first to obtain the patent due to external pressure (Table 3, Column 7). As a reaction, these organizations are making use of the proprietary strategy to defend their competitive advantage and keep competitors at bay. It appears as if the proprietary strategy is a base strategy to which others can be added. The leveraging strategy is the second most common with 60% of the cases using it and is followed closely by the defensive strategy used in 40% of the cases.

When it comes to strategy selection, most organizations were using more than one patenting strategy, implying that when patenting blockchain technology the strategies are not mutually exclusive. However, further analysis shows that these organizations have a dominating strategy and secondary strategy. For example, Case 4 was patenting primarily to shield their competitive advantage (proprietary strategy), but had a secondary motivation to capture the attention of investors (leveraging).

Organizations' strategy selection also differed based on their size/level of development. Large financial institutions are using all three types of strategies, but were primarily using the defensive or leveraging strategy. Perhaps they perceived blockchain technology to be too immature for use in production but instead of standing idle, they have decided to patent defensively to ensure they cannot be kept out of the market. Alternatively, these large financial organizations appear to be patenting the technology for future leverage in negotiations or licensing agreements. On the other hand, small start-up organizations are primarily using the proprietary or leveraging strategies. This suggests they are motivated to grow their organizations by keeping competitors from imitating their blockchain solutions and if possible, leveraging their patents to attract the interest of investors. Small-to-medium organizations used a variety of strategies, but primarily employed the proprietary strategy. They are motivated to defend their competitive advantage and prevent imitation.

5.3. Open Source Patenting

One particularly intriguing insight gleamed from the empirical study was the presence of anti-patent sentiment. Several start-up organizations we interviewed explained that innovation for blockchain technology should be conducted in an open source network and in a collaborative manner. These organizations feel that patenting, in the traditional sense of keeping the patented technology exclusive, is a hindrance on blockchain's development. As a result, some have decided not to patent[2]. However, the results of our empirical study show that experts in the field highly recommended these organizations patent their novel blockchain solutions. If they want to keep the open source network alive, they should patent their solutions and allow others to use them freely. Without filing the patent in an open source network, a competitor can start filing ahead within the technology stack and stop the open innovation. Filing the patent and making it open source can ensure the technology grows. It also thwarts a separate entity from entering the space, patenting the technology, and preventing others from using it. In a sense, our results indicate a sub-patent strategy within the proprietary strategy; patent the technology but make it open for other actors within an open innovation network can use it. This way competitive organizations cannot start their own version of the innovation or patenting it themselves. Figure 5 shows where different sized organizations fall in terms of their patent strategy.

[2] These were the cases removed from the final sample. They do not appear in Table 1 or 3.

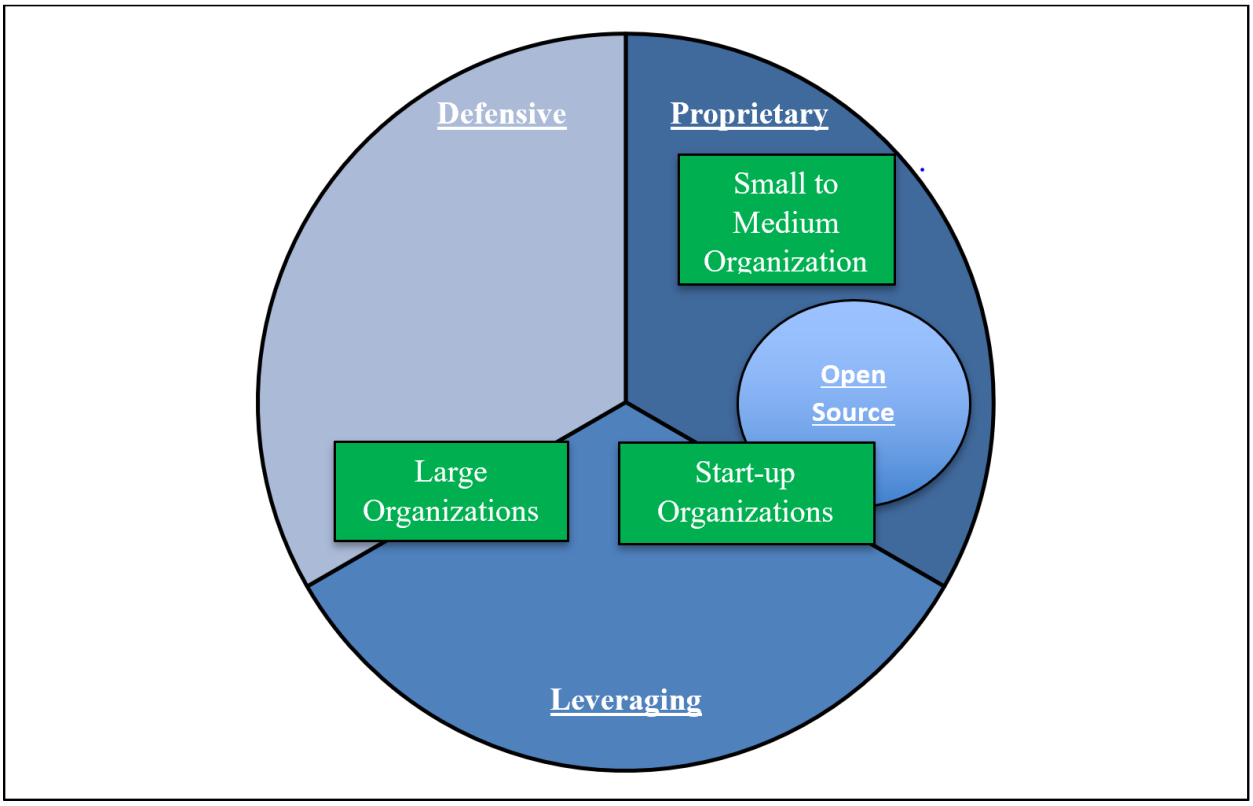

Figure 5 - Patent Strategies by Organizational Size

5.4.Theoretical Implications

Three theoretical contributions are made by this research. Most of the existing research about blockchain technology has focused on possible use cases, potential market disruption, technological limitations, and improvements to the technology (Hughes, 2019; Yli-Huumo at al., 2016). Analysis of innovation within the blockchain space, as indicated by patenting, has been severely neglected. To the best of our knowledge, this research represents the first patent analysis for blockchain technology aimed at understanding its innovation trends. In addition, this research is the first to conduct an empirical study in the form of multiple case studies, with organizations currently using blockchain technology, to identify, analyze, and understand the patenting strategies used in the blockchain space. Several novel insights regarding the strategies used for blockchain technology patenting have been discovered and discussed. Finally, the empirical analysis has revealed that within the blockchain space, there exists strong anti-patent sentiment which results in the lack of patenting by start-up organizations. However, this anti-patent sentiment has led to, in some cases, a form of open source patenting, whereby an organization patents the technology, but makes it available for other innovators to use. This has the potential

to extend Somaya's (2012) framework to include a sub-strategy within the proprietary category, showing new patenting motivations.

5.5. Managerial Implications

This research has several implications for managers operating within the blockchain technology space. A comprehensive picture of the blockchain patenting landscape has been presented. With an understanding of the current landscape, managers can strategically position their organization, regarding their blockchain patenting, within the space. Organizations of all types should realize that blockchain patenting has largely just begun, but is rapidly accelerating. As a result, managers of organizations currently operating within the blockchain space or organizations hoping to enter the space need to determine their strategic position now.

Organizations can also understand the geographical distribution of blockchain patenting and determine where gaps exist to enter the market. When it comes to patenting strategies, organizations should employ multiple strategies to fully reap the benefits of their patents, as the strategies are not mutually exclusive. Large financial organizations should realize that although their competitors may not be using blockchain technology currently, they may be building a large defensive blockchain patent portfolio. In response, these organizations need to start innovating within the blockchain space if they want to be able to use the technology in the future. These large organizations should also realize that blockchain technology does not have to be fully mature for them to begin innovating. A patent portfolio can be leveraged for several strategic reasons such as for better negotiations or to avoid costly patent infringement lawsuits (Somaya, 2012). Start-up organizations harbouring anti-patent sentiment and refusing to patent, should consider the open source patenting strategy to ensure that collaborative and open source innovation network survives. They should also consider collaborative patenting by forming strategic alliances with other actors within the network to cut the costs of filing. As blockchain technology is a significant enabler of B2B networks, organizations can patent in a collaborative manner when establishing shared solutions. Overall, knowing the current state of blockchain patenting has positive implications for managers to maneuver their current and future blockchain endeavors.

5.6. Limitations and Future Research

The main limitation of this research is surrounding the empirical study's sample. Although the number of cases is relatively low, considering the immaturity of blockchain

technology, the sensitive nature of patenting, and the time frame of the study, this sample is all that could be obtained. The sample is also limited to North American organizations which is considered one of the lead innovators for blockchain technology (See Figure 2). Future research should attempt to analyze blockchain patenting with a larger sample size representing organizations from a more diverse set of countries.

Another avenue for future research could be to analyze how the patenting landscape changes over time. Being that blockchain patenting has only recently become aggressive, the patent landscape is likely to change over the next few years. It would be interesting to conduct a longitudinal study, analyzing the development of the blockchain landscape over time.

The main goal of the empirical study in this paper was to identify which patent strategies were used. Future research should conduct an in-depth analysis of the factors contributing to the selection of an organization's patent strategy. This study discovered a difference based on organizational size and development level, however other factors may be involved. One final opportunity for future research could be to empirically validate our observation of a potentially new open source patenting strategy with a large sample of organizations.

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