Dissecting trust and relationships within the industrial hemp sector in the digital era

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Abstract

Traceability is becoming increasingly vital in agri-business. Timely delivery of accurate information about the process and the product will help meet both regulatory requirements and consumer demand and potentially cultivate trust between businesses. New traceability technologies such as blockchain further claim that businesses could operate in a "trust-less" system in which decentralized consensus and code would replace centralized authority and intermediaries. 2018 marked the year of legalization of recreational marijuana in Canada. While it created substantial economic opportunities for Canada, it also created considerable confusion as the market boundary between industrial hemp and marijuana becomes blurred. This research aims to assess the perception and attitude of the Canadian hemp industry stakeholders towards a comprehensive, industry-wide traceability system, and explores the potential impact of introducing such a traceability system on trust and relationship dynamics within the industry.

Twenty-two industry stakeholders were interviewed between February and July 2020. This group of industry stakeholders use the word "trust" and "good relationship" interchangeably. Both take time to develop. There is a significant divergence of opinions when it comes to the interpretation of a "industry-wide traceability" program and very few research participants understand what the blockchain technology entails. The traceability program is deemed to enhance competency trust and to monitor output. While industry stakeholders think that could be critical in supporting the growth of the hemp industry, it will not replace existing human relationships.

The success of any system-wide change depends on endorsement from all stakeholders; digital technologies are no exception. However, conventional analysis often focuses on the system itself and overlooks the individual constituents. Technology developers concentrate on the technical characteristics but pay little attention to any interrelationship with interorganizational governance. While this study sketched the complexity of a rapidly evolving hemp industry network, it was able to uncover some of the nuances and potential challenges that will be faced by individual actors in the broader sector as it goes through a series of transformations. It is my hope that my research findings will help support stakeholders in change management and reduce coordination failure during the technology development and implementation stages.

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CBD: Cannabidiol

CDSA: Controlled Drugs and Substances Act:

CFIA: Canadian Food Inspection Agency

CHTA: Canadian Hemp Trade Alliance

CSGA: Canadian Seed Growers Association

CTLS: Cannabis Tracking and Licensing System

IHR: Industrial Hemp Regulations

Interorganizational information systems: IOIS

IT: information technology

LP: Licensed Processors

NT: Network theory

PAT: Principal-agent theory

TCT: Transaction cost theory

RBV: Resource-based view

THC: tetrahydrocannabinol

1. Introduction

The agriculture and agri-food industry has experienced considerable changes in recent decades. Consumers have become increasingly concerned about the health, safety, ethical, and environmental aspects of their food. Many people now not only demand high quality food, but also want to be assured that the food they consume aligns with their lifestyle and ethical attributes. In response, more agri-food businesses are seeking ways to provide information associated with their products that will satisfy the consumers' desire to know where their food comes from.

Industrial hemp (or 'hemp') has been a niche crop in Canada since the government allowed for hemp cultivation in 1998. Canadian hemp product export peaked at $147 million in 2016 but dropped to $87.5 million by 2018 due to international competition (Expansion Strategic Inc. 2019). Hemp seeds are the main components and represent 2/3 of total exports. Other products include hemp cake, oil, and fibre. The year 2018 marked the year of legalization of recreational marijuana in Canada. While it created substantial economic opportunities for Canada as the global cannabis industry is projected to be worth up to $130 billion USD by 2029 (George-Cosh 2019), it also created considerable confusion as the market for hemp now overlaps with marijuana. In Canada, hemp production is tightly regulated, and all growers are required to use certified seeds from a list of approved cultivars. On the other hand, a seed system for commercial marijuana production is non-existent. Liberalization of the cannabis space in Canada has allowed the hemp industry to step into the health and wellness market with cannabinoid fractions, but quality assurance protocols for these products are inconsistent and vague. Ineffective product differentiation mechanisms to distinguish hemp and marijuana products could pose a threat to the Canadian hemp industry. Health Canada, the federal regulatory body

for cannabis in Canada, is responsible for tracking the flow of cannabis throughout the regulated commercial system. Health Canada launched the Cannabis Tracking and Licensing System (CTLS) in 2018 to both manage the licensing process and collect inventory information from license holders. CTLS could function well as a tool for intermittent inventory monitoring but does little to help distinguish between hemp and marijuana products and tackle supply chain issues. Tracing responsibility still primarily rests on the cooperation amongst industry stakeholders which could be a time- and resource-intensive process. The competitiveness of the Canadian cannabis sector could suffer because of its inability to respond to market changes and supply chain issues promptly.

In theory, agri-food businesses could address both regulatory requirements and consumers' demand by implementing a robust traceability system – the ability to follow the movement of food products and its ingredients throughout the supply chain, both backward and forward. Timely delivery of accurate information about the food product and associated activities could serve as part of the company's product differentiation strategy. The traceability system could also seamlessly feed the information into the regulatory system. In addition, it could help businesses to improve efficiency, better manage their supply chain and relationships, and reduce overall cost of business operation. But how can robust traceability be achieved? Recent advances in digital technology such as blockchain can enable the creation of a comprehensive information system where businesses can rapidly disseminate and share information. It is now technically feasible to expand the scope of traceability from providing quality assurance to demonstrating the integrity of the entire supply chain. In Canada, two blockchain-based traceability programs were launched within the past 24 months to track certified seeds from farm to table. A similar seed-to-retail traceability program could be of benefit to the Canadian hemp industry in terms of

provenance and quality assurance, regulatory compliance, operational efficiency, intellectual property protection, and gaining confidence from buyers and consumers. However, the creation of a full backward and forward traceability will first require a willingness from all participants in the chain to commit to providing timely, accurate, and standardized data to the system. The system also entails greater interdependency and coordination across multiple players from different segments and a new form of organizational governance will likely emerge. The creation of an industry-wide digital value chain incurs significant risks, including coordination failures or opportunism by player(s) within the chain.

Researchers have been studying interorganizational governance under information technology-enabled information systems since the 1980s. Four theories have been widely used – principal-agent theory, transaction cost theory, resource-based view, and network theory – to explain these governance initiatives. The first two theories view governance mechanisms as a way to minimize cost and improve efficiency, while the latter two seek to understand the effectiveness of these inter-organizational systems. Regardless of the approach, most researchers agree that information technology creates a new governance construct that is maintained by a combination of trust and control.

The concept of trust has been studied in many disciplines and carries numerous meanings. Trust can also be understood by labeling the trusting object - individual trust (singular relationship) or system trust (a network of relationships, which could become an entity on its own). Trust and/or control are used to facilitate collaboration and secure performance in a business environment, but how these two mechanisms inter-relate is not well defined. The role of technology within a trust conceptual framework and the relationship between people and

technology under the trust-control nexus are even more contentious. Some researchers simply reject the validity of the 'technology trust' idea.

Conventional evaluation of a policy intervention often focuses on the cost and benefits of the intervention on the system itself and overlooks the individual constituents. Most research on traceability stresses on the technical details with little regard for its interrelationship with interorganizational governance. These analyses tend to overlook two critical components – members' attitudes towards the new technology and how the new information system would affect existing relationship dynamics. In the case of traceability, its intended benefits will only be fully realized if everyone decides to adopt. The likelihood of a successful adoption will depend on how well the technology aligns with both the individual's preference and the collective's intention to organize.

This thesis research aims to identify the potential opportunities and obstacles that a comprehensive, industry-wide traceability system could bring to the Canadian hemp industry using the trust lens. First, an industry synopsis for the Canadian hemp industry was developed to better understand the current business environment, trends, threats, and opportunities. The thesis also reviewed the concepts of traceability in the agri-food sector, interorganizational governance, trust, and control. Based on literature review and early feedback from industry informants, a questionnaire was developed to answer the following research questions:

1) What does trust mean and what is its role in a business relationship for the Canadian hemp industry?

2) What are the hemp industry stakeholders' perception towards a comprehensive, industry-wide traceability system?

3) What are the potential impacts of introducing such a traceability system on trust level and relationship quality?

Research data was analyzed using both quantitative and qualitative methods and compared with other studies on blockchain traceability. The survey offers information on how a comprehensive, industry-wide traceability program would affect existing relationships within the industry network and recommendations on how the hemp industry could move forward, should the industry decide to embark on such an endeavor. Specifically, this study highlights the need to raise awareness of the technology either before or as an integral part of the technology implementation. A sound governance framework is also critical in reducing coordination failure during the technology development and implementation stages.

2. Background

The mention of the word ‘cannabis’ would often raise an eyebrow in a room because people generally associate cannabis with its psychoactive properties. In plant taxonomy, *Cannabis sativa* is a catch-all species, representing one of the oldest crops in the world cultivated for food, fibre, and medicinal purposes. Within the *C. sativa* genus, plants are further divided as the *indica* and *sativa* subspecies (McPartland 2018). People generally refer to ‘industrial hemp’ (or just ‘hemp’) when it is grown for food and industrial applications and only apply the *indica* vs *sativa* distinction when ‘marijuana’ is concerned, even though all fall under the *C. sativa* genus. The primary psychoactive compound of a cannabis plant is tetrahydrocannabinol (THC). The level of THC in the plant has been used by policymakers and regulators worldwide to distinguish between hemp and marijuana. However, recent studies suggested that there are over 100 different cannabinoids that could play a role in modulating the psychoactive effects of the plant (Atakan 2012). While marijuana and hemp are significantly differentiated at the genome-wide level, interbreeding and hybridization between *indica* and *sativa* has rendered their distinction almost meaningless (Sawler et al. 2015). In other words, the current hemp-marijuana distinction is primarily driven by custom. There is currently no evidence-based differentiation mechanism.

For this thesis, hemp refers to a cannabis class that is grown for food, nutrition, and industrial uses and contains low level of THC (<1%). Marijuana refers to a cannabis class that is grown for its psychoactive components. The term ‘cannabis’ is used to describe both hemp and marijuana.

2.1 Overview of Canadian hemp industry

Cannabis has been banned internationally under the United Nation's Single Convention on Narcotic Drugs for decades. In Canada, cannabis is a controlled substance under the Cannabis Act, and prior to 2018 the Controlled Drugs and Substances Act (CDSA) . Possession, trafficking, import, export, and production of cannabis regardless of the THC content are prohibited unless authorized according to regulations or exemption. Recognizing the crop's potential in diversifying the Canadian agricultural economy, the Canadian government began to amend the laws to allow the growing of hemp by the mid-1990s. The Industrial Hemp Regulations (IHR) were created under the CDSA in 1998 to allow for the production, processing, and sale of industrial hemp for commercial purposes. The use of marijuana for medical purposes was first legalized in 2001 with the implementation of The Marihuana Medical Access Regulations. The regulations have gone through several changes over the years. The Access to Cannabis for Medical Purposes Regulations, implemented in 2016, set out a legal framework to provide reasonable access to individuals who require cannabis for medical purposes (Health Canada 2016).

Fiber has been the most ancient and well-known use for industrial hemp. It was the primary driver for the creation of a hemp industry in Canada (Canadian Hemp Trade Alliance 2020). Such pledged market opportunities for hemp fibre, however, did not come to fruition and the industry suffered from a rocky start (Canadian Hemp Trade Alliance 2020). The industry's emphasis has since been redirected to food use. Hemp seeds contain high levels of omega-3 and omega-6 and are processed into oil, protein powder and hulled or shelled seeds for the health and nutrition market with limited claims on beneficial health properties. Hemp oil can be further processed into food products such as salad dressing or body care products such as lip balm and

massage oil. Canada hemp exports in 2016 surpassed $145 million (Expansion Strategies Inc. 2019). Most hemp acres are concentrated in the Prairie provinces. Growers initially imported varieties from European countries, but they now have access to locally adapted varieties developed by several Canadian hemp breeding programs. Overall, the industry maintains an upward growing trend as people's demand for plant-based and environmentally friendly products increases.

Changes in cannabis legislation have created a new market opportunity for hemp-derived cannabidiol (CBD) products. It has also triggered major consolidation activities within the industry. In 2019 Aurora Cannabis, a new market entrant organized to exploit opportunities from legalization of marijuana, acquired Hempco Food and Fibre and as part of the Aurora hemp expansion. Similarly, Tilray, initially a medicinal marijuana company, bought Manitoba Harvest, the world's largest hemp foods manufacturer. Legalizations of cannabis in some of the US' states provided further appeal for companies to venture into the cannabis space, but constant revisions in laws and regulations in different jurisdictions remain one of the major challenges for the cannabis industry – marijuana and hemp alike. The regulatory framework for cannabinoid in the US has yet to be released. Given that the rules for the two markets are not fully synchronized, commingling creates problems for both market segments.

2.2 Cannabis regulations and supply chains

Currently, the Cannabis Act (2018) and its regulations provides the legal framework for activities involving cannabis in Canada. Under the Cannabis Act, the IHR sets out the regulations for hemp, which is defined as a cannabis plant or any part of the plant in which the THC concentration is 0.3% (weight by weight) or less in the flowering heads or leaves (Health Canada

2006). Health Canada controls various activities with hemp through a mandatory licensing system. Beside securing appropriate license(s) from Health Canada, license holders are also responsible for compliance with other applicable legislations and by-laws.

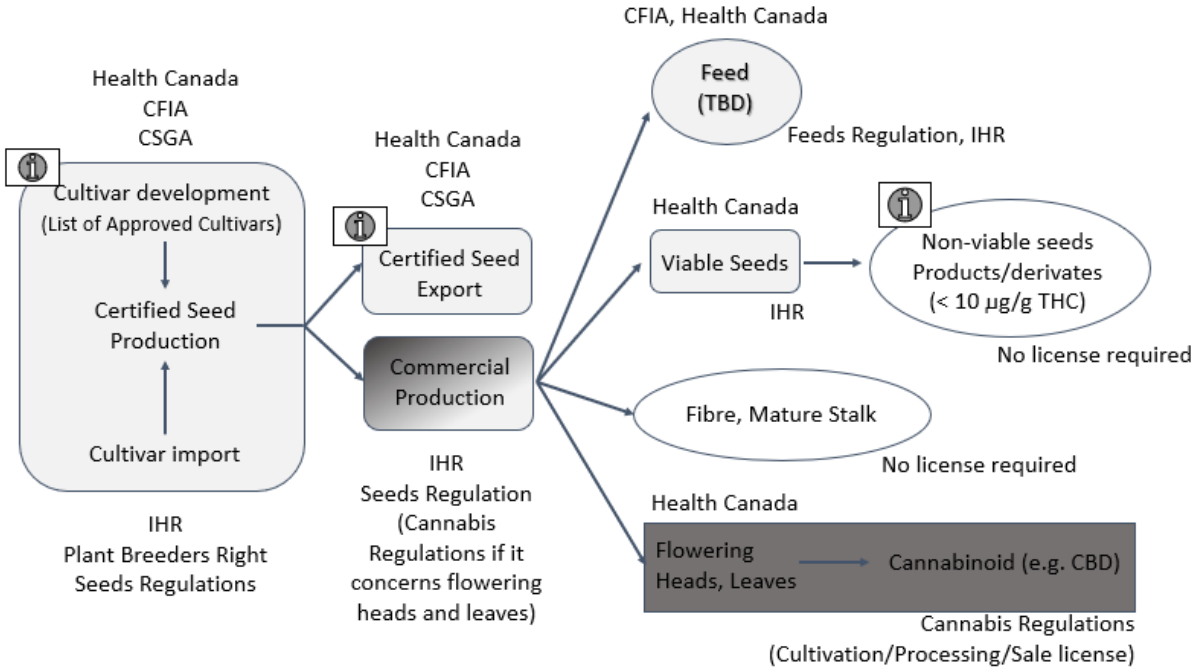

Figure 1.1. Simplified Hemp Supply Chain in Canada.

Activities that are governed by the Industrial Hemp Regulations (IHR) are shaded in light grey. All activities relating to the flowering heads and leaves require appropriate licenses under the Cannabis Regulations and shaded in dark grey. Commercial production could involve both regulations depending on the nature of production and hence are colored in shaded grey. The information symbol means the activity will require field sampling and testing of THC content. (Source: author)

Before 2018, the primary focus for the Canadian hemp industry was on food ingredients. The process of legalizing recreational cannabis in Canada has benefited the industry in two ways: it has reduced the regulatory burden on industry stakeholders and, more importantly, opened cannabinoids as a new opportunity for the industry. There are currently three approved market channels: food, fibre, and fractions (extracts, concentrates, and isolates that contain cannabinoids

that are low in THC). The industry has also begun working with the Canadian Food Inspection Agency (CFIA) to gain approval to access the livestock feed market. After reviewing information available on CHTA and Government of Canada websites, a simplified version of the hemp supply chain, along with its regulatory requirements and institutions involved in implementing those requirements, are summarized and presented Figure 1.

According to the IHR, only pedigreed status seeds of varieties listed in the Health Canada List of Approved Cultivars can be used for commercial hemp production. The Canadian Food Inspection Agency (CFIA) regulates the import, export, certification, and grading of hemp seeds under the Seeds Act and the Plant Protection Act. The agency also works closely with the Canadian Seed Growers Association (CSGA) in managing the production of pedigreed status seeds (or 'certified seeds'). Commercial hemp growers must plant with certified seeds and on-farm seed saving for future cultivation is not allowed. Suppliers of certified seeds must provide valid certified seed tags to growers; and growers and processors must be able to provide the same to the inspectors upon request. In contrast, strain identification and seed certification systems are not available for marijuana.

Since 2018, Health Canada has reduced and simplified the licensing and regulatory requirements placed on hemp-related activities. Mature stalks that are stripped of their leaves, flowers, seeds and branches, and fibre derived from mature stalks, are out of the scope of both IHR and Cannabis Act. Activities with hemp fibre, once removed from the field, do not require a license. Activities with processed, non-viable hemp seeds also do not require a license. A person may now import, export, sell, possess, transport, send and deliver derivatives of hemp seeds, viable grain or non-viable cannabis seeds, or products made from such derivatives, without the need for license or authorization under the IHR. On the other hand, hemp seeds capable of

germination can only be sold to licensed hemp buyers. The flowering parts or the leaves are not considered as hemp and most activities with whole hemp plants, including sprouts, leaves, flowers, or bracts, remain controlled under the Cannabis Act as they contain cannabinoids which are listed in the Prescription Drugs List (Health Canada 2006). Hemp chaff (flowers, leaves, and branches) can only be sold to licensed processors (LPs), who can then extract and sell hemp-derived cannabinoid products within Canada's regulated cannabis market (Health Canada 2020).

All cannabinoids derived from a cannabis plant, including THC and CBD, have been added to the Prescription Drug List. Current regulations do not distinguish between CBD derived from hemp and CBD derived from other cannabis plants and do not pose a limit to the CBD content in hemp plants. However, hemp producers may not extract the CBD themselves unless they have an appropriate license in place or work with an LP (Health Canada 2020). Health Canada's move to put CBD in the Prescription Drug List was deemed unfavorable by the hemp industry as it limited options for marketing. In summer 2019 the Canadian Hemp Trade Alliance (CHTA) and the Canadian Health Food Association released a White Paper urging Health Canada to relax the regulations and permit including certain-level of hemp-derived CBD to natural health products and supplemented food (Canadian Health Food Association 2019). In September 2020, several national hemp associations, including CHTA, released a joint position paper calling for the clarification and a transparent debate on the international law and regulations related to hemp (National Hemp Association 2020). The paper came ahead of a United Nations Commission on Narcotic Drugs (CND) vote in December 2020 that removed cannabis from Schedule IV of the 1961 Single Convention on Narcotic Drugs — where it was listed for 59 years alongside other deadly, addictive opioid to which the strictest control

measures apply. While this does not fully legalize cannabis, it opens up research on the health effects of CBD.

Requirements	Hemp	Cannabis(Marijuana and hemp for the cannabinoid market)
Use of certified seeds	Yes	No
Import/export permit	Yes	Yes
Cultivar identification and standard	Yes	Only need to meet weed seed and other crop seed standards
Reporting frequency	Annually	Monthly
Cultivation location	Yes	Yes
Inventory	Production level, sale volume, quantity of products retained	Inventory level (both packaged and unpackaged products), sale volume and destination, quantity of products retained/lost/destroyed
Reporting category	Seed, grain, fiber, flowering heads, leaves, and branches	Seeds, plants (vegetative vs flowering), cannabis (fresh vs dried), purchased hemp, pure intermediate, edibles (solids vs non-solids), extracts (inhaled vs ingested vs others), tropical, and others
THC testing	In some occasions	Yes
Personnel identification	Yes	Yes
Personnel security clearance	No	Yes
Information on physical security	No	Yes

Table 1.1. An abstracted list of reporting requirements for hemp and cannabis license holders in Canada.

Specific requirements vary for cannabis license holders depending on the type of license received. Details can be found in Health Canada's Cannabis Licensing Application Guide. (Source: author)

Along with the legislations and regulations, Health Canada also launched a national cannabis tracking system – the Cannabis Tracking and Licensing System (CTLS) – to monitor high-level movements of cannabis and help prevent supply chain diversion and/or inversion. The system serves as a centralized web-portal both for the purposes of license application and of submission of tracking reports. Regardless of the crop in question, all license applications must be submitted to the CTLS. There is one license for hemp, but there are 3 major license classes for cannabis - cultivation, processing, and sale. License holders must submit activity reports to Health Canada using the same platform. Reporting requirements vary depending on the license type (see Table 1 for an abstracted list of reporting requirements for hemp and cannabis license holders). Advancing planning is crucial for hemp producers who wish to sell flowering heads, leaves, and branches in the cannabis market. While the CBD market forecast appears promising, the risk is also much higher as the plants must be harvested green to collect chaff suitable for extraction.

2.3 The Canadian hemp industry – a SWOT analysis

A SWOT matrix table briefly illustrates the industry's current status (Table 2). On one hand, modernization of cannabis regulations in Canada opened new market channels and made it possible for the Canadian hemp industry to finally utilize all parts of the crop. On the other hand, it led to the creation of big cannabis corporations like Aurora and Tilray which now operate business in both hemp and marijuana sectors. For decades, the hemp industry operated under a tightly regulated environment and successfully branded its products as "a healthy food, not a drug". Cannabis modernization legalizes recreational marijuana but does not reduce the

suspicion around its use, making some industry actors feel that the stigma will negatively affect hemp sale.

A key problem is that some feel that they are now operating in a low-trust environment as many CBD contracts have fallen through either because of buyers not honoring payment or because of sellers' misrepresentation. For the hemp industry, new opportunities come with a significant upfront cost to maintain its "not a drug" claim in their existing markets. Conversely, modernization simply lowers the barrier to entry to new markets for the marijuana industry. Many hemp industry stakeholders feel that they are in a competitive disadvantage in the CBD market due to existing regulations. They see hemp as a commodity crop for grain and fiber and feel that Health Canada is the not the right regulatory body for the crop. Health Canada's recent move to put CBD in the Prescription Drug List only deepens their discontent.

Strengths:	**Weaknesses:**
Products appeal to health and environment-conscious consumers	Onerous regulatory system creating a competitive disadvantage
Experience and reputation in hemp production & marketing	Lack of resources – small acres and no check-off system in place
Industry proponents' dedication and enthusiasm	Opportunistic behavior damaging to both business environment and overall industry's position[1]
Opportunities:	**Threats:**
Increasing demand for healthy and environmentally friendly products	Stigma surrounding marijuana harming hemp's reputation
Fast growing cannabinoid market, especially CBD	Tough competition in the cannabinoid market

Table 1.2. SWOT analysis of the Canadian hemp industry

[1] Personal communication with industry informants, November 2019.

2.4 Traceability in the agriculture and agri-food sector

Given the complex and ever-changing regulatory environment, supply chain traceability is a fact of life for the Canadian cannabis sector. According to the International Organization for Standard (ISO) 22000:2018, traceability is defined as "the ability to follow the history, application, movement, and location of an object through specified stage(s) of production, processing and distribution" (ISO 2018). When it comes to food, international traceability standards are set through the joint FAO and WHO Food Standards Program – the Codex Alimentarius Commission. The Commission has adopted a pragmatic "one up/one down" arrangement in which actors are assumed to be connected to their suppliers and to know where their product has gone. However, such an approach still leaves the supply chain vulnerable as many food products have complex supply chains and multiple diversions (Pearson et al. 2019).

Traceability is a broad concept and many interpretations exist for a food traceability system. Opara (2003) claimed the food traceability system is an information-based proactive strategy to affirm food quality and safety. It consists of six elements: 1) product traceability, 2) process traceability, 3) genetic traceability, 4) input traceability, 5) disease and pest traceability, and 6) measurement traceability. The TraceFood Framework (Storøy, Thakur, and Olsen 2013), assembled by several EU-funded projects, provide guidelines to implement food traceability system based on the following key principles: 1) unique identification of traceable units, 2) documentation of transformations, and 3) standardization of information exchange. Salampasis and colleagues (Salampasis, Tektonidis, and Kalogianni 2012) further advised the key requirements for traceability to include the ability to address both internal (inside a company) and chain (between companies) traceability, and the ability to address both backward (tracing)

and forward (tracking) traceability. The system should also be cost effective, user-friendly, and extensible to accommodate new traceability data. Food traceability information can be classified as "operational", which fulfills legal and safety requirements, or as "strategic", which is information used as part of the business' competitive strategy (Canavari et al. 2010). Drivers, obstacles, and benefits of implementing a traceability have also been extensively examined (Karlsen et al. 2013). While motivation is deemed to be a critical factor for implementing traceability programs, Karlsen and colleagues (Karlsen et al. 2013) noticed that there is a lack of theoretical framework with respect to implementation. As well, empirical documentation as to the importance of people in the process is missing.

Traceability theories and its utilities have been studied by both natural and social sciences (Karlsen et al. 2013). According to Smyth and Phillips (Smyth and Phillips 2003), traceability could be used as a product differentiation mechanism that focuses on maintaining food safety. Product differentiation could also be achieved by identity preservation which seeks to capture value, and segregation which aims to manage liability. But such distinctions are becoming less precise as digital technologies rapidly evolve. Recent innovations in product identification, geographic information tracking, and electronic data exchange systems have further enhanced the functionality of a food traceability system, inexorably enabling it to offer multiple product differentiation functions in a single package. One of the hottest technological trends in the traceability space is blockchain technology.

2.5 The Blockchain revolution

In 2008, Satoshi Nakamoto – an individual or a group of individuals – published a paper describing Bitcoin, the first of its kind peer-to-peer electronic cash system based on a distributed

ledger system known as “blockchain” (Satoshi 2008). In the paper, Nakamoto attempted to solve an decades-old question: how do two parties conduct an online transaction without knowing or trusting each other and without the need for a trusted third-party intermediary? Nakamoto’s Bitcoin solution becomes the first and most prominent use case for blockchain. In principle, blockchain is a permanent, decentralized database where information can only be added, never deleted. The database stores records in blocks, with each new block “chained” to the previous block, in linear, chronological order, using a cryptographic hash. The technology’s remarkable appeal could be attributed to its distributed consensus, immutability, and permanency. A single distributed ledger reduces transaction cost since reconciling many private ledgers for consistency is no longer required (Werbach 2017). Ledgers can only be modified and built upon by consensus of a majority (51% or above) of actors in the chain.[2] This eliminates the need for verification by a centralized figure and prevents actors from manipulating the data. Permanent record-keeping further deters fraud behavior and secures the evidence chain for rapid tracing and resolution when issues arise (Pearson et al. 2019). For these reasons, blockchain advocates believe that the technology allows an individual to engage in a transaction without trusting the integrity of the other individual, intermediaries, or authorities (Werbach 2017). Blockchain’s promise is to create a “decentralized brave new world” (Beck et al. 2017) with enhanced objectivity and trust, in which no one will be in full control, and no one can distort or lie about past and current events.

Initially developed as a virtual currency to challenge the conventional banking system, blockchain applications have since expanded substantially and beyond the financial sector. Technological giant IBM launched FoodTrust™, a blockchain-based cloud network that will

[2] Several consensus algorithms exist for the technology, but they are beyond the scope of this research.

allow food industry participants to publish and share data across the food system. Supermarket chains such as Walmart and Carrefour are adopting blockchain technology in their food traceability programs. In 2018, Louis Dreyfus Company, Shandong Bohi Industry Co. Ltd., ING, Societe Generale, and ABN Amro successfully completed the world's first agricultural commodity transaction based on a blockchain platform developed by Louis Dreyfus (Louis Dreyfus Company 2018). In the same year, BLOCKStrain Technology (now TruTrace Technologies) announced that it has developed the first integrated blockchain platform that registers and tracks intellectual property for the cannabis industry (BLOCKStrain 2018). In 2019, CSGA and Grain Discovery launched a blockchain traceability pilot project (Canadian Seed Growers' Association 2019) that allows tracking of a specific soybean variety (OAC Kent, developed at the University of Guelph) from certified seed to tofu production to market. The program's objective is to guarantee the genetic identity, purity, and food ingredients that are expected by the consumers throughout the value chain. A year later, Grain Discovery, Olds College, and Decisive Farming launched Barley Trail (Grain Discovery 2020). Barley Trail is a lager made by the Olds College Brewery. The beer's entire journey from the certified barley variety (CDC Copeland, developed at the University of Saskatchewan) to distribution is traced and recorded by a blockchain-based traceability system. Each beer contains a QR code that, when scanned, reveals the digital passport of that brew. Both traceability programs focus on preserving the identity of a special crop variety (soy and barley) throughout the supply chain, ensuring the delivery of a specific quality or trait to the end products (tofu and beer).

Identity-preserved products, backed by a robust traceability program, are believed to generate economic benefits. While technologies have blurred the boundaries between the various product differentiation tactics, one needs to be mindful that the rationale behind identity

preservation is value capture while the objective of traceability is safety assurance. To establish an "identity preservation/traceability" hybrid program – blockchain or not – all participants on the supply side will have to commit to providing timely, accurate, and standardized data to the information system. Under the rational decision-making model, business entity will assign a value to its own business data and sharing its data beyond what is required to carry out a transaction. On the demand side, the end-users and/or consumers might not wish to bear the full cost of knowing. A hybrid system will only proceed when both suppliers and consumers incentives are aligned. More importantly, the system cannot succeed unless it is able to generate and distribute sufficient benefits to all players so that no one in the chain is worse off than they would be outside the chain (Smyth and Phillips 2003).

2.6 Chained by information

Even prior to Nakomoto's Bitcoin paper, companies have already found themselves more and more interconnected with their collaborators and competitors in the digital space. As well, their success is increasingly dependent on strategic management and exploitation of information. The "information revolution" was recognized by Porter and Millar in their 1985 article entitled "How information gives you competitive advantage". The authors proclaimed that information technology (IT) has changed industry structure and the rules of competition. Not only IT affects how activities are performed within the company, it also enhances the company's ability to exploit linkages between activities both inside and outside of the company. With IT, companies can now function as networks, and coordinate their actions more closely with those of their buyers and suppliers (Porter and Miller 1985). Davenport and Cronin (Davenport and Cronin 1988) further contended that strategic information management can also help reduce

environmental uncertainty and improve market opportunity for the company. Rapid adoption of the internet has given rise to new IT-enabled organizational forms such as net-enabled organization (Straub and Watson 2001) and virtual integration (Magretta 1998) with firm boundaries becoming less distinct. These new partnerships drive the development of many interorganizational information systems (IOIS), which was first defined by Johnston and Vitale (Johnston and Vitale 1988) as an IT-enabled system that facilitates the creation, storage, transformation, and transmission of information by interconnecting two or more parties and enabling the transmission of information across organizational boundaries. In theory, a blockchain system can be described as an IOIS since it enables the formation of interorganizational networks by connecting firms throughout a business network (Seebacher and Schüritz 2019). This allows social science researchers to examine the applications, value creation, and governance of blockchain and related digital protocols using knowledge drawn from studies in the information system and organizational governance disciplines, without being too preoccupied by the miniscule designs and features of the technology (Risius and Spohrer 2017; Treiblmaier 2018). This tactic is in line with Shapiro and Varian (1998), who argued that durable economic principles can be used to understand the impacts of "information revolution" and navigate the evolving network economy.

2.7 Interorganizational governance

Four theories have been widely used to analyze interorganizational governance – principal-agent theory (PAT), transaction cost theory (TCT), resource-based view (RBV), and network theory (NT) (Halldorsson, Mikkola, and Kotzab 2015; Treiblmaier 2018). PAT describes positive agency costs as expenses by the principal to align incentives and monitor

performance (Jensen and Meckling 1976). TCT evaluates the efficiency of different organizational and governance mechanisms in terms of transaction cost, which includes costs associated with information search, decision making, and agreement negotiation, control, and adjustment (Coase 1937). RBV focuses on identifying and exploiting specific competences within the company to gain competitive advantages (Wernerfelt 1984). For inter-organizational partnerships, RBV emphasizes the value generated by firms collaborating and sharing complementary resources (Wang and Wei 2007). Finally, NT explores the dynamics of inter-organizational relations by focusing on relationships between the parties as well as mutual creation of trust through cooperative relations and exchange processes (Treiblmaier 2018). Both PAT and TCT view governance mechanisms as a means to minimize cost and improve efficiency, while RBV and NT seek to understand the effectiveness of these inter-organizational systems.

Using a combination of PAT and TCT, Mahoney (1992) proposed a framework to envisage how firms should be organized based on task programmability (whether observing inputs is a good measure for making rewards), non-separability (whether observing outputs is a good a measure for making rewards), and asset specificity (whether the asset can have use across multiple situations and/or purposes. While it concentrates on various methods of conventional vertical integration, one could also make use of Mahoney's framework to understand whether firms should cooperate beyond sporadic market transactions and short-term contracts in terms of information exchange. Today, more companies are embracing new hybrid structures that embrace partnerships and inter-organizational systems (Gallivan and Depledge 2003) as IT becomes more accessible and markets more turbulent. But researchers also warned about "recurrent transactional contracting" in which an alliance only manifests superficial qualities of a

partnership (Ring and van de Ven 1992). Other scholars observed the "coopetition paradox" – tensions resulted from the simultaneous pursuit of cooperation and competition between firms (Raza-Ullah, Bengtsson, and Kock 2014). Some further argued that coopetition is not a simple concurrence between cooperation and competition, but a new kind of strategic interdependence between firms for value creation (Dagnino and Padula 2002). Nevertheless, most agree that IT can reduce transaction cost and create hybrid governance forms between markets and hierarchies (Wang and Wei 2007). These new IT-enabled constructs involve both trust and control offered by relational norms and virtual integration.

2.8 Trust and control

The concept of trust has been studied in many disciplines, including sociology, psychology, law, economics, and computer science, and therefore numerous interpretations exist. It is believed that trust is central to understanding individual behavior in a variety of situations such as work group interaction and commercial relationships (McKnight et al. 2011). Trust is perceived to be the most important factor for business success and serves as a function of imperfect information that supports decision making under uncertainty (McKnight et al. 2011; Blomqvist 1997). Economists consider trust to be a tool that helps reduce transaction costs of an exchange between two parties (Quddus and Fukuyama 2014). For this thesis, trust is defined as "the willingness to engage in a transaction in the absence of adequate safeguards" (Noorderhaven 1992).

There are many dimensions embedded within the notion of trust. Concepts such as credibility, competence, confidence, faith, hope, loyalty, and reliance have been used as synonyms of trust in previous literature (Blomqvist 1997). McKnight and colleagues (McKnight

et al. 2011) identified three attributes of trust – competence, benevolence, and integrity. Trust has a strong contextual and temporal aspect (Blomqvist 1997). Initial trust denotes the trustor's judgement before they experience the trustee and experiential trust refers to the trustor's expectations of trustee's behavior during their interactions (McKnight et al. 2011). These two types of trust are akin to the calculus-based trust and knowledge-based trust, as coined by Lewicki and Bunker (Lewicki 1996). Others have also pointed out that the trustor's mindset is critical, as trust is limited when the trustor does not believe in the process nor the trustee's credentials or overall trustworthiness (Moorman, Deshpandé, and Zaltman 1993).

Trust can also be understood by labeling the trusting object - individual trust (singular relationship) or system trust (a network of relationships, which could become an entity on its own) (Noorderhaven 1992). Such distinction was relatively straightforward before technologies infiltrated our everyday life. Research in technology trust flourishes, but its very definition and the role of technology within a trust conceptual framework are highly contested. Some researchers question the viability of the technology trust idea because "people trust people, not technology" (Friedman, Khan, and Howe 2000). On the other hand, Misiolek *et al.* (2002) proposed that technology trust could be formed based on a combination of social, institutional, and technological factors. Social trust includes both interpersonal interaction through technology and authoritative influence regarding technology. Institutional trust refers to organizational encouragement and managerial capabilities with respect to technology use. Technological trust concerns the role of technology in creating a direct trusting relationship with an individual (Kivijarvi, Leppanen, and Hallikainen 2013). McKnight et al (2011) proposed that trust in technology could be divided in two stages: 1) initial trust and 2) knowledge-based trust. Initial trust rests on the trustor's judgement prior to the experience and involves three factors: a)

propensity to trust, b) institution-based trust, and c) trust in specific technology. Propensity to trust is highly dependent on the trustor's faith and trusting stance on technology in general. Institution-based trust is composed of structural assurance (infrastructure supporting technology use) and situational normality (individual considering technology use is favorable to positive outcomes). For trust in specific technology, the authors modified the three attributes of trust in people for better representation – functionality (competence), helpfulness (benevolence), and reliability (integrity) (McKnight et al. 2011). Past studies indicated that initial technology trust improved perceived performance and promoted adoption behavior. Knowledge-based trust is formed as the trustor becomes familiar with the technology. Initial trust is prone to change quickly with changes in costs and benefits. On the other hand, knowledge-based trust is more persistent and may be more influential in determining continuation and commitment behavior (McKnight et al. 2011). Previous research further advised that an IOIS would establish trust through gathering and disseminating information regarding the trustworthiness of an agent (i.e., individual trust) and implementing a series of digital policies, protocols, and procedures to ensure actors are trustworthy and play by the rules that regulate the system (i.e., system trust) (Ramchurn, Huynh, and Jennings 2004). Institution-based trust (i.e., infrastructure supporting technology use) then plays a role in establishing people's initial trust in technology. Using a policy capturing approach, Bahmanziari and colleagues (2003) found that there is a significant positive relationship between trusting a software vendor (trust in institution) and the decision to adopt a software technology. Others (McKnight and Chervany 2002; Ratnasingam and Pavlou 2004) proposed that technology trust is a critical antecedent of trading partner trust. Technology trust positively affects the company's own trustworthiness and relationship with its trading partner, which will increase trading partner trust and influence on-going technology trust

(Ratnasingam and Pavlou 2004). It gives the impression that there is a feedback loop connecting these two trust components.

Under uncertainty, it is believed that one relies on two mechanisms to maintain business alliance and secure performance: inter-organizational control and trust (Das and Teng 2001). How these two mechanisms inter-relate remains a highly debatable arena. Trust and control have been argued to act as substitutes as well as complements (Dekker 2004). Das and Teng (2001) submitted that there are two forms of trust (goodwill and competence) and three forms of control (behavior, output and social) under two dimensions of risk (relational vs. performance; subjective vs. objective). Inter-organizational control is often a mixture of output, process, or normative control practices (Weibel et al. 2016). Holtgrave and colleagues (Holtgrave, Nienaber, and Ferreira 2017) tested the connection between different control and trust strategies in shaping business relationship strength between international buyer-suppliers in the textile industry. They found that the interplay between control and trust followed neither a substitution nor a complementary perspective. This resonated with Gallivan and Depledge's earlier contention (2003) that each of the two constructs is only meaningful when it is considered in relationship to the other.

The relationship between people and technology under the trust-control nexus is even more complicated. Technology trust is shown to be dependent on both subjective probability/leap of faith (trust) and various security measures (control) (Bahmanziari, Pearson, and Crosby 2003; Ratnasingam and Pavlou 2004). It has also been shown to affect technology adoption behavior. Christopher (2016) employed a bridging model of trust to investigate the roles of trust and enforcement in adopting Bitcoin as a currency and payment system. The bridging model postulates that there is a distance between wanting to transact and actually

transacting. The distance between wanting and doing will need to be bridged by a combination of trust and enforcement mechanisms (i.e., control) before an individual or an organization decides to use the technology.

2.9 Traceability and hemp – better information, stronger industry?

Besides various internal supply chain management systems adopted by individual businesses, two types of monitoring systems exist within the Canadian hemp industry: Health Canada's CTLS which aims to track high-level movement of cannabis and the CSGA seed certification system which allow tracking and tracing of products from plant variety development to the initial stage of seed processing based on the current "one up/one down" traceability framework. CTLS could function well as a tool for both intermittent inventory monitoring and statistical purposes but does little to tackle the issue of supply chain diversion (i.e., products sold through or by an authorized seller or channel) and/or inversion (i.e., selling legacy products in the legal market). For hemp industry participants, CTLS functions more like a bureaucratic instrument that they use to apply for licenses and fulfill reporting requirements. While the federal licensing process offers some assurance of the integrity of the hemp production process to the buyers, hemp industry stakeholders extract little benefits from the platform itself. The information gathering responsibilities still rest on the cooperation between actors across the supply chain which is time- and resource-intensive. Hemp by itself has a multi-step branching supply chain. As illustrated in previous sections (Figure 1 and Table 2), few mechanisms are available to support tracking and tracing at the product processing level. They also do not allow for the rapid verification of the provenance and quality of the materials. Combined with lack of experience with CBD production and processing, and a hazy industry forecast, opportunistic

behaviors flourished within the CBD market. From the seller's end, input materials that do not meet quality and safety parameters are offered in the marketplace. From the buyer's end, grower contracts are often breached due to company's poor inventory planning and management. Under the current setting, both sides suffer from high search, screening, monitoring and enforcement costs. Growers further suffer from a power imbalance as they find themselves in a legal dispute with a large multi-national cannabis enterprise such as Aurora, Tilray, and Canopy Growth.

Harmonizing information flow using digital technologies – in this case, a blockchain-based, industry-wide traceability program – could address many problems currently faced by the hemp industry. One of the potential applications is traceability for hemp-based CBD oil (Figure 2). Similar to the CSGA's tofu traceability program, the hemp-based CBD program will connect various digital technologies such as QR code, Global Positioning System, and online certification to the blockchain network. Every action performed along the supply chain is recorded, validated by a consensus model, and stored in the blockchain. Information could automatically be sent to fulfill regulatory (Health Canada) and seed certification (CSGA) requirements. All supply chain participants have information about the entire process, and consumers can be certain about provenance (100% Canadian hemp based) and quality standard of the product (i.e., CBD concentration in the oil). In addition, the smart contract functionality (i.e., a transaction protocol that intends to automatically execute the legal and financial transactions when predetermined terms and conditions are met) could be added to the traceability system to enforce the contract performance. Blockchain's immutable record-keeping and smart contract function could lower transaction costs and improve trust within the CBD market.

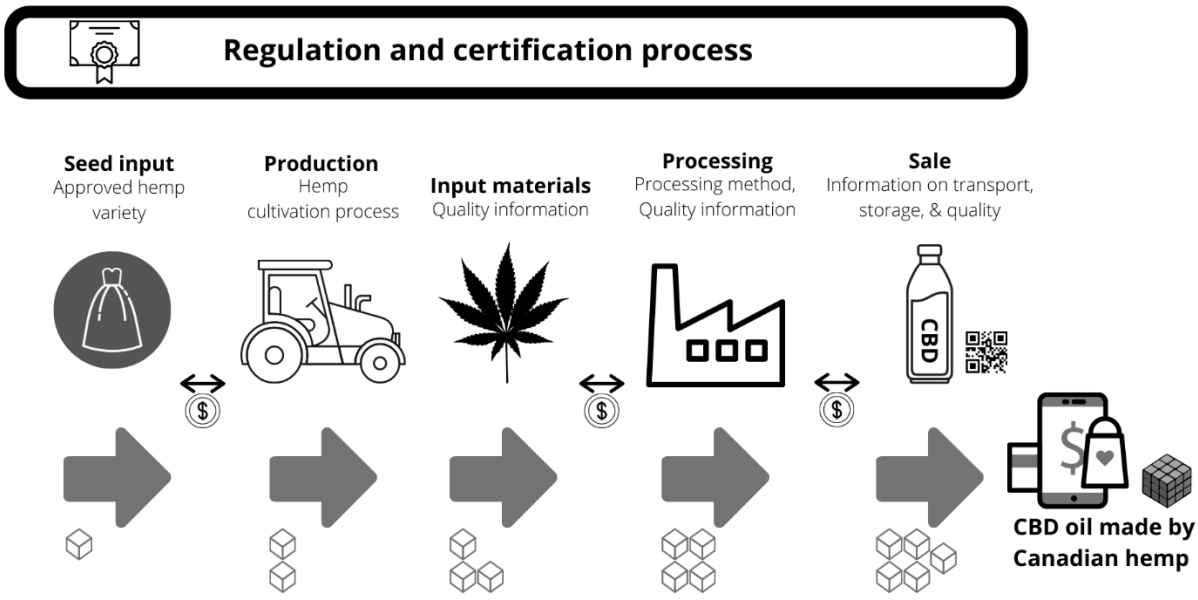

Figure 1.2. Simplified hemp-based CBD oil supply chain, supported by blockchain-based traceability. The middle layer depicts the physical flow of the product and information associated with the product will be captured in the blockchain network (bottom layer). Pertinent information will also be sent to the regulatory bodies (top layer). Smart contract functions (bilateral arrow with dollar sign) could be incorporated within a blockchain network to enforce contract performance. (Source: author)

Real-time capture, storing, and dissemination of information will allow the industry to address supply chain issues quickly. It also helps to distinguish hemp-based products from other cannabis blends, therefore preserving hemp's "not a drug" identity to its customers. Integration of other digital technologies into the traceability system could reduce the need for third-party certification and improve regulatory efficiency. Better body of information and improved flexibility are two key strategies to success in today's global trade market where non-tariff barriers such as unjustified phytosanitary requirements are becoming the norm. Enhanced transparency would help improve customer trust and, ideally, overall supply chain trust for the hemp industry.

The issue is, would everyone within the industry agree to this? This thesis uses a survey to explore this question.

3. Trust in markets

Rooted in rationality, many economic theories possess a dichotomous view of "market vs. hierarchies" (Williamson 1973) – firms compete with each other in the market, while managers exercise authority to curb opportunistic behavior within the organization (Powell 1990). As mentioned in the previous section, companies have found themselves increasingly interconnected over the past decades, and such "market vs. hierarchies" distinction fails to capture a variety of hybrids that do not resemble either the spot market or the ideal vertical integration description. Powell (1990) first proposed the concept of "network" in which individuals are engaged in reciprocal, preferential, and mutually supportive actions. Instead of legal contracting (in the case of market) and authority (in the case of organizational hierarchy), networks operate on continued participation, mutual benefits, and normative sanctions that target an individual's reputation. Trust emerges as a sense of generalized reciprocity developed through recurring transactions. Mahoney (1995) also suggested a "relational contract" approach in situations where both output and behavioral controls are ineffective. Fukuyama further asserted that social capital – the ability of individuals to work together effectively to achieve a common purpose – can affect economic development by lowering or increasing transaction costs (Quddus and Fukuyama 2014). Specifically, high levels of trust promote market efficiency. Powell (1990) contends that the desire for continued participation in the network successfully discourages opportunism. On the other hand, low levels of trust, or insufficient social capital, increase transaction costs and undermine commerce in the economy (Quddus and Fukuyama 2014). The notion of trust and its role in market relations were examined even by trust-skeptics like Oliver Williamson (1993), who submitted that calculativeness is a better way to describe the judgement process. Nevertheless, Williamson agreed that better definitions on trust and associated

vocabularies will enable more productive dialogues in economic and organizational behavior studies. A better understanding of the concept of trust and its role in network creation and maintenance would better inform policies and programs.

Trust has been widely studied as a standalone concept (as reviewed in previous section) but can also be viewed as a relationship quality component. According to Powell (1990), relationships serve as a strong foundation for a functional network and continuous positive exchange relations build trust. Previous studies identified the following antecedents of a long-term relationship - trust, involvement, openness, investment, commitment, satisfaction, and control mutuality (Grunig and Huang 2000; Hon and Grunig 1999; Ledingham and Bruning 1998). Based on decades of research in public relations, Hon and Grunig (1999) developed a set of guidelines for measuring relationship quality, with trust considered as one of the key characteristics. Like McKnight *et al.* (2011), Hon and Grunig view trust in three elements,

- Integrity: the belief that an organization is fair and just;
- Dependability: the belief that an organization will do what it says it will do; and
- Competence, the belief that an organization has the ability to do what it says it will do.

These trust and relationship measurement tools allow researchers to gain a better insight into the existing interorganizational governance structure and to assess the impact of a policy intervention on existing and long-term relationships.

4. Research Question and objectives

Conventional policy assessments often focus on the economic cost and benefits of an intervention on the system in its entirety. For traceability analysis, most research concentrates on the engineering aspects while little attention is paid to the importance of people in the implementation of food traceability (Karlsen et al. 2013). These evaluation approaches overlook two critical components – members' perception and attitude towards the intervention (i.e., introduction of a new technology) and how the intervention would affect information exchange, relationship dynamics, and organizational governance. When it comes to IT, people often confuse governance with data management protocols. They mistakenly rationalize that the technology itself will improve data governance and the interorganizational structure will naturally adapt. Ignoring the "social" aspect of the data governance results in a technology that is at odds with the existing interorganizational governance structure. This is an especially important consideration when implementing a traceability technology, as its intended benefits would only be realized when the technology is universally adopted. Poor understanding of the effects of traceability technology on individual actors and their existing business relationships often lead to poor design, and eventually, low buy-in.

This thesis research was initially inspired by the "trust-less" system as vouched by the blockchain proponents. Many blockchain initiatives have already been implemented in the agri-food sector worldwide, but convincing business cases remain scare (Kamilaris, Fonts, and Prenafeta-Boldύ 2019). In Canada, CSGA's tofu traceability program has demonstrated the technical feasibility of following a specific certified seed variety from development to the grocery shelf. It shows the potential of using blockchain to improve supply chain efficiency. From a trust perspective, however, does the technology improve trust, strengthen one's control,

or eliminate the need of trust in business transactions entirely? Will blockchain reduce the number of intermediaries and make the agri-food sector less fragmented?

The primary objective of this research is to examine the potential opportunities and obstacles of a blockchain based traceability system in the agri-food sector using the trust lens. As described in the previous section, trust is the basis for adoption and acceptance of new technology (Bahmanziari, Pearson, and Crosby 2003), perceived performance of the technology (Kivijarvi, Leppanen, and Hallikainen 2013), and – in the case of IOIS – a foundation for developing trust in trading partners (Ratnasingam and Pavlou 2004).

The hemp industry was chosen as a case study for several reasons. For hemp, product distinction and segregation are critical in its business model and traceability is a legal requirement. More importantly, the industry is undergoing a systemic transformation after the 2018 cannabis liberalization. Industry actors are concerned that the CBD market speculation is eroding trust within the hemp industry.[3] Regulatory hurdles, combined with a low-trust business environment, could drive people away from growing and marketing hemp and damage the industry's long-term growth potential. This thesis seeks to assess existing trust in the system and explores how blockchain might change the trust relationships and the resulting effects of those changes.

Initially, my thesis research planned to use a series of semi-structured interviews to explore three key basic questions:

- What does trust mean for an agri-food business (in this case, the Canadian hemp industry)?

[3] Personal communications with industry informants. November 2019.

- Does a blockchain-based traceability improve trust or eliminate the need for trust altogether?
- Would a blockchain-based traceability replace any business relationship?

Preliminary conversations with industry informants during the questionnaire development stage suggested there was a general lack of understanding of what blockchain entails. To avoid confirmation bias, I dropped the mention of "blockchain" in the final version of the questionnaire. Instead, all study participants were asked to imagine an "industry-wide traceability system that will connect everyone within the industry". Two specific questions towards the end of the questionnaire on the participant's impression and familiarity with blockchain. Additional questions were also included in the survey to assess participants' knowledge and experience with traceability.

Based on literature review and initial responses from industry informants, I settled my thesis research objectives as follows:

1) To describe the meaning of trust and its role in a business relationship for the Canadian hemp industry
2) To assess the perception and attitude of the Canadian hemp industry stakeholders towards a comprehensive, industry-wide traceability system
3) To understand the potential impact of introducing such traceability system from a trust and relationship perspectives

4.1 Survey instrument

In terms of experimental design, a questionnaire (see Appendix A) was developed using questions/statements based on insights in Hon and Gruing (1999), Gruing and Huang (2000), and Paine (2016). It seeks to achieve the following:

- Understand stakeholders' perception towards the hemp industry and the quality of some of their existing business relationships
- Understand stakeholders' perception and attitude towards a comprehensive, industry-wide traceability program
- Assess the potential effect of a sector-wide traceability program on the stakeholders' existing business relationships

It is impossible to investigate all business relationships within the hemp supply chain given its complexity and dynamic nature. Based on my review of the hemp supply chain in Canada (see Figure. 1), it appeared that most hemp businesses will have regular interactions with 3 national organizations: Health Canada, CSGA, and CHTA. This research study therefore focuses on the quality of the relationship with these three organizations.

In terms of relationship quality, the study questionnaire primarily focuses on Hon's three elements of trust: integrity, dependability, and competence. Given trust is often pondered alongside with control, questions concerning control mutuality, the degree to which parties agree on who has the rightful power to influence one another, are also included in the questionnaire. After answering questions on trust and control mutuality, participants are asked to evaluate their satisfaction with the organization. For each statement, participants were asked to use a 1-to-5 scale to indicate the extent to which they agree or disagree with the statement in relation to one of the three organizations. I concluded the study questionnaire with several open-ended questions related to trust, hemp versus cannabis distinction, blockchain and its potential applications. The

research protocol was approved by the University of Saskatchewan Behavioral Ethics Board in 2020 (ID 1760).

Interview participants were identified using the business directory in the CHTA website, the Hemp Industry Directory assembled by BioAlberta, and the referral of interview participants in a snowball sample manner. All interview participants must have been involved in the Canadian hemp industry (production, processing, manufacturing, research, and marketing) for a minimum of 2 years. All interviews were conducted on a voluntary basis via phone (or Viber, a Voice over IP mobile application, on one occasion) where study participants gave explicit verbal consent at the beginning of the interview. Interview duration ranged between 30 min to 1 hour and 45 minutes. These interviews continued until I felt the point of theoretical saturation was reached (Lincoln 2007), and no new information would be revealed by continuing additional interviews (Handbook of Interview Research 2001). Transcribed notes and interview audiotapes were coded using NVivo 12. Questionnaire data was analyzed using both quantitative and qualitative approaches. Based on the questionnaire structure, initial round of coding involved sorting the qualitative data with the following broad topics – trust (integrity, dependability, and competence), industry perception, opinions regarding the three national organizations (CHTA, CSGA, Health Canada), and traceability technology. New codes were identified and collected in the second round of coding. The collection of codes was then analyzed and re-categorized to detect consistent and overarching themes.

4.2 The survey population

Between February and July, twenty-two (22) industry stakeholders participated in the research study. Nineteen (19) of the participants reside in the Western Canadian (British

Columbia, Alberta, Saskatchewan, and Manitoba) provinces. Fourteen (14) have served, or are currently serving, on the CHTA Board or one of the sub-committees. Only 4 participants have less than 5 years of experience in the hemp industry.

5. Results

Study participants were asked about their overall impression about the hemp industry and its future potential. Fifteen (15) participants believe that they have influence on how decisions are made within the industry. To them, active participation, industry knowledge, and experience are key to boost their influence at the industry level. Opinions were split on whether the current systems and regulations support their business, but most participants remain optimistic about the future even if the status quo is unchanged (Figure 3).

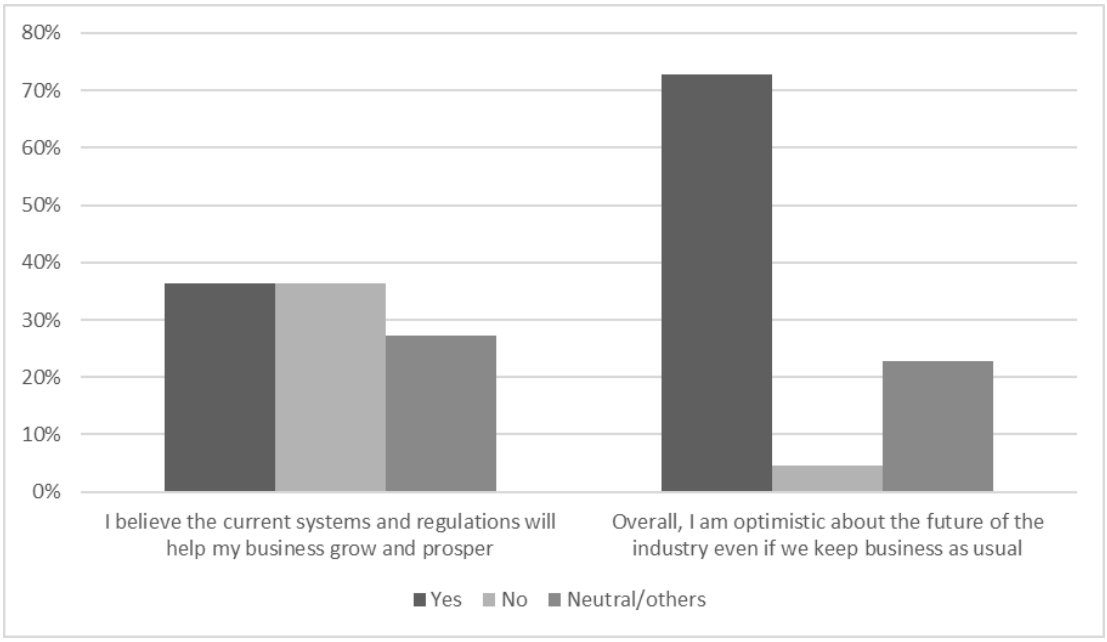

Figure 5.1. Participants' attitude towards the current industry environment and future potential

5.1 Existing trust and relationship quality

This study first asked the industry stakeholders about their relationship quality with the 3 national organizations (CHTA, CSGA, and Health Canada) under 3 primary attributes – trust (5 questions), control mutuality (2 questions), and satisfaction (2 questions). For the 5 questions on

trust, there are 2 questions for integrity, 2 for dependability, and 1 for competence (see Appendix 1).

Using the guidelines provided by Hon and Grunig (1999), a composite score was calculated for the 3 primary attributes and 3 trust elements using the 5-point scale rating provided by the participants. Scores for negative statements (i.e., the "does not" and "will not" statements) were reversed. The answers measuring each attribute were averaged so the final score was also on a 5-point scale. No answer was excluded in the composite score analysis.

The study group rated CHTA positively on all 3 primary attributes. As expected, most respondents felt they have less control over CSGA and the least control over Health Canada. Health Canada also scored the lowest when it comes to trust and satisfaction (Table 3).

Relationship indicator	**CHTA**	**CSGA**	**Health Canada**
Control mutuality	3.91	3.24	2.45
Trust	3.95	4.05	3.21
Satisfaction	4.41	4.41	3.57

Table 5.1. Participants' perception towards their existing relationship with three national organizations

Within the 3 trust elements, CHTA was rated the highest in terms of integrity, but came second to CSGA on the other two (Table 3). I am, however, hesitant in drawing conclusions based on this comparison as approximately 30% participants did not provide a ranking to CSGA on several trust and satisfaction components.

Trust element	**CHTA**	**CSGA**	**Health Canada**
Integrity	4.22	4.09	3.25
Dependability	3.82	4.06	3.2

Competence	3.7	3.94	3.1

Table 5.2. Participants' perception towards three national organizations under the trust context

5.2 Traceability – attitude, knowledge, and experience

Half of the respondents claimed that they are familiar or very familiar with the technologies that are involved in a traceability program. Most of them claimed that they have worked with more than one program in their business operation. The organic certification and the certified seed systems were mostly frequently cited examples. Conversely, only 3 respondents bought up the CTLS.

Respondents generally associated traceability with authentication, quality control, and quality assurance. Some of them also viewed it as a type of liability insurance because a traceability program allows them to address food safety issues promptly. Few participants also mentioned about the logistics, data volume, and data quality requirement to successfully implement a traceability system.

Eighteen respondents have heard about the word "blockchain", but only six individuals could relate blockchain to traceability and only one brought up the Ontario soybean traceability program unprompted.

5.3 Effect of an industry-wide traceability program on relationship quality

Industry stakeholders were asked if an industry-wide traceability program would change their relationship quality with the three national organizations. Opinions varied greatly as to

whether the program will improve the control mutuality and dependability attributes of the 3 national organizations (Figure 4).

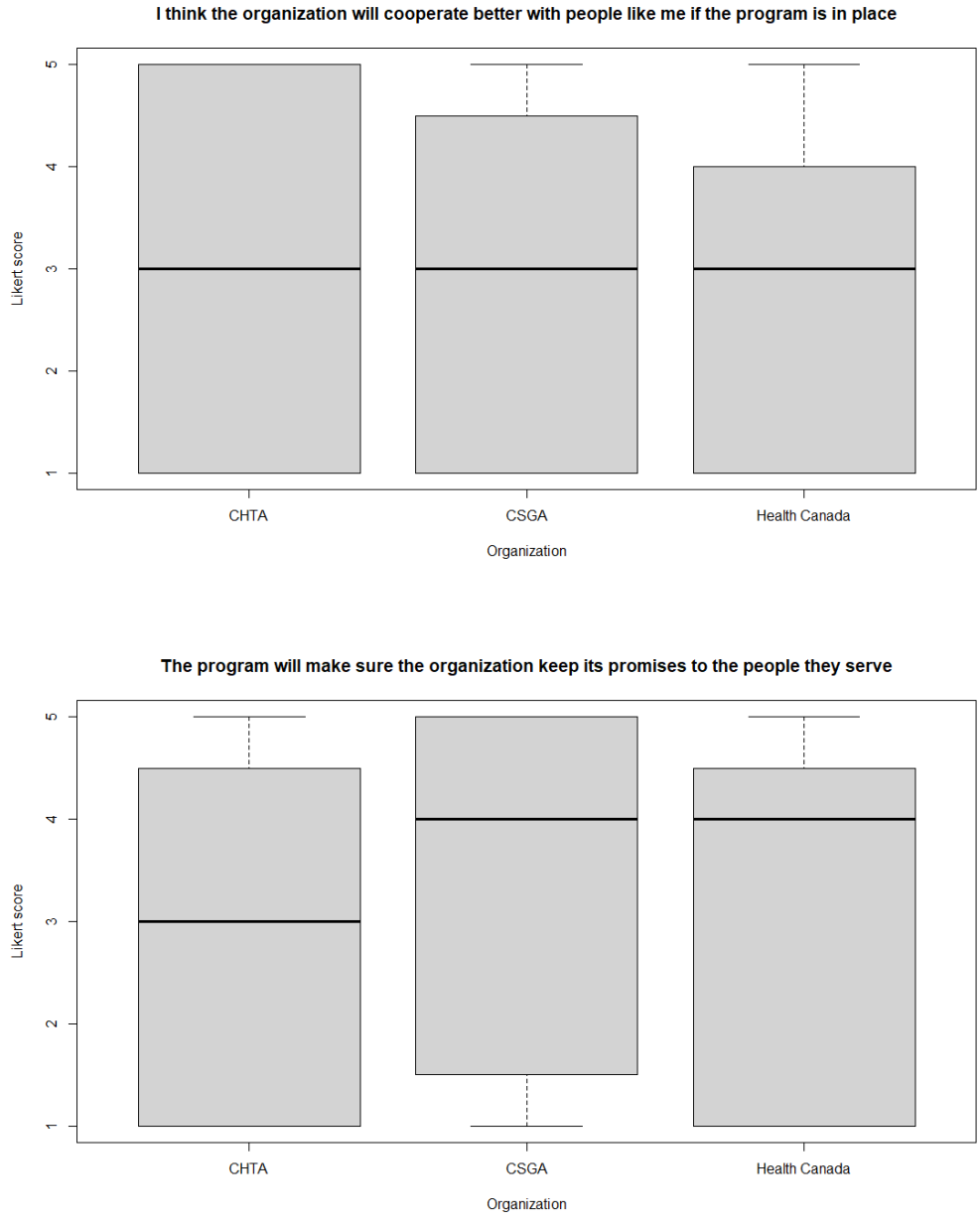

Figure 5.2. Participants' view on the effect of an industry-wide traceability program on their relationship quality with the three national organizations.

The box covers the interquartile range with the thick line indicating the median score.

There is a consensus that a traceability program, while it provides value, does not replace the existing relationship with the three organizations because these organizations perform many more functions beyond tracking and sharing data (Figure 5). Several study participants elected to not give a rating because they did not think it is fair to compare a program with an organization.

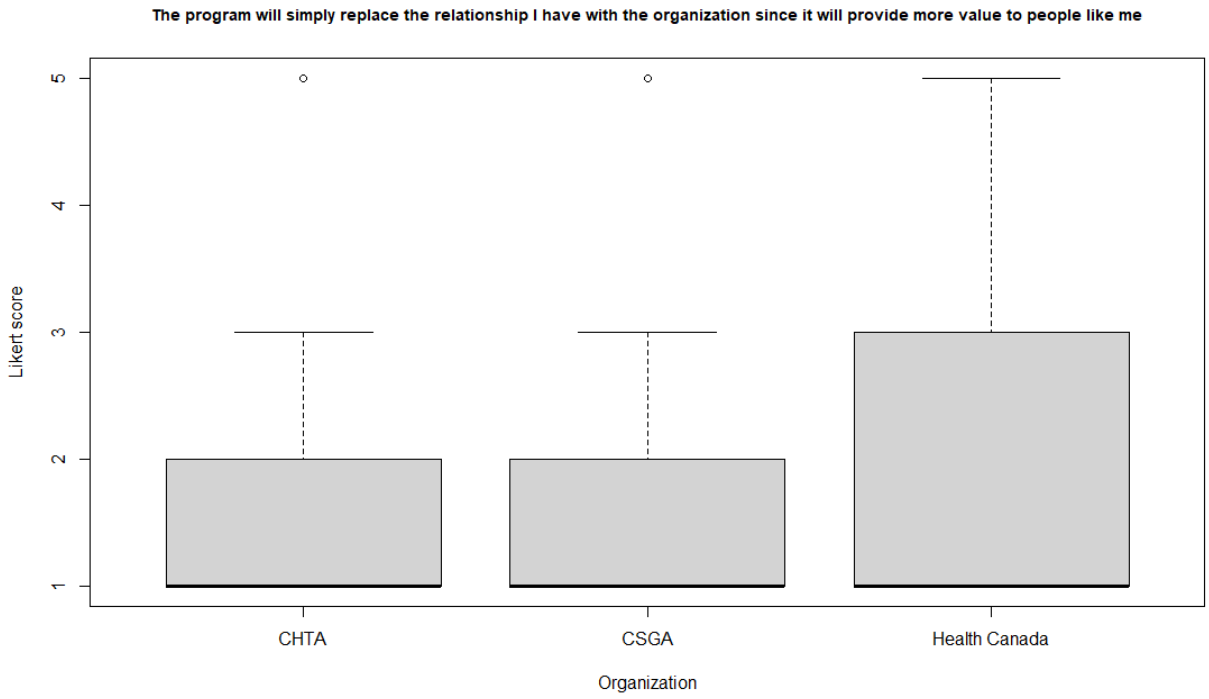

Figure 5.3. Participants' view on the effect of an industry-wide traceability program on their satisfaction level with the three national organizations.

The box covers the interquartile range with the thick line indicating the median score. Outliers are shown as hollow circles.

5.4 Perception and attitude towards an industry-wide traceability program

Half of the respondents do not see how an industry-wide traceability program could change their influence at the industry level (Figure 6). This is consistent with their belief that

active participation, industry knowledge, and experience, are key to shape the decision-making process.

On the other hand, 15 out of 22 participants believed an industry-wide traceability program could foster good behaviors within the industry and they will be more willing to work with a new company if the traceability program is in place (Figure 7).

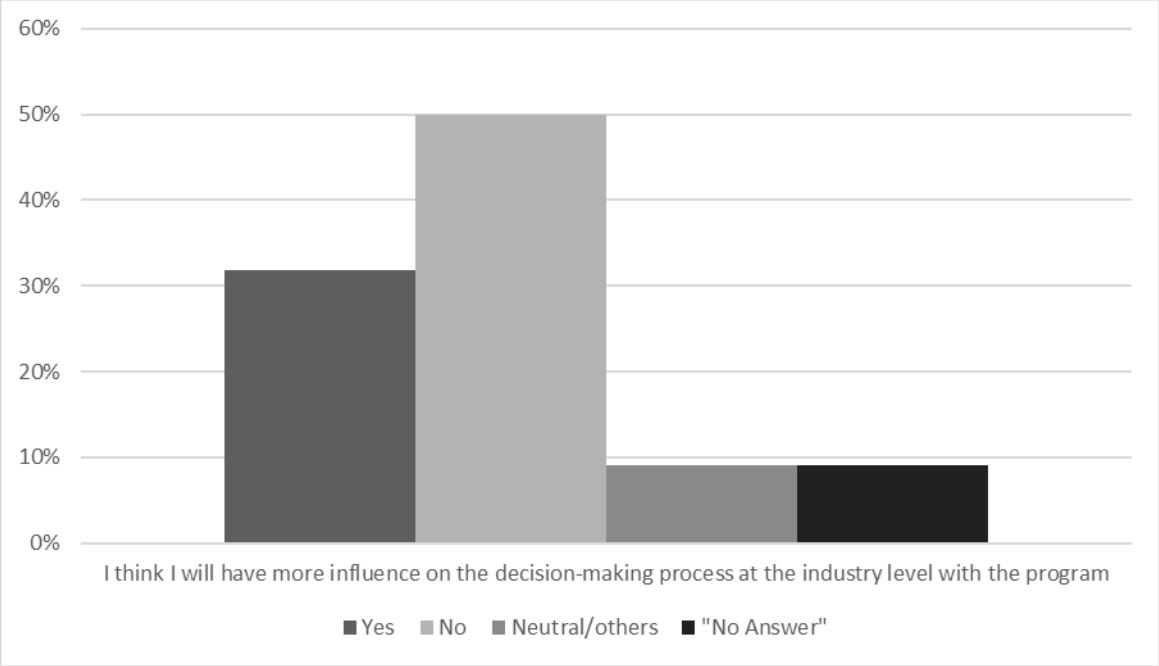

Figure 5.4. Participants' view on the effect of an industry-wide traceability program on their industry influence

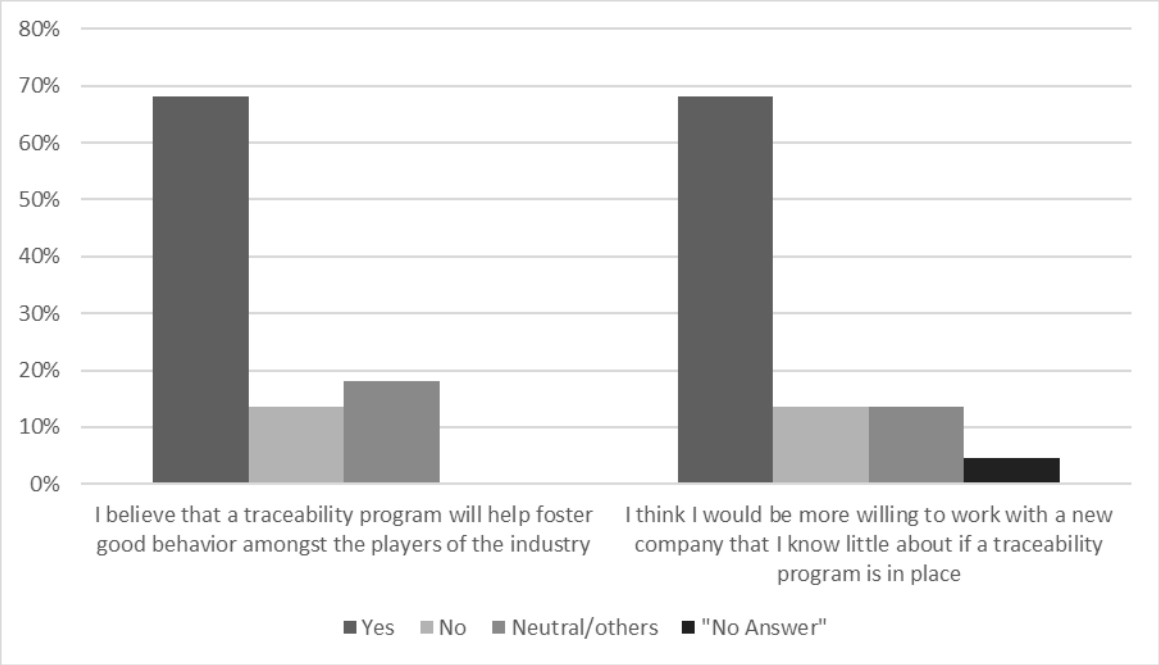

Figure 5.5. Participants' view on the effect of an industry-wide traceability program on the industry environment

While they did not think an industry-wide traceability program would change the industry dynamics and governance, 15 participants (68%) believed that the program is critical for the growth of the industry (Figure 8). It is because the program will help build consumer confidence and trust by raising the industry standard. This will in turn create a "Canadian brand" and a competitive marketing advantage in the global trade environment.

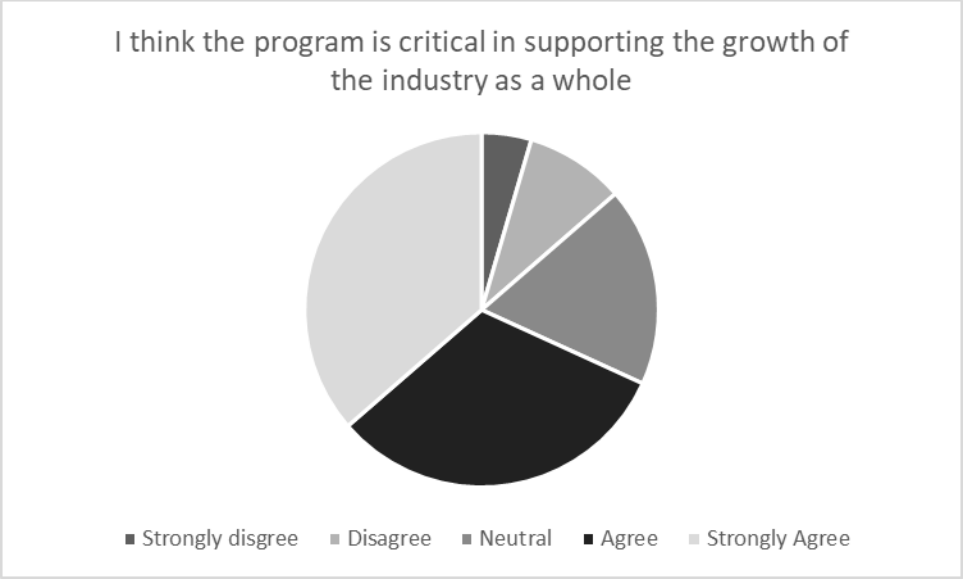

Figure 5.6. Participants' view on the importance of an industry-wide traceability program

5.5 Cluster analysis

Given that there is a split in opinion within the study group on their industry perception, a cluster analysis was performed to identify possible drivers behind their thought process. Based on their response on the question, "*I believe the current systems and regulations will help my business grow and prosper*", participants were divided into two groups – 1) optimists (those answered "yes", n = 8) and 2) skeptics (those answered "no", n = 8). While both groups believed they have influence on how decisions are made within the sector, the skeptics appeared to feel particularly less in control when it comes to their relationship with CHTA (Table 4). They also viewed both Health Canada and CHTA more critically and were less satisfied with the two organizations (Table 4). Predictably, skeptics were considerably more pessimistic about the future. Everyone in the optimist group expressed their optimism about the future of the industry, but less than 40% of individuals in the skeptics group felt the same way.

Relationship indicator	Organization	Optimists	Skeptics	Difference
Control mutuality	CHTA	4.29	3.64	0.65
Dependability	CHTA	4.14	3.21	0.93
	Health Canada	3.29	2.79	0.5
Competence	CHTA	4	3	1
	Health Canada	4	2	2
Trust	CHTA	4.09	3.51	0.58
	Health Canada	3.34	2.94	0.40
Satisfaction	CHTA	4.57	3.86	0.71
	Health Canada	3.71	3.14	0.57

Table 5.3. Differences on existing trust and relationship quality indicators between optimists and skeptics. Composite scores are shown.

Comparing the two groups' perception and attitude towards an industry-wide traceability program yield a few notable observations (Table 6). First, the skeptics appeared to be less proficient with traceability technologies than the optimists. While both groups agreed that the traceability program would help foster good behavior within the industry, 75% of the individuals in the skeptics group are willing to work with new companies while only half of the individuals in the optimist group would do the same.

Question on traceability	Optimists	Skeptics
Are you familiar with the technologies that are involved in managing a traceability program?	Median score: 4	Median score: 2
I think I will have more influence on the decision-making process at the industry level with the program	Yes: 25%	Yes: 25%
I believe that a traceability program will help foster good behavior amongst the players of the industry	Median score: 4	Median score: 4
I think I would be more willing to work with a new company that I know little about if a traceability program is in place	Yes: 50%	Yes: 75%
I think the program is critical in supporting the growth of the industry as a whole	Median score: 4	Median score: 4

Table 5.4. Differences in perception and attitudes towards a sector-wide traceability program between optimists and skeptics

Both groups felt that the traceability program would be beneficial to the industry but would do very little their overall industry influence (Table 5). However, the optimists believed that the program would facilitate better cooperation with the three national organizations (Table 7). On the other hand, the skeptics thought that the traceability program would ensure the three national organizations, especially CHTA, pay more attention to their opinions (Table 7).

Question on traceability	Optimists' ranking	Skeptics' ranking
A traceability program will make sure (organization) to be more attentive to opinions from people like me when it comes to making important decisions	CHTA: 2 CSGA: 2 Health Canada: 2	CHTA: 5 CSGA: 4 Health Canada: 3
I think (organization) will cooperate better with people like me if such a program is in place	CHTA: 3 CSGA: 3: Health Canada: 4	CHTA: 1 CSGA: 1 Health Canada: 1

Table 5.5. Differences in the perceived effects of implementing an industry-wide traceability program on relationship indicators between optimists and skeptics.

Median scores are shown for the ranking.

6. Discussion

6.1 The meaning of trust in agri-business

All participants indicated that trust is fundamental in all aspects of their business operations. In line with Noorderhaven's (1992) definition, trust represents a willingness to commit in a transaction to this group of participants. Trust also means that all parties working together to ensure things come through and sharing the risk and rewards equitably. As one participant noted: "Trust is an understanding of … who you can count on at the end of the day."[4] Another asserted: "Risk is high in the agriculture sector and you need to make sure your partner is willing to ride the wave with you."[5]

Several participants explained trust from a contract (control) perspective. This supports Gallivan and Depledge's (2003) view that the two constructs only make sense when considered in relationship to the other. How they set up the contract reflects how much they trust the other party. If the other party is new or is not deemed as trustworthy, the contract will usually carry a higher upfront payment and/or involve a smaller volume of products. This observation somewhat aligns with the bridging concept (decision to act requires a combination of trust and control) as proposed by Christopher (2016). The level of trust is also partially dependent on the trustor (Moorman, Deshpandé, and Zaltman 1993), as two participants expressed that they insist on doing their own investigation about the trading partner and they would always rely on their gut feeling over what is being presented to them. The person's openness to risk was noted to be an important element of trust by Grunig and Huang (2000).

[4] Participant 2. Interview by author. February 2020.
[5] Participant 13. Interview by author. April 2020.

Given the hemp industry is relatively small[6], participants often referred to "previous industry experience" and "reputation" as a yardstick to measure the trustworthiness of the other business entity. Notably, study participants used the word "trust" and "good relationship" interchangeably and emphasized the need to gradually build trust/relationship over time. One participant summed up the general view well: "Trust is built over time and experience."[7]

To this group of participants, trust specifically refers to the knowledge-based trust coined by McKnight *et al.* (2011) and has a strong temporal aspect (Blomqvist 1997). Majority of the participants have been involved in the industry since its infancy, a network is inadvertently created based on relational norms and continuous reciprocal and mutually supportive actions (Powell 1990). Accordingly, new industry players, especially those joined for the cannabinoid market after 2018, are regarded with skepticism. As stated by Powell (1990), "when the diversity of participants increases, trust recedes, and so does the willingness to enter into long-term collaborations". Indeed, six participants pointed out that recent industry restructuring has brought down the level of trust in the industry environment. This echoed the early sentiment of industry informants as I was developing the questionnaire. One individual even claimed that trust simply does not exist when it comes to the LPs.

6.2 The trust-control nexus within the Canadian hemp industry

Given the complexity of the hemp industry and its association with the marijuana industry, different business entity will have their own unique set of core business relationships. The research study specifically selected three organizations because of their extensive

[6] According to a CHTA presentation made in spring 2020, there were 500 members from 9 provinces in 2018.
[7] Participant 5. Interview by author. March 2020.

involvement throughout the industry supply chain – Health Canada and CSGA for their regulatory responsibility, and CHTA for its role as the national industry association. As well, given their national mandate, these organizations could take on the lead role in implementing an industry-wide traceability program.

Overall, CHTA was regarded highly by the study group with the lowest score of 3.7 on the competence element. Several participants opined that, CHTA has good intentions but does not have sufficient resources to act on its deliverables. To address the issue, a group of industry stakeholders applied to the Farm Products Council to establish a national check-off program to fund hemp research and market promotion activities in 2018. The new agency will be distinct from CHTA but is expected to work closely with CHTA during the early stages (Johnson 2018).

CHTA scored the highest in the control mutuality attribute followed by CSGA then Health Canada. The ranking is predictable because most of the participants either have been or are currently involved in the CHTA functions, and a few collaborated or are collaborating with CSGA on other endeavors. The control mutuality score with Health Canada is lowest of all (2.45).

Though some participants acknowledged that there have been some improvements within Health Canada over the recent years, the relationship remains to be a "love-hate" one with little reciprocity. As a government department, Health Canada is either viewed to "*have the power to do whatever they want*"[8] or as "*a messenger who only delivers the final message from above*"[9]. Many respondents did not feel their opinions are being taken into consideration by Health Canada. A sense of detachment might be one of the reasons why few people considered the

[8] Participant 11. Interview by author. March 2020.
[9] Participant 5. Interview by author. March 2020.

CTLS as a traceability tool. When being asked about their overall satisfaction with the organization, 5 individuals gave a positive rating (>3) with a caveat that "the relationship is good because it has to". One participant responded to the satisfaction question by first offering the following analogy:

> "If (the situation) give(s) you a lemon, you look up a recipe for a lemonade."[10]

The findings with CSGA are peculiar. Given the mandatory requirement to use certified seeds, it was assumed that most industry stakeholders will have a relationship with the organization. Curiously, while most respondents unreservedly commended the certified seed system when CSGA was mentioned, a portion of participants (13 – 30% depending on the question) declined to give a rating citing a lack of direct experience with the organization. These people either do not consider seed as part of their business activity or they rely on their certified seed grower contact to handle the seed side of their business. Remarkably, even those who work with CSGA regularly are also unaware of the Seed Synergy Initiative and their traceability undertakings. Geographical distance may be at play here since most participants are based in Western Canada and they may be oblivious to developments that are taking place primarily in Ontario. The craft beer traceability program was only announced towards the end of the study period (July 2020).

Our cluster analysis signaled an association between relationship quality and industry perception. Those who were unhappy with the current system and regulations (the skeptics) tended to be more judgmental towards CHTA and Health Canada. We noticed half of the skeptics group never take part in CHTA activities and three of them have less than 5 years of

[10] Participant 22. Interview by author. July 2020.

experience. The optimist group, on the other hand, consists of only two individuals who have never been involved in various CHTA committees and only one with less than 5 years of experience. This led us to believe that the skeptics group's anxiety and criticism are primarily contributed by their relative inexperience within the industry. Given that trust for this group of participants refers to the knowledge-based trust, it is reasonable for these individuals to remain cynical towards other industry players.

We are not able to draw any conclusions on whether implementing an industry-wide traceability program would change the relationship quality of any of the three national organizations. This is partly because the "industry-wide traceability" interpretation varies greatly from one respondent to another. Some considered current rules and regulations to be a type of traceability and believed that adding another computer program would only add to the existing bureaucratic hurdle. Those envisioned a program that will enhance data sharing within the industry had a slightly better appreciation of how information could moderate their relationship quality. Given half of the respondents claimed they are proficient with traceability technologies, we are unable to establish a correlation between technology proficiency and perception of the technology's utility in terms of relationship quality. We speculate that replacing "industry-wide traceability" with "blockchain" would likely prompt an even more significant divergence of opinions.

Regardless of their interpretation of "industry-wide traceability" and their satisfaction level with the organizations, majority of the respondents still believe their existing relationships provide them with more value than a traceability program would. To this group of participants, traceability program is simply a tool that has some potential to improve information quality and flow.

6.3 The implications of an industry-wide traceability system

It has been recognized that relational governance and IT-enabled virtual integration are two important mechanisms for governing interfirm relationship, with the former focusing on the relationship aspect and the latter on the technology aspect (Wang and Wei 2007). But several researchers have proposed an ISIO (i.e., a bundle of IT technologies) could modify relational risk and influence business alliance outcome. An ISIO could be used as a collaborative platform to reinforce trust and promote relationship building, or as a monitoring platform to exercise better control in the electronic partnerships (Gallivan and Depledge 2003; Wang and Wei 2007). In this research, we wanted to discover whether an industry-wide traceability system, as an ISIO, would be deemed as a trust-building mechanism or a control mechanism by the hemp industry stakeholders.

To this group of industry stakeholders, an industry-wide traceability program is not expected to have much impact on the current industry dynamics and their industry influence. In fact, 10 participants expressed they did not see how traceability can be related to industry influence. However, many of them see that the industry-wide traceability program has an outward-facing function - to build consumer's trust and confidence through raising the industry standard. Our findings implicated that the program would serve both as a trust-building and as a controlling mechanism. The program could strengthen one's control over a business transaction because supporting documentations will be readily available to hold the other party accountable when things go wrong ("output control"). Participants also noted that the program could enhance the credibility of all the industry players ("competence trust" as remarked by McKnight et al. 2011; Holtgrave, Nienaber, and Ferreira 2017; Grunig and Huang 2000). They opined that the

industry would benefit by working in a more transparent environment and from a better body of information, but human relationships and active participation in industry activities remain most critical when building trust and advancing business goals in this industry. One participant's comment summed up our findings well: "A traceability program could potentially provide more accurate data to inform decision making. Whether people will make that decision is another matter."[11]

When the participants were divided into two groups based on their industry perception, we noted that the optimists felt the traceability program would improve cooperation, while the skeptics believed the program would make the organizations (especially CHTA and Health Canada) more attentive to their opinions. Interestingly, despite their cynicism towards existing organizations, skeptics appeared to be more willing to work with new companies if an industry-wide traceability program is in place. We believe that the "time in industry" factor is again at play here. While both sides put their faith in the program's ability to provide better evidence, new entrants are looking for validation while old-timers are looking for incremental bargaining power. Old-timers would also have tried-and-true marketing channels and hence be less inclined (or motivated) to work with new companies.

While study participants were generally in favor of implementing an industry-wide traceability program, they cautioned that the program success is highly contingent on how it is being implemented. An augmented traceability program will inevitably lead to more reporting requirements which could make hemp an even less appealing crop to get into. As Williamson (1993) warned, stronger environmental safeguards are not always better because they could make the business environment oppressive and even dysfunctional. For this group of

[11] Participant 15. Interview by author. April 2020.

participants, the program could exacerbate the power imbalance within the industry since established industry players would have better resources to handle traceability obligations. There is a concern that decisions would be shifted even further towards the big players' favor because of their large sales volume. This is partly reflected by the skeptics' disapproval on the program's ability to improve cooperativeness of the three national organizations (Table 5). Depending on the technical complexity, some worried that the program will create a technological barrier that will put some farmers in a disadvantage. Another increase in the cost of business could be the last straw that drives the small players out of business. Worse yet, some players may decide to move their business to the legacy market which defeats one of the original intents of implementing a traceability program.

Participants who were cynical about the industry-wide traceability concept argued that traceability would only ever be as successful as its accompanying enforcement mechanism. These individuals pointed to the persistence of the legacy cannabis market despite recent efforts in regulatory modernization, and technology alone will not solve this issue:

"Traceability cannot cover everything because illicit stuff is meant not to be traceable."[12] Another observed:

"Nothing in life is perfect. Some people will always find a loophole… (compliance) is dependent on how cumbersome the (traceability) program is."[13]

Others agreed:

[12] Participant 8. Interview by author. March 2020.
[13] Participant 20. Interview by author. April 2020.

"If there is a political will to enforce compliance… then things will change. There needs to be jail time or criminal charges, but right now there is none."[14]

Institution(s) in charge of the implementation process could also play a role in influencing the program outcome. The study did not seek out participants' opinion on who should be responsible for the hemp traceability initiative, but we made two noteworthy observations on that front. First, rules and regulations (as administered by Health Canada) were viewed as a type of a traceability, but it appeared that CTLS was not viewed as one. Second, even before they answered the questions associated with hemp traceability, few respondents claimed that Health Canada would refuse to participate in the process which renders the idea useless. One of them attributed their response to their previous experience with the CTLS:

"Health Canada developed this technology platform (CTLS) and asked the industry to use it without seeking any inputs (prior to implementation). Everyone absolutely hates it … it takes a lot of time to finally come around and understand the rationale…"[15]

The notion of "stakeholders' active participation" was mentioned again in this part of the survey. For the program to generate business value, study participants strongly recommended the traceability implementation team to consult extensively and avoid letting technology developers dictate the development process. One opined that: "Technology developers who are not familiar with the industry often produce a product that does not work well with the industry."[16]

6.4 Is blockchain just a paperless tiger?

[14] Participant 22. Interview by author. July 2020.
[15] Participant 1. Interview by author. February 2020.
[16] Participant 13. Interview by author. April 2020.

Study results confirmed our initial speculation that most stakeholders within the hemp industry know very little about blockchain. Most of the study participants considered blockchain as a buzzword. While the concept sounds attractive, they believed the technology is either going to be too expensive or too complicated to be relevant. One participant lamented the following when being asked about their impression towards blockchain: "Everyone is trying to use blockchain to solve some problems."[17]

Curiously, few individuals who felt they had the technical expertise to comment on blockchain were also not in favor of the use of blockchain in hemp traceability. They acknowledged blockchain has some appeals because of its potential price transparency, data automation capability, and smart contract function. However, they reckoned blockchain proponents are too obsessed with the technology and its initial promise to bother understanding the problems that needed to be solved. In food supply chains, blockchain's most compelling value is its data integrity and secure transaction channels. A blockchain-backed traceability system will therefore require a robust data standard and coordinated transactions across the supply chain. CHTA has been working on establishing both domestic and international standards for all hemp food products (ASTM International 2018), which could serve as a first step to support business-to-business traceability beyond the seed level.

In 2018, the McKinsey digital group assessed the strategic business value of blockchain to major industries. Their analysis revealed that blockchain could have a very high impact to the most industries, but feasibility to scale is an issue partly because of the difficulty in resolving the "coopetition paradox" (Carson et al. 2018; Dagnino and Padula 2002; Raza-Ullah, Bengtsson, and Kock 2014). Similarly, Behnke and Janssen (2020) also identified "having a joint platform

[17] Participant 14. Interview by author. April 2020.

and independent governance" as one of the key boundary conditions before blockchain can be used. Coordination complexity increases along with the network size, so the biggest challenge to a successful blockchain implementation is properly aligning the incentives of all the players and reaching a consensus on how the system and data will be led and managed. This view was echoed by Seebacher and Schüritz (2019), who identified compatibility of business and social structures, trust, and missing goal alignments as some of the key implementation barriers for blockchain technology. From this perspective, it seems that blockchain is merely highlighting the magnitude of an age-old organizational puzzle rather than solving it.

Given that the technology has generated a lot of hype and continues to evolve very rapidly, it is imperative to clearly articulate what the use cases are and what specific business problems the technology is looking to address (Carson et al. 2018; Seppälä 2016; Treiblmaier 2018). More critical and impartial assessments are also warranted to assess the technology's potentials and limitations (Carson et al. 2018; Treiblmaier 2018). Any industry looking to explore blockchain opportunities should find a way to bring together both industry and blockchain expertise (Seppälä 2016).

One of the key insights submitted by McKinsey Digital's team is that blockchain does not have to be a disintermediator to generate value. While this finding may encourage sector-wide adoption, one may question whether blockchain can deliver one of its initial promises – the ability to engage in a transaction without any intermediacy. Zamani and Gialis (2018) predicted a three-staged outcome when implementing decentralization-based technologies such as blockchain – disintermediation, reintermediation, and cyber-mediation. Complete disintermediation is unlikely. Instead, new types of intermediary will emerge in which traditional intermediaries transform themselves and find previously unthinkable roles to play in mediating

blockchain-based economic transactions". A group of researchers is currently evaluating the technology's disintermediation potential using several business case studies in Taiwan (Chiu and Shang 2019). Their preliminary findings suggested that intermediaries still operate in the new environment and the old system still co-exists with blockchain systems. Nevertheless, companies are still able to benefit as the technology solves some organizational issues and enhances transparency of data management (Chiu and Shang 2019). A major challenge for wider adoption continues to be the lack of public awareness and knowledge about the technology.

6.5 The path forward – chicken or egg first?

Blockchain invention is founded on the ideal that trust is to be established by decentralized consensus and code rather than a central authority and intermediaries, but a growing body of evidence signals that the technology would more likely trigger re-intermediation. The roles of traditional intermediaries may be reduced, but they will continue to operate even in a blockchain-based system. Our study participants shared similar sentiment that a technology platform will not replace their relationship with an institution – even the one with Health Canada.

How would an industry sector move along with rapid digital innovation, rising demand for transparency and quality assurance, and highly volatile market conditions? A sound governance framework seems to be the key to navigate through the muddy water. Both academic and corporate analysts suggested the development of a consortium within business sectors with the support from a regulatory body or a government institution (Behnke and Janssen 2020; Carson et al. 2018). With CSGA's technical expertise in implementing blockchain technologies in the Canadian agri-food sector, CHTA's knowledge of the hemp industry, and their good

reputations (as per this study's result), a partnership between CHTA and CSGA could be a potential path forward. Health Canada could serve as a review body to ensure records generated by the traceability program will meet regulatory requirements. Lessons learned from the tofu and craft beer traceability development projects could provide great insights, but extensive education and public awareness efforts will be the priority to ensure industry stakeholders have sufficient digital literacy to participate in the discussion. The industry needs to first identify the "pain point(s)" (Carson et al. 2018) that would require blockchain technology to tackle.

In a blockchain transformation, Zamani and Giaglis (2018) proposed that one of the new intermediary roles will be the business provider that offers blockchain as a service. The relationship dynamics will inescapably shift within a new system. From an academic research perspective, we cannot help but ponder upon these questions – How do we classify this new intermediary role? What is the trusting object when blockchain and the "blockchain service provider" are concerned? Fundamentally, blockchain is a digital ledger where transaction records are added into the system and validated using a specific consensus protocol. Once established, a blockchain system may enable a "trust-less" business environment. However, the process will involve commitment and coordinated actions from the stakeholders. In other words, a "trust-less" setting would still require trust, which "comes down to the human beings (that are) involved."[18]

[18] Participant 18. Interview by author, April 2020.

7. Conclusion and future directions

7.1 Research activities

In this thesis research, I outlined the Canadian hemp industry and illustrated the industry's current status. I also performed a literature review on food traceability and blockchain technology as an IOIS, and interorganizational governance. I learned about previous research on trust as a standalone construct, the role of trust in markets, and how trust influences technology adoption and implementation. I conducted a survey to identify the potential opportunities and obstacles that a comprehensive, industry-wide traceability system could bring to the Canadian hemp industry using the trust lens. Twenty-two individuals who have been involved in the Canadian hemp industry for more than two years were interviewed between February and July 2020. Questionnaire data was analyzed using both quantitative and qualitative approaches.

7.2 Key findings

To hemp industry stakeholders, trust is often used interchangeably with good relationship and both take time to develop. Trust remains fundamental to any business exchange and requires continuous reciprocal and mutually supportive actions over time (Powell 1990). CHTA was rated positively on all three primary relationship attributes (control mutuality, trust, and satisfaction) but CSGA fared slightly better in two of the three trust elements (dependability and competence). Many see their relationship with Health Canada to be one of "love-hate" with little reciprocity. Some participants gave a positive rating with a caveat that "the relationship is good because it has to".

There is a significant divergence of opinions when it comes to the interpretation of a "sector-wide traceability" program and very few research participants understood what the blockchain technology entails. Nevertheless, our findings showed that traceability is seen by the industry stakeholders as a tool that will provide quality information and support their marketing endeavors. Most research participants believed that a sector-wide traceability program will help foster good behavior amongst all the players in the industry, and they would be more willing to work with new companies if such a program is in place. The program also serves to enhance competency trust and monitor outputs, but it will not replace interpersonal relationships. While research participants were generally in favor of implementing a sector-wide traceability program, they cautioned that program success is highly contingent on how it is being implemented.

7.3 Study limitations and extensions

There are several limitations to this study. The study questionnaire was designed to capture participants' view on a wide range of topics. Because the questionnaire lacked specificity and only twenty-two participants participated in the study, we were unable to look for statistical significance in our data. For trust and relationship quality assessment, Hon and Grunig (1999) recommended having at least four questions for each of attributes. This will mean having twenty questions for each of the three organizations (60 questions total). Given the size of the industry (~500 registered CHTA members[19]), a more in-depth evaluation on relationship quality is not feasible.

[19] In fall 2020, CHTA administered a survey seeking for input on identifying research needs. About 10% of the members responded (personal communication).

This study focused solely on the hemp industry. We noted that some research participants felt hemp should remain a separate entity, while others believed that the separation is artificial and not conducive to future industry development. Because of the overlap between hemp and marijuana in the fractionation market, future research could expand the scope and re-examine the questions using the wider cannabis industry angle.

This study also deemed the introduction of sector-wide traceability to be one of the changes in the business environment and did not specifically seek for participants' view on the technology itself. As indicated in past literature, technology can be viewed as a trusting object or a system. Blockchain could be both at the same time. Future research can further investigate the relationship between users and blockchain from a trust perspective. One can also examine the difference between the traditional "institutional intermediary" and the emerging "technology intermediary" as offered by blockchain. Given blockchain systems share information real-time in a decentralized system, existing power and control structure is bound to be disrupted. Future research should also investigate the potential shift in power and control in a technically decentralized network. Still, a major obstacle lingers for all future blockchain research – people's unfamiliarity with the technology.

7.4 Policy Implications

This research explores the implications of a comprehensive traceability program for the existing relationships within the industry network and offers recommendations on how the Canadian hemp industry could move forward.

One could view the ambiguity associated with an "industry-wide traceability" program as a weakness of this study. However, because traceability and blockchain technologies continue to rapidly evolve, this lack of clarification will remain a major challenge for all future research endeavors. It has been noted that most research on blockchain is driven by IT specialists who focus on certain technological designs and features (Risius and Spohrer 2017; Karlsen et al. 2013). Widening the knowledge gap between developers and users will only further hinder technology uptake. It is becoming apparent that we need a multi-disciplinary approach to advance our knowledge of the potentials and implications of blockchain for the society (Risius and Spohrer 2017; Seebacher and Schüritz 2019; Treiblmaier 2018), and more importantly, how to realize these potentials.

Our research findings reinforced the recommendation from previous work that implementation projects would need to take on a community-oriented approach, rather than being spearheaded by a single business or government entity. Behnke and Janssen (2020) found that an individual's technical capability to have access to the traceability information system to be one of the boundary conditions for sharing information to improve traceability. Others have also recognized capacity and awareness limitations as key barriers in implementing effective food traceability systems (Bosona and Gebresenbet 2013). As mentioned in the previous section, specifying a use case is highly critical for accurate value identification and successful implementation (Treiblmaier 2018). To stipulate a specific use case and its value proposition would likely be a significant undertaking.

Introduction of systemic change is often met with doubt and resistance because of uncertainty and our risk averse nature. Reaching a consensus to move forward will therefore require more than just listing benefits to the sector as a whole under the most optimistic scenario,

especially when it comes to introduction of an unfamiliar technology. This study adopted a more inclusive approach and examined the individual components within the system. By illustrating some of the nuances within the industry network and challenges that will be faced by the individual industry actors, this study highlighted the need to actively engage industry stakeholders on the communication and governance aspects of the technology either before or as an integral part of the technology implementation. Implementing a comprehensive traceability system, blockchain or otherwise, will require an awareness and knowledge generation strategy in place. Sector-wide consultation is still a feasible option for a niche crop like hemp; stakeholders' active participation throughout the development process would work to build trust in both the technology and the business environment. For the near term, tougher sanctions could be useful in reducing opportunistic behaviors in the fractionation market. If the industry decides to proceed with a sector-wide traceability system, engaging experts in the fields of interorganizational governance and management science would facilitate stakeholder engagement and address co-ordination issues. A trust and reputation system, similar to the one on the Airbnb platform could be incorporated in the traceability system to uphold the normative control within this rapidly evolving industry network. Ultimately, a better understanding of relationship dynamics and trust levels within the supply chain will help inform the design process, which will affect the efficiency, effectiveness, and scalability of the technology. As well, better linkages between different motivations could support reducing coordination failure during the technology development and implementation stages.

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Appendix A. Study Questionnaire

1. Current relationship dynamics

Please think of your overall impression with the following organizations when answering the following questions,

[CHTA – Canadian Hemp Trade Alliance; CSGA – Canadian Seed Grower Association]

Do you know about this organization?	Health Canada	
	CHTA	
	CSGA	
Do you think you have a relationship with this organization? If the answer is yes, what are the first things that come to your mind?	Health Canada	
	CHTA	
	CSGA	
[control mutuality] I think I have control over (organization) when it comes to making decisions that will affect me	Health Canada	1 to 5 scale (1 – Completely disagree; 5 Completely agree)
	CHTA	
	CSGA	
[control mutuality - reverse] I think (organization) will not cooperate with people like me	Health Canada	
	CHTA	
	CSGA	
[trust – integrity] I think (organization) is fair and just when it comes to performing its function	Health Canada	
	CHTA	
	CSGA	
[trust – integrity] I think (organization) take opinions of people like me when it comes to making important decisions	Health Canada	
	CHTA	
	CSGA	
[trust – dependability] I can rely on (organization) to keep its promises to the people they serve	Health Canada	
	CHTA	
	CSGA	
[trust – dependability, reverse] I think it is important to watch (organization) closely so	Health Canada	
	CHTA	
	CSGA	

that it does not take advantage of people like me		
[trust – competence] I am confident that (organization) has the ability to accomplish what it says it will do	Health Canada	
	CHTA	
	CSGA	
[Satisfaction] I value the relationship I have with (organization) right now	Health Canada	
	CHTA	
	CSGA	
[Satisfaction - reverse] I believe nothing of value has been accomplished between (organization) and people like me and I would rather work with some other groups if I have the choice	Health Canada	
	CHTA	
	CSGA	

Please think of the hemp industry as it stands at the moment when answering the following questions,

I believe people like me have influence on how decisions are made within the sector these days What makes you think that way?	1 to 5 scale (1 – Completely disagree; 5 Completely agree)
I believe the current systems and regulations will help my business grow and prosper Why or why not?	
Overall, I am optimistic about the future of the industry even if we keep business as usual	

2. Traceability technology for the industry

Have you heard about traceability?	
Can you identify a traceability program you know of or have experience with?	
If yes, what are the first things that came to your mind?	

Are you familiar with the technologies that are involved in managing a traceability program?	1 to 5 scale (1 – Not at all; 5 – Proficient)

Imagine an industry-wide traceability program is in place for the hemp industry,

[trust – integrity] A traceability program will make sure (organization) to be more attentive to opinions from people like me when it comes to making important decisions	Health Canada	(1 – Completely disagree; 5 – Completely agree)
	CHTA	
	CSGA	
[trust – dependability] It will make sure (organization) keep its promises to the people they serve	Health Canada	
	CHTA	
	CSGA	
[control mutuality] I think (organization) will cooperate better with people like me if such a program is in place	Health Canada	
	CTHA	
	CSGA	
[satisfaction – reverse] It will simply replace the relationship I have with (organization) since the program will provide more value to people like me	Health Canada	
	CHTA	
	CSGA	

Please think of the hemp industry as a whole when answering the following questions,

I believe that a traceability program will help foster good behavior amongst the players of the industry How so?	1 to 5 scale (1 – Completely disagree; 5 Completely agree)
I think I would be more willing to work with a new company that I know little about if a traceability program is in place Why or why not?	
I think I will have more influence on the decision-making process at the industry level with the program	

What makes you think that way?	
I think the program is critical in supporting the growth of the industry as a whole Why?	1 to 5 scale (1 – Completely disagree; 5 Completely agree)

3. Wrap up questions

- In your opinion, does trust play a role in how you handle business relationships? How/why?

- Do you know about the Seed Synergy Canada Initiative? What do you know about it?

- Have you heard of the “blockchain” technology?

- What are the first things come into mind? Do you have any opinions on whether it might be useful in your part of the Agri-food industry?

- Do you think there should be better distinction (or separation) between hemp and marijuana?

- Do you have any other comments you would like to provide?

Appendix B. Recruitment Email and Consent Form

Recruitment Email

Dear (Name of participant),

Hope this email finds you well. My name is Crystal Chan and I am conducting a Master of Public Policy thesis research under the supervision of Dr. Peter Phillips at the University of Saskatchewan.

For my thesis research, I seek to examine the potential opportunities and obstacles facing the Canadian industrial hemp industry as the demand for a sector-wide traceability system grows along with the industry transformation. I would like to gain a better understanding of the current perception towards some of the major stakeholders within the hemp sector. Considering your position and experience, I would like to ask you to kindly participate in a 45- to 60-minute phone interview with me.

Participation in the interview is voluntary, and you can decide to withdraw at any time during the interview process by informing me that you no longer wish to proceed. You can also decline to answer any specific questions that you are uncomfortable with.

All information you provide is considered completely confidential. Your name will not appear in any report and publication resulting from this study. With your permission, anonymous quotations may be used in the reports and publications. Study participants will be referred as participant 001, 002, and so on. The interviews will be anonymized and stripped of your identity. For instance, we will not disclose your employer's name. No one outside of the research team will have access to your interview response. You will not be able to be identified in any way. Study findings, containing only the aggregated, analyzed data, will be released in the public domain.

Thank you very much for your kind consideration. Please let me know if you are interested in having this conversation and we could set up a time that would work best for your schedule. Please do not hesitate to contact me for any questions you may have.

Sincerely,

Crystal Chan

Consent Form

Hello, my name is Crystal Chan. I have recently contacted you via email about a phone interview regarding the Canadian industry hemp sector and thank you for taking the time to talk to me today.

[If necessary, remind the interviewee the nature of the conversation:

I am conducting a Master of Public Policy thesis research under the supervision of Dr. Peter Phillips at the University of Saskatchewan. For my thesis research, I would like to gain a better understanding of the current perception towards some of the major stakeholders within the industrial hemp sector.]

First, I would like to let you know that I will turn the recorder on, and then I am going to read to you the Consent form as follows:

Participation in the interview is voluntary, and you can decide to withdraw at any time during the interview process by informing me that you no longer wish to proceed. You can also decline to answer any specific questions that you are uncomfortable with.

All information you provide is considered completely confidential. Your name will not appear in any report and publication resulting from this study. With your permission, anonymous quotations may be used in the reports and publications. Study participants will be referred as participant 001, 002, and so on. The interviews will be anonymized and stripped of your identity. For instance, we will not disclose your employer's name. No one outside of the research team will have access to your interview response. You will not be able to be identified in any way. Study findings, containing only the aggregated, analyzed data, will be released in the public domain.

Can I have your consent to participate in this interview?

If applicable, do you give us permission to use anonymous quotations from your statements?

Appendix C. Survey Data

[Control Mutuality] I think I have control over (organization) when it comes to making decisions that will affect me

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	18%	0%	36%	32%	14%	0%
CSGA	36%	14%	27%	5%	5%	14%
Health Canada	68%	23%	5%	5%	0%	0%

[Control mutuality - reverse] I think (organization) will not cooperate with people like me

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	68%	23%	9%	0%	0%	0%
CSGA	36%	41%	5%	0%	0%	18%
Health Canada	27%	27%	18%	18%	9%	0%

[Trust – Integrity] I think (organization) is fair and just when it comes to performing its function

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	0%	5%	9%	32%	45%	9%
CSGA	0%	5%	9%	32%	36%	18%
Health Canada	9%	18%	9%	27%	36%	0%

[Trust – Integrity] I think (organization) take opinions of people like me when it comes to making important decisions

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	5%	9%	0%	36%	45%	5%
CSGA	0%	5%	9%	32%	36%	18%
Health Canada	14%	27%	23%	32%	5%	0%

[Trust – Dependability] I can rely on (organization) to keep its promises to the people they serve

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	0%	5%	18%	36%	41%	0%
CSGA	0%	0%	14%	32%	32%	23%
Health Canada	14%	9%	27%	18%	27%	5%

[Trust – Dependability, reverse] I think it is important to watch (organization) closely so that it does not take advantage of people like me

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	45%	14%	9%	9%	23%	0%
CSGA	45%	9%	14%	0%	14%	18%
Health Canada	36%	14%	0%	18%	32%	0%

[Trust – Competence] I am confident that (organization) has the ability to accomplish what it says it will do

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	0%	9%	32%	32%	23%	5%
CSGA	0%	5%	9%	55%	14%	18%
Health Canada	18%	14%	18%	27%	18%	5%

[Satisfaction] I value the relationship I have with (organization) right now

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	5%	5%	5%	32%	55%	0%
CSGA	0%	0%	14%	23%	36%	27%
Health Canada	14%	18%	5%	32%	32%	0%

[Satisfaction - reverse] I believe nothing of value has been accomplished between (organization) and people like me and I would rather work with some other groups if I have the choice

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	73%	18%	5%	0%	5%	0%
CSGA	50%	18%	0%	0%	5%	27%
Health Canada	45%	18%	9%	9%	18%	0%

I believe people like me have influence on how decisions are made within the sector these days

Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
5%	5%	23%	45%	23%

I believe the current systems and regulations will help my business grow and prosper

Yes	No	Neutral	No Answer
36%	36%	27%	0%

Overall, I am optimistic about the future of the industry even if we keep business as usual

Yes	No	Neutral	No Answer
73%	5%	23%	0%

Are you familiar with the technologies that are involved in managing a traceability program?

Not at all	Basic	Moderate	Familiar	Very familiar
14%	18%	18%	18%	32%

[Trust – Integrity] A traceability program will make sure (organization) to be more attentive to opinions from people like me when it comes to making important decisions

	1 (Completely disagree)	2	3	4	5 (Completely agree)	No answer
CHTA	14%	9%	9%	18%	32%	18%
CSGA	14%	9%	18%	9%	14%	36%
Health Canada	20%	15%	15%	15%	25%	20%

[Trust – Dependability] It will make sure (organization) keep its promises to the people they serve

	1 (Completely disagree)	2	3	4	5 (Completely agree)	No answer
CHTA	27%	5%	14%	18%	23%	14%
CSGA	18%	5%	9%	9%	32%	27%
Health Canada	27%	0%	9%	27%	23%	14%

[Control Mutuality] I think (organization) will cooperate better with people like me if such a program is in place

	1 (Completely disagree)	2	3	4	5 (Completely agree)	No answer
CHTA	32%	5%	14%	9%	23%	18%
CSGA	27%	0%	18%	5%	18%	32%
Health Canada	32%	0%	18%	23%	9%	18%

[Satisfaction – reverse] It will simply replace the relationship I have with (organization) since the program will provide more value to people like me

	1 (Completely disagree)	**2**	**3**	**4**	**5 (Completely agree)**	**No answer**
CHTA	45%	18%	5%	0%	5%	27%
CSGA	36%	9%	9%	0%	5%	41%
Health Canada	41%	14%	5%	9%	9%	23%

I believe that a traceability program will help foster good behavior amongst the players of the industry

Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
0%	14%	18%	23%	45%

I think I would be more willing to work with a new company that I know little about if a traceability program is in place

Yes	**No**	**Neutral**	**No Answer**
68%	14%	14%	5%

I think I will have more influence on the decision-making process at the industry level with the program

Yes	**No**	**Neutral**	**No Answer**
32%	50%	9%	9%

I think the program is critical in supporting the growth of the industry as a whole

Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
5%	9%	18%	32%	36%