Executive Master in Customs and Supply Chain Compliance

Voluntary Information Sharing to Customs: A Case Study in China Customs

Author : Xin Zhou

Email : zhouxin@shcc.edu.cn

First Supervisors: Prof. Yao-Hua Tan

Second Supervisor: Dr. Boriana Rukanova

Rotterdam School of Management

Erasmus University

2020

Preface

I knew this program would be a challenge when I applied for it three years ago. It would be hard to balance work, study, and family. It would tough to fly from Shanghai to Rotterdam for eleven times, which was equivalent to two and a half circles around the earth. However, the program was so appealing to me like a magnet because the combination of its three pillars, customs regulations, supply chain management, and IT-based compliance, perfectly matched my background.

Three years later, I have reached the set goal of study. In the process of writing the thesis, I am very grateful to my two supervisors Prof. Yao-Hua Tan and Dr. Boriana Rukanova, for their great efforts and time on my thesis. They gave me plenty of constructive and detailed comments and shared lots of literature relevant. I was so impressed by their professionalism and academic rigor. The more communication with the supervisors, the more common research interest I found we had. It was a delightful research experience. Besides, I would also thank the experts from China Customs and the companies interviewed, who contributed to the case description of the thesis. Their opinions were extremely valuable for this research.

It's also lovely to meet all the interesting classmates from different countries. In the past three years, I have experienced the differences in cultures and ways of thinking between the East and the West countries. It make me fully aware of the importance of mutual respect, understanding, and communication.

The Netherlands is a charming country which perfectly combines the beauty of modern high technology and traditional scenery. I like the people in this country who are open-minded, pragmatic and friendly. Although the study time in the Erasmus campus was concise, it would be my fond memories.

Executive Summary

The development of digital technology and its implementation in international trade has led customs administrations to seek to improve their analytics capabilities with additional data and advance commercial information. However, because of the fragmentation of supply chain information, customs do not receive complete, accurate, and timely descriptions of the goods from the mandated declarations. To improve global supply chain visibility, customs have explored different approaches to promoting business and government information-sharing, such as data pipeline innovations. Several regional customs in China initiated business–government data cooperation projects to encourage the private sectors to voluntarily share extra commercial data, thereby enabling the integration of trade data from multiple sources. The private participants were also expected to benefit from this cooperation.

This study analysed an exploratory case study on two projects, the Cross-Border Trading platform and the Global Quality Traceability System (GQTS), to investigate how business–government data cooperation can be achieved. The research question were *as follows:* (1) *How is voluntary information-sharing to customs achieved* and (2) *What are the sources of value for the business and customs?* The following sub-questions were also investigated to further clarify the first research question: *What to share? How to share? Why share?*

To address these questions and reveal the sources of public interests, project group members in the regional customs and private participants in the two projects were interviewed. The objectives of the Cross-Border Trading platform were to integrate the logistics and trade information from the ERP system of the local companies involved before the mandated declarations to prevent security and fiscal risks and facilitate trade. The objectives of the GQTS were to integrate and share quality proofing information, such as production information, trade information, certificates, and customer feedback, to prevent quality risks and the distribution of counterfeit products. Although the objectives and architectures of these cases varied, businesses shared more commercial data than required by the current customs declaration. The framework was borrowed from digital trade infrastructures, and the characteristics of the two cases were compared in the dimensions of architecture, process, and governance.

This study found that the information shared voluntarily beyond the scope of the mandatory declaration and the business-to-government (B2G) IT connection methods were explored in each case. Stakeholder analyses were used to identify the main benefits for customs and the private sectors that participated in the projects. This study demonstrated that the sources of public value are associated with supply chain visibility. However, the data interactions were not limited to B2G and G2B. The B2B, G2B, C2B, and C2G information-sharing also contributed to the improvement of supply chain visibility and generation of public value. In these two government-driven projects, the government provided the platform and enabled information exchange among private sectors. The government achieved its objective by integrating the fragmented information from different sectors to enhance the monitoring of risk management. The private participants who shared information contributed to the supply chain visibility and in turn benefitted from it. Supply chain visibility is the common interest of both the public and private sectors. The values for the business were determined to be improved compliance, reduced

cross-border delays, and optimized supply chain operation. These voluntary information-sharing initiatives enhanced customs' data quality and improved the performance of risk management.

To facilitate trade, customs can do more than shortening the release time because supply chain visibility is the primary source of public value. Both customs and businesses can search for other benefits of data cooperation. To fully utilize the extra commercial information, customs must integrate the internal and external multisource data to improve risk assessment and facilitate trade. Moreover, designing a more adaptable IT platform with flexibility and scalability is beneficial in attracting more private participants and maximizing the created public value.

The main contribution to of this thesis can be summarised as follows: (a) this case study demonstrated that data pipelines could be government-driven, which contradicts the previous assumption that they had to be business-driven; (b) more business incentives were identified than for logistics optimization; (c) the second case indicated that the data pipeline could be extended to the final customers, whose feedback was another critical information source; (d) the role of coordinated border management in the data pipeline was emphasized in the second case; (e) in the first case, forwarding the information of supply chain partners to customs using local companies presents an alternative approach to "obtaining data from the source" without establishing the international data pipeline.

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Chapter 1 Introduction

1.1 Background

The development of digital technology and its implementation in international trade has led customs administrations to seek to improve their analytics capabilities with additional data and advance commercial information. Data analysis plays an increasingly crucial role in effective border management. Customs administrations collect information and data for risk analysis through three primary sources: (a) supply chain actors that provide information regarding the shipments before, during, or after the physical flow crosses customs borders; (b) information from other authorities; and (c) external sources (i.e., third-party sources; Hintsa, Männistö, Urciuoli, & Ahokas, 2012). Currently, the primary data sources are supply chain actors. Supply chain actors (i.e., exporters, importers, and carriers) are obligated by law to submit data to customs administrations regarding exports, transits, and imports as part of advance cargo information schemes and actual customs declarations.

The data held by customs should be complete, reliable, accurate, detailed, and timely to "fit for the use" (Wang & Strong, 1996). However, in reality, customs hold enterprise declarations whereby importers are accountable for goods they have probably never seen, and the declarations are often outsourced to the freight forwarder or brokers. International conventions cover the transport of goods between the seller and buyer. However, these conventions concentrate more on limiting liabilities than on ensuring the accurate description of the goods (Hesketh, 2010). These factors inevitably lead to inaccurate data in cargo declarations. Because of the fragmentation of supply chain information, customs do not receive all the supply chain information; for example, logistics information such as the vessel or aircraft details is owned by the carrier, the trade transaction information is owned by the buyer (consignee) and the seller (consignor), and the payment information is owned by the banks (Hu, Tan, & Heijmann, 2016). Customs only receive partial information regarding their transactions and international movements instead of complete trade data.

If more data were available for customs administrations, different categories of data could be combined and correlated, allowing the identification of trends and patterns in the subjects of control (i.e., cargoes, conveyances, and people), and the accuracy of data in question can be ascertained and verified (Okazaki, 2017). Therefore, customs authorities have sought to expand the external data sources and add data to the current pool to piece together a complete and accurate description of the goods and supply chain operators involved. For example, customs could purchase commercial databases and exchange data between customs administrations and other agencies nationally.

Another approach is enriching the supply chain data and "obtaining data from the source" (Hesketh, 2010), whereby customs could use trade data to cross-validate the accuracy of import and export declarations. However, this method inevitably adds to the administrative burden of traders because of the increase in mandatory fields and documents that must be submitted to customs. The revised Kyoto Convention stated that *"the customs shall limit the data required in the goods declaration to only such particulars as are deemed necessary for the assessment and collection of duties and taxes, the compilation of statistics, and the application of customs laws"* (General Annex Standard 3.12, RKC**).** In

response, the WCO developed a Data Model, which contains a collection of carefully selected standardized items of information to meet the operational and legal requirements of cross-border regulatory agencies that are responsible for border management, such as customs[1].

Therefore, customs have explored different approaches to encourage companies to share more commercial data voluntarily, such as the FloraHolland case (Rukanova et al., 2020) and the TradeLens digital platform.

The FloraHolland case focused on the import of flowers from Kenya to the Netherlands. FloraHolland is a cooperative of growers, which aimed to improve the logistic processes for importing flowers from Kenya to the Netherlands by collaborating with the authorities. FloraHolland and the supply chain partners voluntarily shared additional business information (e.g., Proforma invoice, packing list) with the authorities in the Netherlands. Customs in the Netherlands used this information to cross-validate the customs declarations and perform more efficient risk assessments for fiscal and safety and security purposes. Therefore, trade was facilitated for FloraHolland and its members so long as business information was shared voluntarily to address public concerns related to safety and security, fiscal compliance, and trade facilitation (Susha, Rukanova, Gil-Garcia, Tan, & Gasco, 2019).

TradeLens is a global supply chain platform that enables information-sharing and collaboration among all parties, including shippers, freight forwarders, ports and terminals, ocean carriers, government authorities, and customs brokers. TradeLens attracted attention because it uses the IBM Blockchain Platform based on Hyperledger Fabric. TradeLens provides a real-time data exchanging mechanism for all private parties in the supply chain and enables the customs involved in the shipment to access the data and shipping documents. Therefore, all the private parties in the platform voluntarily share their original data and shipping documents to the customs of importing and exporting countries. Customs can reuse these trade data for risk management purposes, and in return, the customs display the status of the goods on the platform and facilitate the trade.

China customs has also launched pilot projects to integrate various trade data in the supply chain, such as the Cross-Border Trading platform and the Global Quality Traceability System (GQTS).

The Cross-Border Trading platform is a pilot project initiated by Shanghai customs in partnership with COSCO Shipping and Shanghai Port. This platform acts as an information hub that enables data integration from the trade, customs, and other government agencies. Private sectors that joined the platform voluntarily transferred commercial data, such as ERP data from import and export enterprises, shipping routes, and ship location data from the carriers. These data help the customs collect more accurate and complete data for risk management in supply chain security, and customs provide trade facilitation for traders in the process of customs clearance and with the logistics in the terminal.

The GQTS was piloted in Guangzhou and Fuzhou. To solve the problem of counterfeit goods imported through cross-border e-commerce, different parties in the global supply chain such as suppliers, retailers, logistics providers, and third-party quality inspection institutions that join the system voluntarily share any additional information to prove the quality of their product. When the goods

[1] http://www.wcoomd.org/en/topics/facilitation/instrument-and-tools/tools/data-model.aspx

arrive at the port, customs create risk profiles based on this information. GQTS also provides a public service for the customer to trace the information of import product quality, logistics, and clearance through QR code scanning.

These pilot cases in Europe and China serve different purposes. The scope and content of the data voluntarily shared by the private sectors vary by case. However, all these cases rely on private companies voluntarily sharing data with customs. All of these private companies are involved in data cross-boundary exchange and thus may have common obstacles and barriers to overcome. Contrary to the FloraHolland case and the TradeLens digital platform, which were initiated by the private sector, China customs led the aforementioned pilot projects in China. Governments are involved in several aspects of the mechanism of public value creation.

1.2 Purpose and structure of the thesis

The FloraHolland case and TradeLens digital platform have been studied extensively in the literature. The similarities and differences and differences have been observed. The present study is an exploratory case study of the Cross-Border Trading platform and GQTS in China. The purposes and drivers of voluntary information-sharing to customs were investigated and the mechanisms underlying public value creation through their voluntary information-sharing processes were explored.

The remainder of this thesis is structured as follows: In Chapter 2, the problem context is introduced. In Chapter 3, the related literature and theoretical background are reviewed. In Chapter 4, the research methodology is explained. The background of the two cases are described in Chapter 5. How voluntary information sharing to customs achieved is presented in Chapter 6. The value for the business and government are discussed in Chapter 7.The thesis ends with conclusions, recommendations, and the contributions and limitations in the last chapter.

Chapter 2 Problem Definition

2.1 Goals of business and government

To achieve trade security and facilitation, customs authorities must be aware of the data quality problems of the data at their disposal and seek the original trade data to cross-validate the information from declarations.

However, businesses do not have the same goals as that of the government. They face pressure to control costs and generate more revenue. Furthermore, they are legally obligated to comply with all applicable laws and regulations of the country, or countries, in which they conduct business. Therefore, businesses can benefit from voluntarily exchanging information with their supply chain partners to manage and optimize their global supply chain operation, and they are legally required to submit declarations and documents to border control agencies. However, the commercial interest in launching extra business-to-government (B2G) information-sharing is not apparent.

2.2 AEO and Business-to-Government voluntarily information-sharing

In current customs and business partnership programs, such as Authorized Economic Operator (AEO) or Customs-Trade Partnership Against Terrorism (C-TPAT), which are the most influential worldwide, a collaborative relationship is established between government and private sectors. To apply for the status of AEO or C-TPAT, private sectors must prove their reasonable internal control and meet certain criteria, such as customs compliance and appropriate record-keeping. The AEO conditions and criteria are summarised in Table 1. AEO for Customs Simplification (AEOC) and AEO for Security and Safety (AEOS) are two types of authorisations offering different benefits (E.U. TAXUD, 2016).

Table 1. Summary of the AEO conditions and criteria.

Authorised Economic Operator (AEO)

Conditions and criteria	AEOC	AEOS	Reference UCC/UCC IA	Guidelines Part
Economic Operator	X	X	Art. 5 (5) UCC	1.II.1
Established in the Customs Territory of the Union	X	X	Art. 5 (31) UCC	1.II.2
Compliance	X	X	Art. 39 a) UCC Art. 24 UCC IA	2.I
Appropriate Record Keeping	X	X	Art. 39 b) UCC Art. 25 UCC IA	2.II
Financial Solvency	X	X	Art. 39 c) UCC Art. 26 UCC IA	2.III
Practical Standards of Competence and Professional Qualification	X		Art. 39 d) UCC Art. 27 UCC IA	2.IV
Security & Safety		X	Art. 39 e) UCC Art. 28 UCC IA	2.V

Source : Authorised economic operators guidelines(E.U. TAXUD,2016)

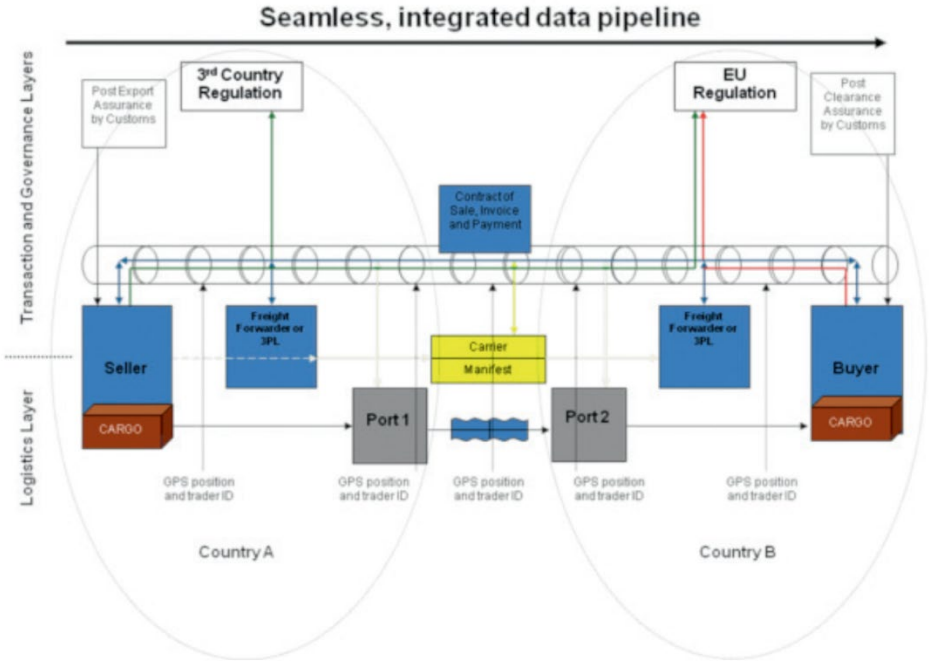
Some countries have expectations regarding the voluntary information-sharing of AEO applicants. For instance, the Dutch TCA expects AEO applicant companies to employ IT in two major capacities to eliminate risks: (1) real-time monitoring, whereby IT is used to continuously monitor the location and

state of the cargo and (2) information-sharing, whereby the Dutch TCA (possible) has direct access to the database of the owner and the carrier, to read the stored data regarding the container and relevant commercial information by using a service-oriented architecture (den Butter, Liu, & Tan, 2012). However, voluntary information-sharing with customs is not currently necessary for AEO or C-TPAT status worldwide.

2.3 Data pipeline and business-to-government voluntarily information-sharing

The data pipeline concept is an IT innovation that enables capturing data at the source. The data pipeline consists of various data sources and information systems available in the supply chain, which results in the availability of source data the moment it is available to the providing party, as illustrated in Figure 1.

Figure 1. Seamless, integrated data pipeline.



Source: Hesketh (*2010*)

Contrary to the business-to-business (B2B) global supply chain digital trade infrastructure, the nature of the data pipeline is both B2B and B2G. The data pipeline is intended to increase legal compliance and minimize safety, security, and commercial risks to improve the effectiveness and efficiency of both business and government operations. Enterprises have no current legal obligations to allow customs access to their commercial supply chain information-sharing platform. To implement the data pipeline concept, voluntary information-sharing between enterprises and customs is indispensable.

However, the data pipeline implies that data travels upstream at the point where goods are packed for transport to the buyer. B2G voluntary information-sharing to customs does not have to be performed through an international data pipeline. Local enterprises could also share information with local customs.

The Cross-Border Trading platform belongs to the regional hub, whereas the GQTS is a data pipeline.

2.4 Research question

Certain cases have explored the possibility of enterprises voluntarily sharing data with customs, such as the FloraHolland case, the TradeLens digital platform in the E.U., and the pilot project in China. China and E.U. customs both explored B2G information-sharing schemes to encourage enterprises to share information voluntarily, which suggests a common need for high-quality data. This approach could be adopted in future cooperation between customs and businesses. However, aligning the goals of businesses and government and building private-public partnerships remain challenging.

Based on the two cases in China, the research questions were as follows:

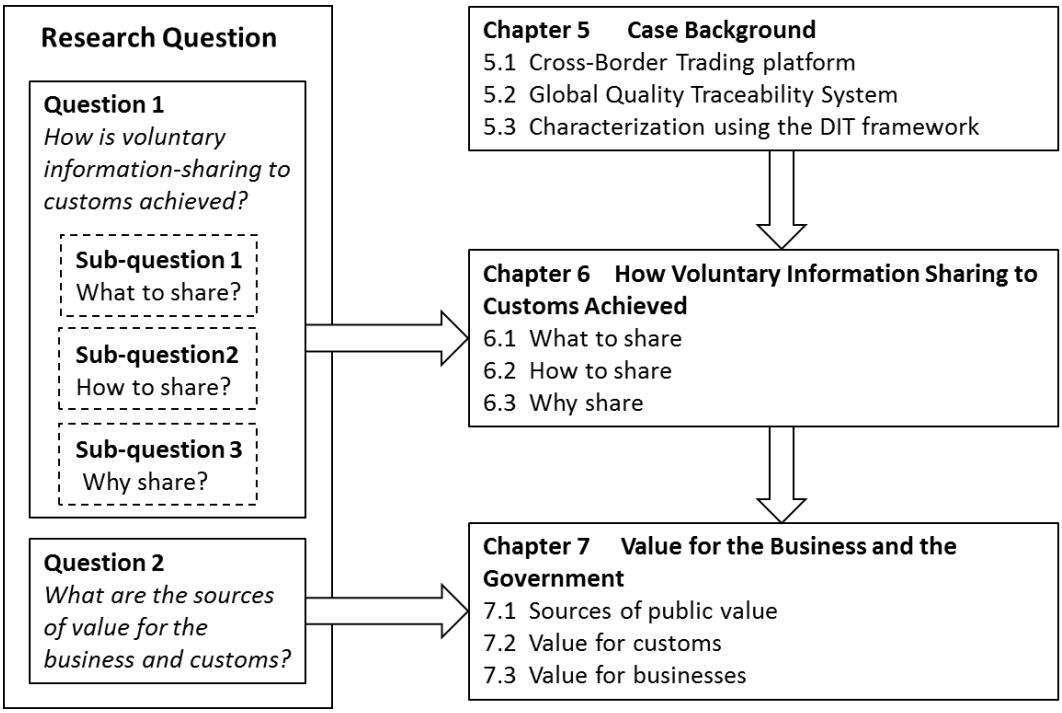
1. *How is voluntary information-sharing to customs achieved?*
2. *What are the sources of value for the business and customs?*

With the first research question of *how is voluntary information-sharing to customs achieved*, there are three sub-questions. The sub-questions and research objectives are as follows

3. *What to share?* The types of data that are shared voluntarily beyond the scope of the mandatory declaration were investigated.
4. *How to share?* The IT architecture was demonstrated and different approaches through which customs platforms connected to the business IT system were investigated.
5. *Why share?* The expected benefits for different stakeholders and the remaining obstacles that affect business' willingness were identified.

The research roadmap is presented in Figure 2, which illustrates how the research questions are answered in Chapters 6 and 7. In Chapter 6, the answer, the sub-questions of "What to share" "How to share," and "Why share" are addressed, which explained the first main research question "How voluntary information-sharing to customs can be achieved." The sources of value for the business and customs are summarised in Chapter 7 to address the second research question.

Figure 2. Roadmap of the thesis.



Chapter 3 Literature Review

3.1 Cross-boundary information-sharing

Cross-boundary information-sharing is defined as the collaboration or interconnection of different information systems or telecommunication technologies to share data between entities (e.g., groups, departments, and organizations) by using a common conceptual schema (Barki and Pinsonnault, 2005). From a technical perspective, cross-boundary information-sharing is supported by various types of interorganizational systems (IOS), such as business-to-business (B2B), government-to-government (G2G), or government-to-business (G2B). Studies on cross-boundary information-sharing are mostly related to public sectors, such as e-Government (Lee, Kim, & Ahn, 2011; Navarrete, Gil-Garcia, Mellouli, Pardo, & Scholl, 2010). Yang, Zheng, and Pardo (2012) identified boundaries as being hierarchical, departmental, personal, geographical, developmental, procedural, or sectoral and concluded that "boundaries" have vertical and horizontal dimensions.

Moreover, information-sharing between businesses and the government plays a vital role in creating public value. Transforming B2G information exchange is the next frontier in reducing government spending while improving performance (Bharosa et al., 2013). However, the willingness of the business is a determinant factor if they are not obligated to share. Although information-sharing between businesses and government agencies is critical, businesses are often reluctant to share information. Connectivity and willingness are defined as two dimensions of information-sharing (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007). The use of business rules that provide businesses with control over their data is recommended to increase willingness (Engelenburg, Janssen, & Klievink, 2015). Furthermore, adopting a partnership–data process perspective is also suggested to increase partners' willingness to share information (Du, Lai, Cheung, & Cui, 2012). To create public value, the data sharing between the public and private sectors is defined as "data collaboratives" (Verhulst & Sangokoya, 2015), which underlines a new public–private partnership, referred to as "data-driven social partnerships"(Ojha, Sahin, Shockley, & Sridharan, 2019; Susha, Grönlund, & Van Tulder, 2019).

However, difficulties in information crossing boundaries are also observed. Studies have investigated the factors of boundaries that hinder information crossing. Yang and Maxwell (2011) categorized the factors affecting interorganizational information-sharing in the public sector based on three perspectives: the organizational and managerial, technological, and political and policy. Similarly, Yang and Wu (2014) reviewed the complexity of cross-boundary information-sharing and concluded that the determinants were legislation and policy, organizational factors, and technological factors. Technology and data are essential factors in effective cross-boundary information and service integration because different IT capabilities can present a challenge for information-sharing (Chen & Lee, 2017). Different data formats and system incompatibilities are the main obstacles. The variety of data definitions and formats present significant challenges for creating a meaningful and personalized view of disparate data from various organizations (Comfort, 2007). The cost and complexity of implementing advanced systems and system incompatibility are among the main barriers to optimal information-sharing (Fawcett et al., 2007).

Despite these difficulties, studies have emphasized the importance of trust and trust-building for cross-

boundary information-sharing initiatives. Building trust among key participants is considered a crucial antecedent to establishing successful information-sharing (Gil-Garcia, Guler, Pardo, & Burke, 2010). Furthermore, both information-sharing and information quality were determined to be positively influenced by trust in supply chain partners (Li & Lin, 2006).

3.2 Supply chain visibility

Information-sharing between supply chain members can coordinate orders and reduce the bullwhip effect (Lee, Padmanabhan, & Whang, 1997). However, the challenge of sharing information in the global supply chain increases when customers and suppliers are spread throughout the world (Shore, 2001). One member of a supply chain may not have detailed knowledge of processes in other parts of the chain (Christopher & Lee, 2004). This lack of visibility increases the vulnerability of supply chains to disturbance or disruption. In the literature, the topic of supply chain visibility has received increasing attention (Caridi, Moretto, Perego, & Tumino, 2014; Ouyang, 2007).

The importance and benefits of supply chain visibility have also been demonstrated by researchers and practitioners. Supply chain visibility is considered crucial for collaboration across organizational boundaries and essential to the competitiveness of the supply network (Bartlett, Julien, & Baines, 2007). Williams, Roh, Tokar, & Swink (2013) demonstrated that increased visibility could increase responsiveness in the global supply chain. Zhang, Goh, & Meng (2011) reported that global logistics operators benefitted from the visibility of the end-to-end supply chain. Pradhan & Routroy (2018) demonstrated that enhancing visibility by establishing a collaborative relationship with suppliers improved supply chain performance.

However, problems with information transparency remain severe in the extended supply chain (Steinfield, Markus, & Wigand, 2014). To solve these problems and achieve the aforementioned benefits, researchers have employed different approaches to increasing supply chain visibility. Tracking and tracing systems, such as RFID, are widely used to provide end-to-end visibility in the supply chain (Musa, Gunasekaran, & Yusuf, 2014). Zhou (2009) demonstrated that the implementation of RFID enhanced supply chain visibility with item-level product information. With the support of IT infrastructures, Humphreys, Lai, and Sculli (2001) claimed that the competitive advantage created by an interorganizational information system (IOIS) can extend beyond the focal firm and that the upstream and downstream firms can also benefit from an IOIS in the global supply chain context.

Governments are involved in policymaking, policy implementation, monitoring, and control of international trade. Therefore, the governments, especially the border control agencies, also require supply chain visibility to improve decision-making. After the terrorist attacks of 9/11, the US government initiated a global trade system, Trade Data Exchange, which created a continuous cargo visibility and integrity network and connected importers and exporters, carriers, freight forwarders, brokers, financial institutions, and governments along the supply chain (Kothmann, 2007). Marcel, Van Oosterhout, and Veenstra (2007) recommended that supply chain parties connect chain-wide visibility platforms at ports and integrate local information from supply chain actors, port community systems, nuclear detection infrastructure, and authority systems to enhance supply chain security for maritime container transport.

The E.U., U.K., and Dutch customs have jointly developed the concept of a "data pipeline." The seamless, integrated, web-based data pipeline is designed to capture consignment and people data from upstream, as the goods move along the supply chain, thereby reducing the information fragmentation in global trade (Hesketh, 2009; 2010). This concept has attracted the attention of both academics and customs authorities. Various approaches have explored the implementation of data pipelines. The WCO also highlights this concept because it contributes to protecting and securing the global supply chain (WCO, 2018). For instance, Hulstijn, Overbeek, Aldewereld, and Christiaanse (2012) discussed control measures to ensure the integrity of supply chain information and the related flow of goods to ensure the integrity of the virtual data pipeline. In practice, the E.U. 7th Framework Program project CASSANDRA (Common Assessment and Analysis of Risk in Global Supply Chains) aimed to introduce a data pipeline for the exchange of required information along the entire supply chain, which claims to enable open, flexible, and standardized communication among all partners (Ahokas et al., 2012). Moreover, the joint efforts of business and customs are emphasized in building data pipelines because both the businesses and the government can benefit from increasing the visibility of the global supply chain (Klievink et al., 2012). Moreover, the difficulties in multinational information-sharing warrant attention. Influential factors include cross-border factors (e.g., market forces and trade flows), policy activities at multiple levels of governments, the political clout of borderland communities, and the culture of borderland communities (Navarrete et al., 2010).

These initiatives can be categorized as digital trade infrastructures (DTI), which comprise digital infrastructures applied in international trade domains that are used for information-sharing among all parties involved and thus reduce information fragmentation. To further understand the challenges faced by the DTI initiatives and how these can be overcome, Rukanova et al. (2018) proposed a DTI framework that could be applied in business and government interfaces, composed of three dimensions (i.e., architecture, process, and governance) with further specified categories, as illustrated in Table 2. In the architecture dimension, the DTI framework distinguished levels, such as the national, international, and global levels. The actors were categorized as business, government, or intermediary. Another distinction among the actors was the direct and indirect actors. The interactions in the DTI framework were B2B, B2G, and G2G. Under the second dimension, the development phases of the DTI framework was distinguished as (a) initiation, (b) operation and maintenance, and (c) new services. The types of DTI are summarised as a data pipeline and national hub. The types of data pipelines are further distinguished, based on the richness of the information exchange, as the thick data pipeline (where actual documents are exchanged) and the thin data pipeline (exchanging only event information and links to documents rather than the documents themselves). In the third dimension of governance, infrastructure governance (formal/informal) and decision rights (constitutional, collective choice, operational) are used to describe the governance of DTI framework, where the subcategories of collective choice rights are further identified as standards, data access, and cost-benefit sharing.

Table 2. The framework of digital trade infrastructures (Rukanova et al.,2018).

Dimension	Category	Values
Architecture	Levels	National, international, global.
	Actors	Business/government/intermediary; direct/indirect.
	Interactions	Business-to-business (B2B); business-to-government (B2G); government-to-government (G2G).

	DTI type	Data pipeline (thick/ thin); national hub.
Process	DTI development phases	Initiation; operation and maintenance; new services.
Governance	Infrastructure governance	Formal/ Informal.
	Decision rights	Constitutional rights; collective choice rights; standards; cost-benefit sharing; data access; operational rights.

3.3 Customs–business partnership

Bryson, Crosby, and Stone (2006) defined cross-sector collaboration as the linking or sharing of information, resources, activities, and capabilities between organizations in two or more sectors to achieve a joint outcome that could not be achieved by organizations in each sector separately. Customs–business partnerships are an implementation of cross-sector collaboration. As one of the three pillars in the WCO SAFE Framework, the WCO suggested that each customs administration should establish a partnership with the private sector to promote involvement in ensuring the safety and security of the international trade supply chain. Dr. Kunio Mikuriya, Secretary-General of the WCO, highlighted that "*customs cannot act alone without considering the interests of its partners. It must further develop consultation, promote information exchange and cooperation, and reduce the barriers to the smooth flow of trade, by jointly identifying bottlenecks and offering solutions*" (Zhang & Preece, 2011).

The WCO has suggested multiple approaches to partnerships between customs and business, such as cocreation of policies and programs, leveraging partnerships for trade intelligence, and joint development of IT systems (WCO, 2015a). Information-sharing is crucial in the collaboration between customs and businesses. Partnerships between customs administrations and the trade community is critical in establishing an understanding of each party's respective data quality requirements. This understanding can ensure that the appropriate data is delivered at the correct time (WCO, 2015b).

A few studies have been conducted on customs–business information-sharing. Pourakbar and Zuidwijk (2018) examined how sharing information between customs and private firms can enhance supply chain security. Their study also indicated that partnerships for sharing information are mainly based on firms having access to valuable sources of information that customs can use to target high-risk containers. Furthermore, private firms can employ customs' risk management systems to improve their security. The drivers and barriers in customs–business communication were also assessed. Cost-savings and ease of use were determined to be the main drivers, whereas technical constraints, costs, data quality, and B2G trust were determined to be the main barriers (Urciuoli, Hintsa, & Ahokas, 2013).

Contrary to mandated information submission, information-sharing based on the partnerships between customs and businesses is voluntary. Voluntary engagement is a key desirable factor for successful customs–business partnerships, which are based on shared interests and goals, mutual trust, and respect (WCO, 2015a). This collaborative voluntary information-sharing emphasizes the "value proposition," which focuses on both profit maximization for for-profit businesses and public policy goal attainment for governments (Koliba et al., 2017). In the context of customs and business information-sharing, the "value proposition" can be explained as customs requiring commercial information

regarding the supply chain from businesses to strengthen risk management, and at the same time businesses require supply chain visibility and facilitation of the clearance process.

Information-sharing must cross both sectoral boundaries and geographic boundaries, concerning parties abroad. This may be a challenge for customs–business information-sharing because government agencies must encounter and resolve influential factors surrounding the boundaries in an information-sharing initiative (Yang et al., 2014). Organizations manage their processes and business activities with their own goals and objectives, based on their roles and responsibilities in the supply chain (Ahokas et al., 2012). However, businesses and customs may have conflicting goals despite their common interest in supply chain visibility and security. The primary goal of businesses is to increase profits, following laws and regulations, whereas the customs play the dual role of business partner and police officer (Prokop, 2017). Furthermore, the initial setup and transaction costs with authorities should also be considered (Grainger, 2014). The scope of the data that should be shared and approaches to sharing must be adequately defined for the cost to be in an acceptable range for businesses. Therefore, in the context of customs and business information-sharing, considering the interest of all the stakeholders is critical in creating public value (Bryson, 2004).

Chapter 4 Research Methods

4.1 Data collection

The present methodology was designed to understand how and why customs–business collaboration should be implemented (Yin, 2003). An exploratory case study was performed because voluntary information-sharing with customs to improve supply chain visibility is most recognized in the literature, and the papers assessing the early stages are limited. The present study focused on cases from Chinese customs. Qualitative data were mainly collected through semistructured interviews. Reports and documents from the government website and media were also collected for analysis. The data collection process is as follows.

Case 1 Cross-Border Trading

Six people working in the customs or private sectors were interviewed. The list of interviewees is presented in Table 2. First, data were collected from the customs. Three of the interviewees had risk management backgrounds and one had an enterprise administration background. Documents with a detailed description of the project were provided by the project contact people. Semistructured interviews were administered to understand the scope of voluntary data sharing, customs' approach to access the data, and the benefits for all parties. These interviews provided rich information on the main factors that influence the willingness of private sectors to voluntarily share information with customs because the interviewees had held numerous enterprise forums to understand different opinions.

Second, data were collected from businesses. One interviewee was the senior manager of SAIC Volkswagen, who was in charge of cross-border logistics and customs affairs. SAIC Volkswagen is a joint venture between the Shanghai Automotive Industry Corp. Group (SAIC) and Volkswagen AG. SAIC Volkswagen joined the pilot project at an early stage. This interview provided information regarding why and how businesses would voluntarily share information with customs. The second interviewee worked at a consulting firm that provided solutions for compliance programs and trade data management. The consultant was interviewed regarding factors that influence the willingness of private sectors to voluntarily share information with customs. Interviewing a consultant limited biases because their clients displayed different attitudes towards customs–business partnerships.

Case 2 Global Quality Traceability System

Data were collected from the interviews, documents, and reports. First, data were collected from documents provided by customs officers in Fuzhou, where the GQTS was launched in 2019. Second, data were collected in a face-to-face interviews. The interviewee was a customs officer from the former China Inspection and quarantine (CIQ), who had a background in commodity inspection and risk management. Third, data were collected using semistructured interviews (phone and e-mail). The interviewee, based in Nansha Guangzhou, was one of the project designers of former GQTS from the initiation stages. This interview provided detailed information regarding why and how businesses would join these initiatives and concerning the benefits for all the parties. Private-sector participants in Fuzhou were also interviewed. The interviews provided information regarding the perceived benefits and costs

of joining these initiatives. The field investigation was conducted in Pintan, a subordinated customs of Fuzhou. News reports regarding the benefits of GQTS for the private sector were also assessed and quoted in the article. The list of interviewees is displayed in Table 3.

Table 3. List of interviewees of the two cases.

Case 1. Cross-Border Trading

Case-No. Interviewee	Organization	Role
1-1	Customs	Project group, risk management
1-2	Customs	Project group, risk management
1-3	Customs	Risk management
1-4	Customs	Enterprise administration
1-5	SAIC Volkswagen	Senior Manager of cross-border logistics and customs affairs
1-6	Consulting Firm	Compliance program, AEO

Case 2. GQTS

Case-No. Interviewee	Organization	Role
2-1	Customs	Commodity inspection and risk management
2-2	Customs	Project group member in Nansha, Guangzhou Customs, commodity inspection
2-3	Customs	Project group member in Fuzhou Customs, coordination
2-4	Customs	Director of Pingtan in Fuzhou customs
2-5	Customs	Data management and statistics
2-6	Alcoholic beverages importer	Customs manager
2-7	Logistics service provider in the bonded warehouse	General manager
2-8	Logistics service provider in the bonded warehouse	Customs manager
2-9	IT provider of GQTS	Software engineer
2-10	Trader of milk power	Customs contacts
2-11	Importer of health care products	Customs contacts

4.2 Data analysis

To answer the two research questions and the subquestions, the conceptual framework was constructed for analysis with the following five dimensions: 1) the objectives, 2) architecture, 3) what to share, 4) how to share, and 5) why share. The first two dimensions were background of the cases, whereas the other three dimensions followed the research subquestions. The data analysis was performed based on these research questions, and the data collected were categorized into these dimensions. Furthermore, the framework of DTI (Rukanova et al., 2018) was applied to capture the main characteristics of the two cases and compare the different initiatives.

The data scope of the mandated declaration and the information voluntarily shared in the current platform were compared to identify the scope of voluntary sharing. The former clearance time and customs procedures were compared with the current situations to identify the benefits. To obtain a complete picture of the public value created, the sources of value were summarised for the business and customs.

Chapter 5 Case Background

5.1 Cross-Border Trading platform

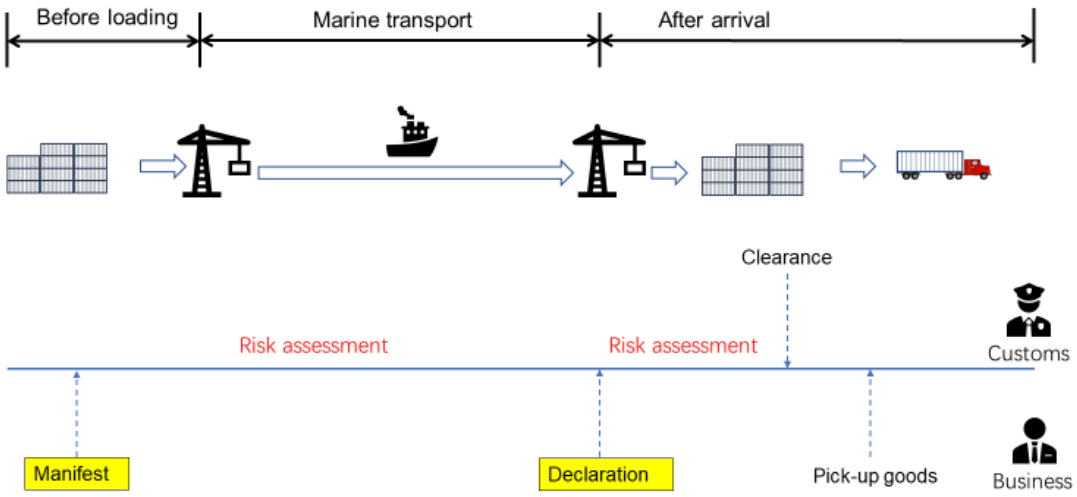
5.1.1 Objectives

China has the largest volume of foreign trade among countries in the world. Shanghai Port, in 2019, had US$896.4 billion in total import and export volume pass through the region's customs offices, the highest in China.[1] Shanghai Customs is large. It accounts for one-sixth of the customs officers in the national customs system, one-quarter of the national business volume monitored by customs, one-third of the national volume of goods inspected, and one-quarter of the national tariff volume. In recent years, the scale of imports and exports has continued to expand, and Shanghai Customs faces the primary challenge of using information and communications technology to improve efficiency and facilitate trade.

Former process

The old import process at Shanghai Customs proceeded as follows. For a general trade import, a customs declaration must be made after the goods have arrived. For example, in the maritime transport process, the carrier transmits the manifest 24 hours[2] prior to loading, and customs conducts a prearrival risk analysis (centred on security risks) based on the manifest. An import declaration is then made after the cargo arrives at port, and the container goes into temporary storage at the terminal yard. Customs conducts risk profiling after accepting the declaration, where based on the profiling results, the containers are either released or inspected.

Figure 3. Former process of importing goods.



Advance declaration

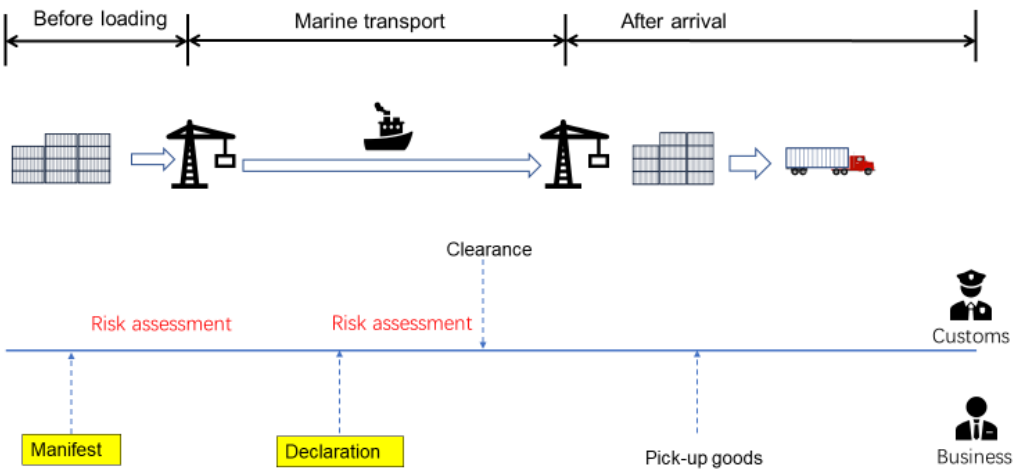
Shanghai Customs has since modified the import procedure. Since September 2018, Shanghai Customs has begun accepting a so-called advance declaration. Specifically, this declaration refers to that lodged

[1] China Customs statistics.

[2] The manifest should be submitted to customs 24 hours before loading for marine transport.

by the consignee and agent prior to the arrival of goods; this declaration is effective only if the manifest data are transmitted in advance. Customs then (1) checks the documents and collects taxes before the arrival of goods and then (2) executes the inspection and release procedures after the arrival of goods at port.[1] This means that goods are declared while at sea or in the air, and customs conducts risk profiling after the declaration is accepted. Furthermore, if a container is not selected for inspection and if all taxes and duties are paid, clearance can be made before the arrival of goods at the Port of Shanghai, which means that clearance also occurs at sea or in the air.

Figure 4. Import process with advance declaration.



This new process with advance declaration has greatly shortened the average release time of goods. Specifically, Shanghai Customs announced that compared with those at the end of 2018, the overall customs clearance times for imports and exports were 31% and 23% shorter, respectively, in the first quarter of 2019.[2]

Cross-Border Trading Platform

Trade improvements are facilitated by improved risk management. At present, the primary data source of Customs, namely customs declarations, is neither accurate nor complete enough for precise profiling. Specifically, the trade data from the current data source are potentially inaccurate, and the data are fragmented and thus cannot be effectively integrated to form a data set covering the entire supply chain. To facilitate trade and make risk management more accurate, Shanghai Customs, together with COSCO Shipping Group and Shanghai International Port Group (SIPG), initiated a pilot project called the Cross-Border Trading Platform (also called the Cross-border Trade Management Big Data Platform) at the Port of Shanghai in 2018. The platform intelligently integrates data pertaining to customs clearance

[1] Shanghai Port Service Office. *Notice of promoting the comprehensive acceleration of cargo declaration and shortening the overall customs clearance time of import by the Port of Shanghai*. August 31, 2018, accessed June 6, 2020.
http://kab.sh.gov.cn/xwzx/001005/001005001/001005001001/20180905/d1d98cf1-0003-4569-be53-879b4f24a03f.html (in Chinese).

[2] Easymoney.com. *Shanghai Customs reforms the process of customs declaration and improves the efficiency of customs clearance*, May 10, 2019, accessed June 6, 2020.
http://finance.eastmoney.com/a/201905101118747069.html (in Chinese).

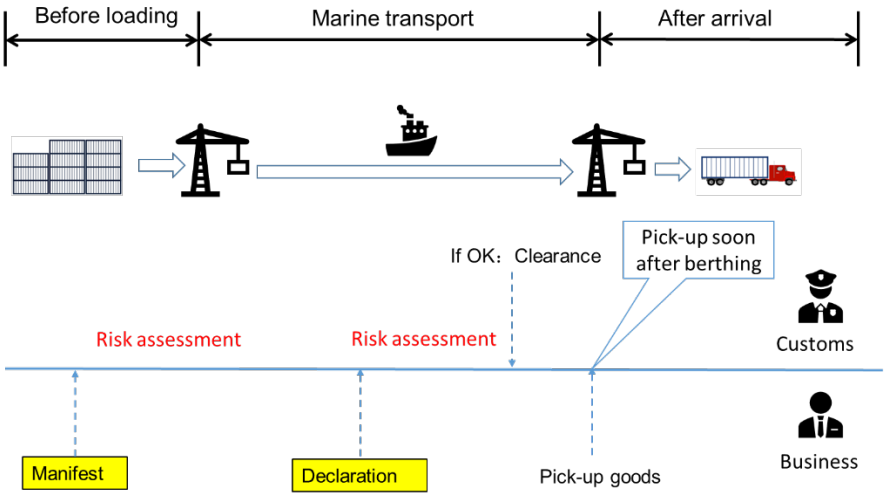
supervision, the trade chain, and the logistics chain.[1]

Similar to the idea of supply chain security assessment underlying the CTPAT programme in the United States, the Cross-Border Trading Platform is based on the supply chain data that trading enterprises voluntarily provide to customs. When customs has access to data that more comprehensively cover the supply chain—from overseas delivery to domestic receipt—customs can better assess the security risk of a supply chain and facilitate customs clearance for low-risk enterprises. Customs focuses on two types of risks: security risks and tax fraud risks. Shanghai Customs officials stated that hundreds of enterprises have joined the platform, most of which are importers and exporters. The platform has also connected customs brokers, logistics providers, and carriers as of December 2019.

With the voluntary sharing of enterprise resource planning (ERP) data by the consignee with customs, the importer can not only make an advance declaration during transport but also forgo temporary storage at the terminal yard: containers that are not selected for inspection can be transported directly out of the port by truck as soon as they are unloaded from their ship or plane.

The chairman of COSCO also noted a particular case of a shipment from the Netherlands, where their client declared the goods 2 days before arrival at the Port of Shanghai, and the documents were checked by customs the next day. Because the documents were released prior to the arrival of the goods, the client could pick up their goods and leave the port within 20 hours of unloading. Compared with the former process, which typically took approximately 130 hours, the current process is much quicker at 20 hours. [1]

Figure 5. Import process after joining the Cross-Border Trading platform.



5.1.2 Architecture

The Cross-Border Trading Platform is a regional platform administered by the Port of Shanghai for integrating customs data. Its main goal is to collect data from multiple sources involved in cross-border

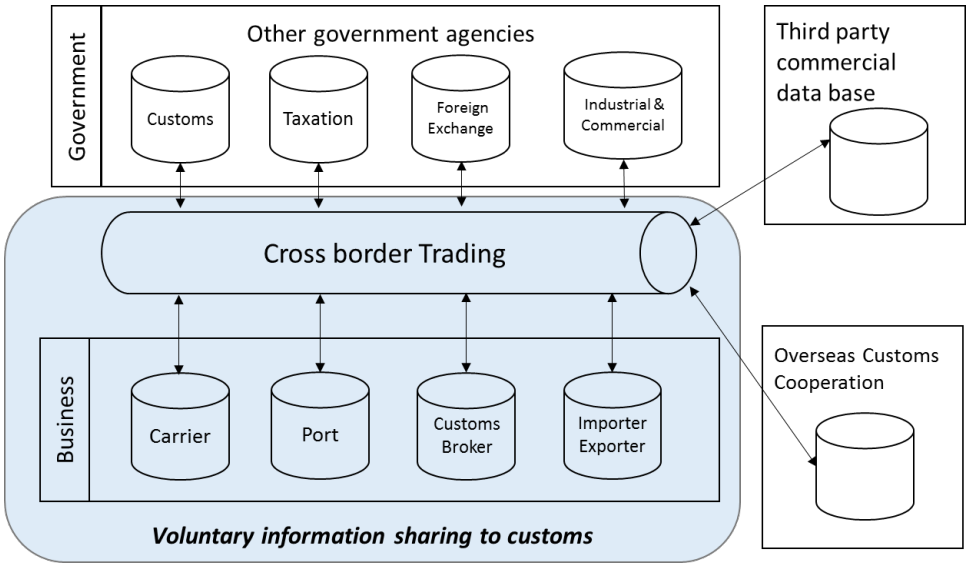
[1] Huan Li, Eastday.com. *Shanghai Customs fully promotes the application of the Cross-border Trading Platform, which has included 700 million pieces of data*, May 10, 2019, accessed June 6, 2020. http://sh.eastday.com/m/20190510/u1ai12494012.html (in Chinese).

trade at ports. The basic architecture of the platform is illustrated in Figure 6. In addition to internal customs data, the platform includes data drawn from port activity, business activity in trade, other local government agencies, and third-party commercial databases related to cross-border trade. The external data incorporated into the platform are of the four following types:

- Data from business-to-government (B2G) voluntary information sharing between Shanghai Customs and trade-related enterprises, including carriers, customs brokers, the port, and importers and exporters.
- B2G third-party data, such as global shipping route data, from commercial databases purchased by customs.
- Government-to-government (G2G) data shared with Shanghai Customs and other local government authorities, such as the tax bureau, commerce bureau, and foreign exchange bureau, in addition to industry organisations.
- Import and export data from G2G exchange between Shanghai Customs and Rotterdam Customs.

This thesis focuses on the first type of B2G data, which are data voluntarily shared by private-sector entities with customs. Specifically, such data comprise the original ERP data and contain supply chain information, and they are directly sent by import and export enterprises to the Cross-Border Trading Platform.

Figure 6. Architecture of Cross-Border Trading platform.



5.2 Global Quality Traceability System

5.2.1 Objectives

The flow of consignments through cross-border e-commerce channels is rapidly growing. In 2018, the total volume of import and export commodities for retail through customs' cross-border e-commerce management platform reached RMB134.7 billion (approximately € 17.3 billion), an increase of 50% from 2017. Of this figure, RMB56.12 billion (approximately €7.2 billion) and RMB78.58 billion (approximately €10.1 billion)—increases of 67% and 39.8%, respectively—were from exports and

imports, respectively.[1] These consignments are small parcels that together carry various goods from various sources and consignees, and their shipment represents a large challenge for border control agencies. Specifically, customs requires decisive measures to cope with fiscal, safety, and security risks that are entailed by goods of, for example, an illicit, restricted, counterfeit, or pirated nature (WCO, 2019). The key to managing cross-border e-commerce lies in access to timely and accurate information, ideally from the source.

The Global Quality Traceability System (GQTS) is an IT platform which makes it possible to integrate the information from upstream factories, traders, e-commerce platforms, border control agencies, and domestic consumers along the cross-border e-commerce supply chain.[2] It was primarily initiated by the Inspection and Quarantine Bureau (former CIQ) in 2015 in the Nansha area of the Port of Guangzhou,[3] with the aims of (1) ensuring the quality of imported products and (2) combating piracy and counterfeiting through cross-border e-commerce channels. This platform resulted in a significant increase in trade volume in the Nansha area. In 2015, it was awarded 'Best Practical Case of a Free Trade Zone in the Country' by China's Ministry of Commerce (Liu, 2017). In 2017, the initiative expanded its scope to the parallel import of vehicles[4] and to export purchases in the market[5] because these two types of trade share common features with business-to-consumer (B2C) e-commerce, such as the small trade volume per order and the presence of multiple sources. The features make it difficult for the authorities to identify a product's source and verify the product's quality.

In 2018, the jurisdiction of China Customs was expanded to cover entry-exit inspection and quarantine, enabling customs to make full use of the data in this platform to prevent a wider range of risks. At present, GQTS is being piloted in many ports under the authority of China Customs—such as Fuzhou regional customs[6]. The GQTS went online in Fuzhou through the China (Fujian) International Trade single-window platform in March 2019 and has been in operation since September 2019. This project focused on imports in cross-border e-commerce. By October 2019, 27 companies had access to the system, and 207,000 commodities had been traced in Fuzhou region. At present, China's leading cross-border e-commerce B2C platforms, such as Tmall[7] and JD, have joined the system.

At present, customs uses the GQTS to reduce the following risks:

- Infringement of intellectual property rights. This arises from the import and sale of counterfeit

[1] China Customs Statistics.

[2] Guangzhou Nansha New Area Innovation Work Bureau, China (Guangdong) pilot free trade zone. *Introduction of global traceability center*, November 11, 2019, accessed June 6, 2020. http://ftz.gzns.gov.cn/zwgk/tzgg/201911/W020191111534983840175.docx (in Chinese).

[3] Guangzhou Daily. *The first cross-border e-commerce commodity quality tracing platform in China for the pilot free trade zone was officially launched in Nansha*, June 3, 2015, accessed June 6, 2020. http://ftz.gzns.gov.cn/zwgk/qydt/content/post_3859192.html (in Chinese).

[9] The parallel import of vehicles refers to vehicles imported by traders from the overseas market for sale without authorisation of the brand's manufacturer.

[10] Market purchase trade pertains to how the trader purchases commodities in the approved market agglomeration area and handles export clearance formalities at the place of purchase. This trade mode is created for 'multi-variety, multi-batch and small batch' foreign trade transactions in the professional market. The maximum value of goods is US$150,000 within one customs declaration.

[6] General Administration of China Customs. *Fuzhou Customs global quality traceability system has been running for half a year; 207,000 commodities have been traced*, October 18, 2019, accessed June 6, 2020. http://www.customs.gov.cn//customs/xwfb34/302425/2647110/index.html (in Chinese).

[7] Tmall is a subsidiary of Alibaba Group.

goods (especially luxury goods) without the permission of the brand owner.

- Quality. This arises from the unwanted entry of unsafe or substandard products. Because China Customs is also responsible for inspection and quarantine, customs must ensure that imported goods conform to national regulations governing health, safety, and environmental protection.
- Logistics. This arises from fabricated import logistics data—such as those pertaining to the place of origin —or from the mislabelling of domestic goods as imported goods.
- Fiscal. This arises from understatements of the real price for the purpose of tax and duty evasion.

5.2.2 Architecture

The GQTS integrates the data from upstream manufacturers and third-party quality-inspection institutions abroad as well as from traders, e-commerce platforms, domestic logistics providers, border control agencies, and consumers. The trader is the one who purchases the goods from multiple sources and exports them to China. For commodity inspection, the importer should submit the inspection certificate, which states that the goods have met the national standards of the importing country. Typically, third-party quality-inspection institutions, which can be domestic or overseas institutions, issue these inspection certificates. The GQTS connects to the corresponding major domestic third-party inspection agency and to some of the third-party inspection agencies abroad who have dual accreditation by the host country and the CNAS (China National Accreditation Service for Conformity Assessment; Ye, Huang, Liao, & Tian, 2017).

The GQTS is a typical data pipeline, with the objective of ensuring supply chain visibility for all parties, including the final consumer. The system acquires the original information relating to commodity quality from multiple sources—including the manufacturer, trader (distributor), third-party inspection agency, e-commerce platform, logistics provider, border control agencies, and the final consumer. All information is shared through the GQTS with all related parties. In fact, the GQTS itself does not judge whether the products satisfy the requisite standards but rather merely ensures supply chain visibility and traceability to guard against counterfeits or substandard products. Specifically, when an offending product is identified, the information in the GQTS can be used to easily identify the parties related to the product.

Traceability can be divided into three levels by the stage of the supply chain the data source is at:

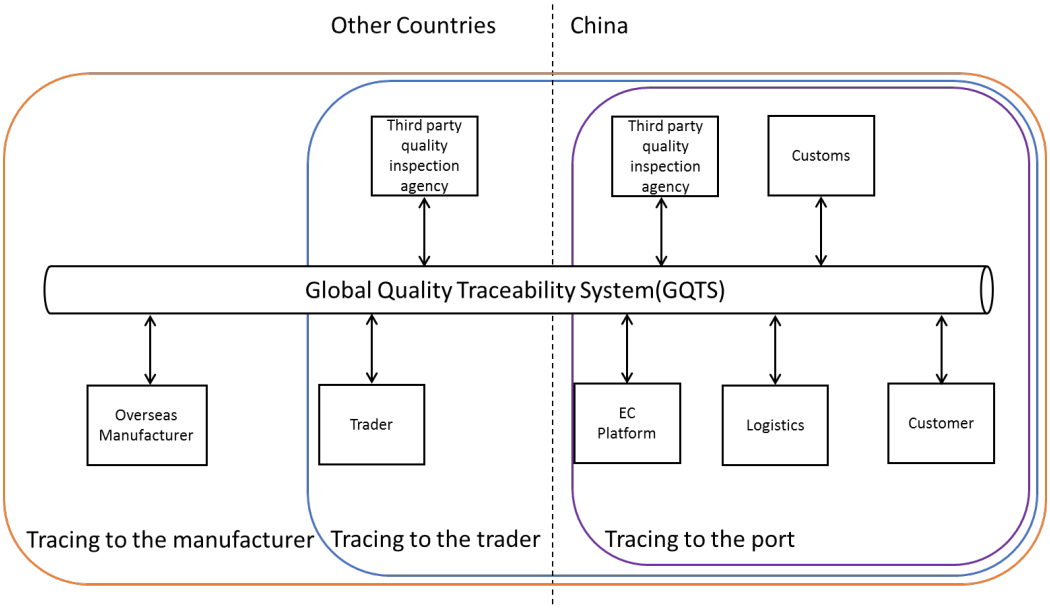
i. Tracing to the factory. When an upstream factory or brand owner agrees to connect its ERP system to the GQTS, this connection allows downstream actors to trace to the source of production. The factory or brand owner is the initiator.
ii. Tracing to the overseas trader (distributor). If the trader agrees to connect its system to the GQTS, this connection initiates the process of trade circulation. Therefore, information can be traced to the trader through the GQTS.
iii. Tracing to the port. This refers to the trade that initiates tracing in the export and import stages according to the feedback of border control agencies.

Therefore, in the three aforementioned levels, which proceed sequentially, the detailed content of the traceable information degrades at each level. The data chain of tracing to the factory is the longest and provides complete information, in contrast to the other two. Such a multilevel design provides flexibility for the private sector to join the platform. The GQTS can provide different levels of traceability for a

given set of participants from various stages in the supply chain. The GQTS architecture is illustrated in Figure 7.

Notably, the GQTS extends the data pipeline to the end of the supply chain (i.e., the customer) through QR code functionality. Specifically, each product has a unique QR code that can be used to access the information in the data pipeline. After the products enter into free circulation, the final customer can access information on the product pertaining to, for example, quality, logistics, and clearance through scanning the QR code label on the product with the GQTS app. Every item has its unique QR code. For example, the Japanese-manufactured diapers of Kao Corporation are very popular in China and are often counterfeited. Thus, Kao Corporation joined the GQTS in Nansha at the factory level. When their diapers are imported into Nansha Port, customers can scan the QR code of the product with their smartphones to access product information. All the information is provided by the different parties in the supply chain and integrated in the GQTS.[1] Another example is Red Seal brown sugar, which is imported from New Zealand. The traceable information pertains to the dates and ports of departure and arrival as well as the commodity quality inspection certificate notarized by GIQCI[2] in Australia, an agency that is also recognised by the Port of Nansha.[3]

Figure 7. GQTS Architecture.



5.3 Characterisation using the digital trade infrastructure framework

[1] China Business. *Scanning a code to check the source of Kao's diapers in the Guangdong Nansha free trade zone*, October 25, 2016, accessed June 6, 2020. https://www.yicai.com/news/5142574.html (in Chinese).

[2] The GIQCI is an independent and nongovernmental third-party notary institution recognised by the ILAC-MRA/CNAS (International Laboratory Accreditation Cooperation-Mutual Recognition Arrangement/China National Accreditation Board for Laboratories).

[3] *The Port of Nansha extends commodity quality traceability to overseas*. November 23, 2015, accessed June 14, 2020. http://ftz.gzns.gov.cn/zwgk/qydt/content/post_3858832.html (in Chinese).

In this study, we adopted the digital trade infrastructure (DTI) framework formulated by Rukanova et al. (2018) to compare the two aforementioned cases. Specifically, the two platforms in the case studies constitute DTIs that are driven by government, which has encouraged the private sector to participate in them by voluntarily sharing information. The application of the DTI to this case studies enabled horizontal comparisons to be made with the DTIs in Rukanova et al. (2018), which were driven by private entities.

Architecture

In its architecture dimension, the DTI framework distinguishes between the national, international, and global levels (Rukanova et al., 2018). However, the Cross-Border Trading Platform is a regional-level platform within Shanghai. However, this regional-level DTI is no less challenging to manage than its higher-level counterparts, considering the large volume of imports and exports handled by the Port of Shanghai. Because China is large, ports vary in their trade volume and foci of supervision, and the needs of DTIs vary as well. By contrast, the GQTS aims to establish global-level infrastructure by connecting traders and manufacturers from various countries.

The actors involved in both case studies are direct actors. In the Cross-Border Trading Platform, the actors are customs and trade actors—such as carriers, ports, and importers and exporters. In the GQTS, the actors are not only direct actors in cross-border e-commerce—such as manufacturers, traders, logistics operators, and e-commerce platforms—but also third-party inspection agencies and consumers. This is because quality risks constitute the primary concern for the GQTS.

In the Cross-Border Trading Platform, the main interactions are B2G, B2B, and G2G. The focus of this study was on B2G interactions because the research focus was on voluntary information sharing with customs. B2B interactions include those between the carrier and local importer. G2G interactions, in this case, occur mainly between Shanghai Customs and other local government authorities, with the data exchange between Shanghai Customs and Rotterdam Customs being an exception. Most interactions occur between local government authorities and the private sector. In the case of the GQTS, B2B and B2G interactions extend overseas. Furthermore, G2C and C2G interactions expand the range of interactions in the DTI framework. Being focused on quality, the GQTS treats consumer feedback as an essential data source.

With regard to the type of DTI, because China Customs is complex and handles a large trade volume, the Cross-Border Trading Platform constitutes a DTI that functions as a regional rather than national hub. By contrast, the GQTS functions as a thick data pipeline through which rich information is exchanged.

Process

The Cross-Border Trading Platform was initiated in April 2018 and became operational in May 2019. The GQTS was initiated in 2015 by the China Inspection and Quarantine Bureau in the Port of Nansha in Guangzhou. After the bureau was incorporated into China Customs in 2018, Fuzhou Customs took over the GQTS initiative, which went online in March 2019 and became operational in October 2019. At present, new GQTS-related initiatives are underway in other regional customs of China.

Governance

We used the DTI framework to analyse infrastructure governance, decision rights, standards, cost–benefit sharing, and data access in the case studies. Although the Cross-Border Trading Platform and GQTS involve many actors, governance is formal and clear because they are both government-driven projects. The standards, decision rights, and control over data access are defined by the regional customs of Custom, who initiated the projects. Both platforms in the case studies are open platforms, where business partners are welcome to join. Table 4 characterises both platforms using the DTI framework.

Table 4. Characterisation of Cross-Border Trading platform and GQTS using the DTI framework.

Dimension	Category	Cross-Border Trading platform	GQTS
Architecture	Level	Regional	Global
	Actors	Direct actor Business/government/intermediary	Direct actors Businesses/government/intermediaries/third-party inspection agencies/consumers
	Interactions	B2B; B2G; G2G	B2B; B2G; G2G; G2C
	DTI type	Regional hub	Data pipeline (thick)
Process	DTI development phase	Operation	Operations in Nansha and Fuzhou; initiation in other regions
Governance	Infrastructure governance	Formal	Formal
	Decision rights	Defined by customs	Defined by customs
	Standards	Defined by customs	Defined by customs
	Cost–benefit sharing	Customs: investment, development, and maintenance of system; enterprises bear the cost of interface development and data transmission	Customs: investment, development, and maintenance of system; enterprises bear the cost of interface development and data transmission
	Data access	Customs can have access to all the data on the platform. Participating enterprises (1) query the status of each batch of goods in real time and (2) obtain electronic and video data on, for example, ship location, port information, cargo flow direction, and customs clearance status.	Customs can have access to all the data on the platform; businesses and customers can have access to information pertaining to the goods that they have sold or purchased.

Chapter 6 How Voluntary Information Sharing to Customs Achieved

6.1 What to share

6.1.1 Cross-Border Trading platform

In the case of Cross-Border Trading platform, the voluntarily shared data are original data pertaining to the trade chain. This scope of this set of data encompasses the data item and the information contained in the documents in the mandated declaration—such as the contract, invoice, loading data, and arrival date. However, these data differ from those contained in the mandated declaration in the following respects.

- Data format. In the legally mandated declaration, the documents attached are uploaded as scanned copies. By contrast, in voluntary information sharing—pertaining to, for example, the contract, invoice, arrival information, and the overseas loading characteristics—the documents are structured because their data fields follow a set format. A customs officer from the project stated the following:

  > The customs declaration [in China Customs] has been paperless for years, but many of the documents attached are actually scanned copies. The data submitted in the Cross-Border Trading Platform are structured data.

- Data granularity. Even within the same scope, voluntary sharing provides more detailed information relative to the mandated declaration: the data are thus more granular. For example, the goods are described on a per item basis in a mandated customs declaration. By contrast, the goods are described with a unique material number in the ERP system. The material number is a core code in the ERP system because the ERP was developed based on material requirement planning (MRP) and manufacturing resources planning (MRPII). In fact, the item-level data in the declaration are consolidated and summarised from the data on the material-number level in ERP. The voluntarily shared information from the ERP system is at the material-number level, and thus, it has greater granularity relative to that in the mandated declaration. A customs officer from the project opined,

  > The customs declaration only provides data on the item-number level. By contrast, ERP data have finer granularity, being able to provide data at the material-number level.

- Sources. In the Cross-Border Trading Platform, the original data in the ERP systems of the importer or exporter are transferred directly to customs. Compared with the mandated declaration, the original data from the ERP system are processed and converted to the format used in the mandated customs declaration. In many cases, the processing of the customs declaration is outsourced to the customs broker. Therefore, the declaration that customs receives contains the data processed and integrated by the customs broker. A customs officer from the project stated the following:

  > We have discussed whether we should connect to the custom management systems [converting system] or the ERP system. The data in custom management systems are the same as those in the customs declaration. ERP data are more authentic.

- Brief description of supply chain partners. Such a description is beyond the scope of the mandated declaration and is provided voluntarily by the importer through a web portal. The description comprises the VAT number of the suppliers abroad as well as the names and addresses of overseas shippers, carriers, and logistics companies. A customs officer from the project stated the following:

> The Cross-Border Trading Platform does not connect to overseas companies; it [the information of supply chain partners] is still provided by local companies...We hope to use the same idea as that underlying CTPAT to evaluate supply chain risk. We want to know which companies are in the supply chain—from overseas delivery to domestic receipt.

The scope of information to be shared was determined after discussion between businesses and customs authorities. Customs made an initial proposal for the scope, which was then modified after in-person negotiations with businesses. According to interviews, the parties to the negotiation were concerned with availability and confidentiality. With regard to availability, for businesses, the data to be provided should be easily accessible through their commercial systems and thus not costly to provide. With regard to confidentiality, businesses were more likely to share logistics than financial data. As stated by a customs officer working on the Cross-Border Trading Platform,

> We are willing to hear requests from the companies and discuss them…From our perspective, the more data, the better. However, companies are limited with respect to the data they can provide…[For certain data,] the business is unwilling or unable to provide them—for example, financial data, especially data about downstream parties…Thus, the current scope is a simplified version. It was more expansive and complicated at first.

In this context, customs authorities working on the Cross-Border Trading Platform tried to make the scope more flexible with regard to both required items and optional items during the platform's implementation, doing so to gain access to more commercial data. In fact, companies vary with respect to their ready-made data and commercial systems: a given type of data may be easy to provide for some companies but difficult for others. Consequently, having the scope of voluntary information sharing be flexible, with a minimum requirement but flexibility on top of that, in the interest of encouraging data partnership rather than imposing a legal compliance mandate makes joining the platform more attractive for businesses.

6.1.2 Global Quality Traceability System

In China, the mandated declaration submitted to customs in the case of cross-border e-commerce trade includes order data (from transactions on the e-commerce platform), payment data (from consumer payment records), and logistics data (from domestic delivery to consumers) in addition to declarations and the requisite certificates. Typically, traders abroad gather quality-related information from the manufacturer or the inspection institutions and provide it to the border control agencies. However, such information is second-hand and may be insufficiently reliable for control purposes.

With the information voluntarily shared by all the parties to the GQTS, especially from factories and institutions overseas, customs can integrate the fragmented pieces of information in the supply chain to obtain more detailed and original information that goes beyond the scope of the declaration. The manufacturer or brand owner voluntarily shares production information, and third-party quality-inspection institutions voluntarily share their inspection information. The voluntarily shared

information comes directly from upstream parties and is thus more detailed, complete, and accurate. A customs officer from the project group with a background in commodity inspection stated the following:

> If the data were not within the scope of the declaration, we used to have no access to them. With the GQTS, data that are scattered across various stages in the supply chain can be collected…Take factory-level traceability as an example. Actors from the whole supply chain—including the manufacturer, trader, warehouse, and overseas inspection agencies—will upload product-related data; the content of such data depends on the actor's function in the supply chain. For example, manufacturers upload data on the production date, production line arrangement, raw materials, as well as date of packaging and delivery, and inspection agencies upload data on the date and results of inspection.

In addition to being used for border control by customs, the voluntarily shared information on the product is also accessible to other actors in the supply chain for them to manage the supply chain and ensure compliance.

To ensure the quality of the information imported into the system, the border control agencies will sample and inspect product quality randomly to confirm the information in GQTS. If the product quality does not conform to the information provided in GQTS, concerned businesses will be punished accordingly. The third-party inspection institution may be disqualified if it has committed fraud.[1]

6.2 How to share

6.2.1 Cross-Border Trading platform

Considering that companies vary in their trade volume and information technology infrastructure, information sharing on the Cross-Border Trading Platform can take two forms:

- Application programming interface (API)

For companies with a large trade volume, the Cross-Border Trading Platform is integrated with users' in-house ERP systems through APIs that are designed for ease of setup and use.

- Web user interface (UI)

The Cross-Border Trading Platform can also be accessed through single-window login without integration. Users upload an Excel spreadsheet of data following a standard template.

In both of these approaches, businesses push their data to customs authorities. SAIC Volkswagen, for example, pushes its data to customs authorities through APIs. Its senior logistics and customs manager stated the following:

> We'll push the data to customs for each consignment of goods. The arrival information of the consignment is the trigger of our data push. For example, 2 days before the time of arrival, we'll push the data to the platform.

The data shared through a web UI must be verified for authenticity because they are written in an uploaded Excel spreadsheet by the company instead of being directly transferred from the ERP system. In particular, the obligations and liabilities pertaining to data quality must be clarified. A customs officer

[1] China Business. *Scanning a code to check the source of Kao's diapers in the Guangdong Nansha free trade zone*, October 25, 2016, accessed June 6, 2020. https://www.yicai.com/news/5142574.html (in Chinese).

involved in the project stated the following:

> If the private company finds it difficult to extract data and connect through the API, it can upload the standardised Excel spreadsheet, filled in with ERP data, to our platform...If the company is willing to join the project, it can sign an agreement with customs authorities to clarify the obligations of both parties, where the company is responsible for the authenticity and accuracy of its data.

6.2.2 Global Quality Traceability System

The GQTS is integrated with the in-house ERP systems of users through APIs that are designed for ease of setup and use. Figure 8 illustrates the data transfer process in the GQTS, as exemplified in factory-level traceability. A customs officer from the project group with a background in commodities inspection stated the following:

> They connect [to the GQTS] through APIs. It is more convenient. They don't need to fill [the data] in manually. We have prepared several standard interfaces because the IT systems of each company may vary. They may make some slight technical changes to their own system…Because many of them have ready-made data and those large enterprises have strong technical teams, it is very convenient for them to connect with us.

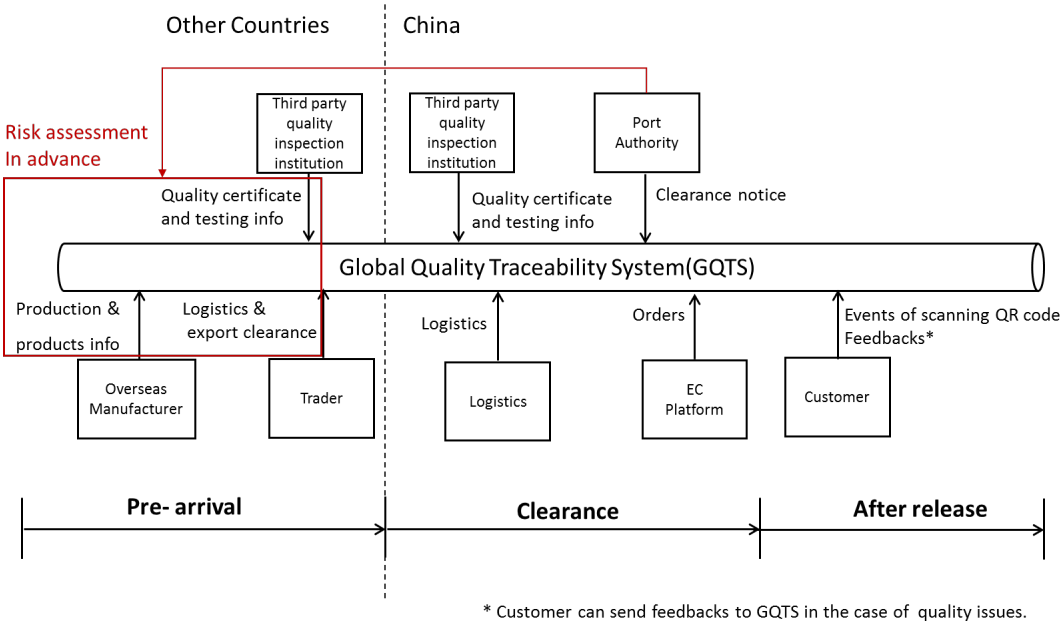
The general manager of a logistics service provider in a bonded warehouse also confirmed that API connection was 'affordable and not very complicated'. The choice of API and UI is also affected by factors other than setup and labour costs.

Before the goods arrive at port, relevant parties push the information to the GQTS. Specifically, the manufacturer pushes production information, the trader and logistics providers push logistics information, and third-party quality-inspection institutions push inspection information. With such information sent in advance, China Customs performs cross-validation and a preliminary risk assessment in advance.

When the products arrive at port, customs conducts risk profiling. If the physical inspection is necessary, the customs officer can scan a QR code to access information on the product in the GQTS, thus speeding up inspection and release. The clearance notice will then be displayed in the GQTS.

After the products are released and enter into free circulation, customers and local authorities can scan a QR code on the product to access tracking information. Should the product be of substandard quality, the customer can lodge a complaint or make an inquiry on the GQTS. All customer feedback is sent to government authorities and to supply chain partners. Therefore, the flow of information takes the form of a closed-loop information chain, with two-way information flow from the source to the customers and from the customers to the source.

Figure 8. Information shared on the GQTS.



6.3 Why share

6.3.1 Cross-Border Trading platform

Benefits for customs authorities

The benefits for customs authorities are as follows. First, with access to original trade data, customs authorities can cross-validate declaration information and conduct the pre-arrival risk analysis. Second, customs can obtain a complete picture of all actors in the supply chain of a given piece of cargo, doing so based on data shared by the business. Such data, although cursory, help customs authorities comprehend and evaluate the risk entailed by an entire supply chain. A customs officer in the risk management department stated the following:

> These supply chain data are not included in the declaration. Such information allows us to link all parties involved in the entire logistics chain, such as who is the supplier and who is the logistics provider…Processed using big data analytics, such data can help us to evaluate how secure the entire supply chain is—similar to the idea underlying CTPAT.

Benefits for businesses

The benefits for businesses are as follows. First, business users can access visualised data on the real-time status of each batch of goods during transport—including information on ship location, port information, cargo flow direction, and customs clearance status. Business users are also notified of how much duty is owed as well as the deadline for payment. SAIC Volkswagen's senior manager of cross-border logistics and customs affairs stated the following:

> Before joining this platform, [the carrier] COSCO would notify us of the estimated arrival date as soon as the container left Hamburg Harbour. However, this estimated date might be changed later due to unforeseen circumstances, such as typhoons. Now, COSCO provides us the precise time of arrival in advance….If you ask me for specific information on a given container, I know where it is…this can effectively reduce uncertainty. We can plan other things…Regarding the information at the port, we

> used to have no idea where they [goods] were at the port after the containers were unloaded. The information was unavailable to us. After joining this platform, the information [concerning goods at port] is transparent to us.

Second, for some given cargo, if its supply chain is profiled as low risk, an intrusive inspection is unlikely and customs clearance is relatively quick, reducing inventory cost. A customs officer involved in the project stated the following:

> It is not that we can reduce inspections if the business shares its supply chain data with us. If they share such data, we can use the data to evaluate the supply chain. If a cargo is from a low-risk supply chain, the inspection rate is typically lower.

According to the interview, SAIC Volkswagen's savings in inventory costs amounted to more millions of yuan annually after joining the project; this large sum was due to the company's large import volume of automobile parts. A senior manager of SAIC Volkswagen stated the following:

> In the past, our customs clearance time was 2 days on average. I kept 5 days' worth of inventory [including safety stock]. If this inventory was exhausted in the case of delays, I had to arrange [additional] air freight [for replenishment]. Now, with the Cross-Border Trading Platform, I only keep 2 days' worth of inventory because I am sure that the cargo can clear customs within 2 days; most of the time, it clears within 1 day. If I calculate the capital turnover of my inventory according to the current interest rate, I may have saved more than a few million yuan…In fact, certainty is the most important [factor] for a supply chain.

Third, business users have greater access to logistics facilities at the port. Sometimes, goods remain in the terminal warehouse due to logistics delays rather than to customs inspections. In particular, port operations constitute the main cause of delays at the port. Data integration in the Cross-Border Trading Platform also facilitates real-time information exchange between carriers, the port, and importers and exporters; this allows enterprises to be better aided by ports and carriers. Enterprises can transfer the requisite manifests and certificates to the port in real time, which enables the importer to submit the pickup plan in advance. The importer can also make an appointment with the shipping company to change the bill of lading online and complete the pickup formalities online with the port. A customs officer involved in the project stated the following:

> Regarding commodities with special customs clearance requirements, such as goods from the China International Import Expo, the terminal and carriers can use the Cross-Border Trading Platform to provide [additional] assistance—such as providing priority booking, allowing for the advance submission of the pickup plan and arranging for immediate pickup after arrival (as soon as the ship berths).

A senior manager from SAIC Volkswagen stated the following:

> In the past, we could only use the physical goods to exchange for the bill of lading. Now, the carrier gives me information on changes to the bill of lading in advance. I can change the bill of lading electronically. In doing so, more electronic data [are exchanged] than before.

Nonetheless, for businesses, the perceived benefits may vary depending on their industry and supply chain strategy. The following, as recounted by a customs officer involved in the Cross-Border Trading

Platform, exemplifies such variability. A pharmaceutical company that imports raw materials under a cold chain were willing to join the project to streamline the trading process because their import process is sensitive to lead time. Another company that imports precision instruments has special requirements for unloading and moving after goods arrive at port to prevent damage. They were also willing to join the project because they can benefit from having priority access to pick up their goods themselves as soon as the cargo plane arrives at the airport. These examples illustrate that benefits for the business are affected by multiple factors—such as sensitivity to lead time, special requirements of movement at the port, and large trade volume.

Investment and cost

Shanghai Customs made the initial investment for the platform and maintains it. All enterprises use the platform free of charge. Business users only bear the cost of connecting their in-house system with the Cross-Border Trading Platform, such as the setup cost of APIs or the labour cost involved in uploading data through a web UI.

However, companies differ greatly with respect to their ERP systems and, by implication, their setup costs. Specifically, such costs depend on the availability and functions of a company's IT connection with its supply chain partners. If the information transfer with its supply chain partners already contains the data required by the Cross-Border Trading Platform, connection through APIs affords greater accessibility. Otherwise, data extraction from scratch is difficult. A senior manager from SAIC Volkswagen stated the following:

> Before we joined this platform, our supply chain operation was supported by electronically input data. That is, when our German supplier dispatched the goods, they scanned the code on each box before loading the container. All information—such as that pertaining to product type, weight, and value of goods—was electronically sent when the goods were shipped. I would receive these data the next day…As I understand it, the system requires data input, processing, and output. In fact, the data sent to customs through the APIs constitute the output, and the greatest expense lies in data input at the early stage. Because we already have systems running to generate these data, the cost entailed by the workload of APIs connecting to the platform is negligible. I think if I didn't have this [SRM system], the cost would be much higher.

To reduce setup cost through the use of APIs, companies with a small trade volume prefer to upload the Excel sheet comprising the ERP data through a web UI—although this increass maintenance and labour costs.

Although the development and maintenance costs of the platform are borne by customs, the business must still be able to bear the setup cost of extracting the data from the ERP system for APIs, or bear the administrative costs of regularly uploading data through the web interface. Thus, perceived cost is related to ease of use, and whether the platform is convenient for data transmission is an essential consideration for businesses. Furthermore, enterprises differ in their information technology (IT) infrastructure (including staffing of IT experts). For SAIC Volkswagen in particular, their setup cost depends on the availability of data prior to getting started. A customs officer involved in the Cross-Border Trading Platform noted that some large companies are capable of having their in-house IT experts conduct data extraction; however, other companies require their ERP providers to support the

connection to APIs. The connection to APIs requires technical support from customs, which constitutes a challenge for customs.

Security and privacy concerns

Information security and privacy are major concerns for cross-border information sharing. In the case of the Cross-Border Trading Platform, some private-sector entities relayed to customs their concerns regarding security and privacy in information sharing. A customs officer who was involved in establishing meetings with businesses to inquire about their intention to join the project recounted the security and privacy concerns expressed by businesses, explaining as follows:

> Data security is an issue, especially for foreign enterprises. Some multinational enterprises have remote database servers located abroad that cannot be linked up with China Customs. Some companies solicited the advice of their in-house legal experts, who said that data transmission through the ERP system fails to meet the data security and confidentiality requirements of their company. Some companies did not have specific rules governing data security, but they still worried about the data security and confidentiality of access to the ERP system.

In response to the concerns of businesses regarding data security and privacy, customs clearly relayed their assurance to businesses that the servers used to store the data, which are shared by businesses, were all located in specialised customs facilities—with strict access control measures to ensure data security. These security and privacy concerns can still hinder cooperation between customs and businesses in voluntary information sharing. However, it was not obvious whether companies were unwilling to join the project out of a genuine concern for security and privacy or whether such concerns were but an excuse—where companies were unwilling to join for some unrevealed reasons of their own. Future research should investigate this question.

6.3.2 Global Quality Traceability System

Benefits for customs

The GQTS was driven by border control agencies in China. The GQTS provides a public service that benefits trade and customers while also helping customs assess risk and facilitate trade. The benefits for customs include the following:

- Making risk assessment more accurate and reducing the risks of counterfeiting and of violations of import laws. Using the original information in the traceability system, customs can optimise the establishment of risk indicators and generate rules that combat the smuggling of (especially counterfeit) goods. These rules will be applied in the overall process, which comprises risk identification, risk analysis, risk profiling, and targeting.
- Increasing supply chain visibility and improving data quality. The information provided from multiple sources constitutes a complete end-to-end information flow along the global supply chain, making it possible for customs to conduct a risk assessment in advance and to continue monitoring goods after they are released.
- Reducing the risk of understating the price. Customs can cross-validate a declaration against data in the GQTS, which reflect the product's real transaction price.
- Accelerating customs inspection. Inspection officials can access complete information on a given products by scanning the product's QR code.
- Enhancing border agency cooperation. The GQTS facilitates intra-agency cooperation, which

became the priority for China Customs after the inspection and quarantine bureau was absorbed into China Customs.

Benefits for the manufacturer or brand owner

The manufacturer or the brand owner utilises the GQTS to prove that their product is genuine. Because businesses are burdened by the cost of combating counterfeiting and copyright infringement, they are willing to use the GQTS to reduce such costs. A customs officer from the project group with a background in commodity inspection stated the following:

> A famous brand told us that they spend several hundred million renminbi annually on combating counterfeiting. Joining this [the GQTS] is akin to us being able to furnish a certificate of identification: customers can easily distinguish between genuine and counterfeit goods.

In addition, traceability can help manufacturers and the brand owner improve their quality control using information on the production line and production batch. For example, Johnson & Johnson and Lesso Group joined the GQTS at the Port of Nansha. A representative of Lesso Group stated that their supply chain includes overseas factories and distributors. Before joining the platforms, controlling terminal sales was difficult for the headquarters of Lesso Group. With direct global traceability from the platforms, the business can now trace a product's origin down to the exact factory and even machine, and they can also identify the materials used for every product sold in the overseas market. The e-commerce director of Johnson & Johnson (China) stated that the GQTS has helped the company solve its reputation problem among Chinese consumers[1]:

> We want to have regular products enter China. Johnson & Johnson has many factories around the world, so the products in China are sourced from all over the world. With this system, we can trace the origin of imported shipments to ensure that products are highly compliant.

Benefits for third-party quality-inspection institutions

In exchange for voluntarily sharing quality-inspection results, third-party quality-inspection institutions can obtain the feedback of downstream customers. Such feedback aids these institutions in identifying substandard products, verifying their test results, and issuing certificates to enterprises.

Benefits for traders

Prior to the establishment of the GQTS, if a product was selected for customs and quarantine inspection, importers had to wait more than 10 days for the conclusion of onsite inspections and the release of the laboratory report. This long time of 10 days negatively affects the selling price of products with a short shelf life. By contrast, the information shared voluntarily on the GQTS—pertaining to the product name, manufacturer, country of origin, and the quality-inspection certificate issued by third-party inspection institutions—prior to the arrival of goods helps customs at the port of entry conduct a risk assessment in advance. This greatly reduces the customs clearance time, as recognised by the general manager of Sizhou (a food trading company), who stated the following[2]:

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[1] *Scanning a code allows for tracking the global quality of commodities; relevant systems will be promoted in the Guangdong Inspection and Quarantine Bureau within the year*, October 24, 2016, accessed June 6, 2020. https://www.sohu.com/a/117050626_119689 (in Chinese).

[2] China Business. *Scanning a code to check the source of Kao's diapers in the Guangdong Nansha free trade zone*, October 25, 2016, accessed June 6, 2020. https://www.yicai.com/news/5142574.html (in Chinese).

> This system is very open. All qualified domestic and foreign inspection and testing institutions can connect [to the GQTS] regardless of which country these institutions are located in.

Benefits for e-commerce platforms

E-commerce platforms enjoy the following benefits.

- E-commerce platforms gain a better reputation. In weeding out counterfeits, e-commerce platforms ensure that only genuine goods are sold, which increases consumer trust. A representative of Funsens, a cross-border e-commerce platform, said that the GQTS has not only protected consumer interests but also helped cross-border e-commerce enterprises gain consumer trust. According to the representative,

> They had intended to do this [traceability system] themselves, but the cost can be very high. Now, with this government-provided platform, it is more efficient and authoritative.[1]

The director of the logistics department of Fujin KTJ, an e-commerce platform, stated the following:

> This system builds a channel of trust between e-commerce enterprises and customers. From a consumer's perspective, this system better assures them of the product's safety and quality.[2]

The customs manager of an alcoholic beverage importer stated the following:

> The most important benefit is that we can transfer the quality information to consumers, and it is accurate and reliable since it is from customs…In the future, the sales volume of trustworthy companies is sure to rise.

- E-commerce platforms can reduce their inventory costs due to fewer inspections and faster customs clearance. According to a customs manager of an alcoholic beverage importer, customs clearance time was significantly reduced after joining the GQTS:

> The customs release time used to be 2–3 days. Most of the time, it was 2 days. Now, the products will be released on the day of arrival except for when the cargo is randomly sampled for inspection.

- E-commerce platforms can promote sales. After the products enter free circulation, the QR code scan events will be recorded by GQTS if customers scan the code on the products. The platform can access the statistics of scanning events in certain regions. Therefore, the platforms make market analysis and plan sales promotion according to the data of customer regional distribution indicated by the scanning events. A customs officer from the project group with a commodity inspection background stated the following:

> Scanning statistics can be used for data analysis. In fact, these data are shared. We can see them, and the e-commerce platform can also see them. Therefore, they can use this platform to do their own sales and postmarket management analysis.

Benefits for customers

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[1] *Scanning a code allows for tracking the global quality of commodities; relevant systems will be promoted in the Guangdong Inspection and Quarantine Bureau within the year*, October 24, 2016, accessed June 6, 2020. https://www.sohu.com/a/117050626_119689 (in Chinese).

[2] Wang, Pingtan Times, *Global Quality Traceability System helps Pingtan build an internationally renowned shopping island without counterfeit goods*, October 14, 2019, accessed June 6, 2020, http://www.china-fjftz.gov.cn/article/index/aid/13145.html (in Chinese).

The GQTS provides a public service to customers. Customers enjoy the following benefits:

- Customers can access detailed information on a product—such as those pertaining to its manufacture, quality-inspection results, and import history—by scanning the product's QR code through apps or a WeChat applet.
- By lodging a complaint online, customers can seek redress from government agencies against being sold a defective product.
- Customers receive timely recall announcements from the manufacturer, allowing them to cease using a defective, and potentially dangerous, product.

In summary, voluntary information sharing by businesses with customs in the GQTS reduces information asymmetry and increases supply chain visibility. These benefit government, businesses, and consumers, yielding a win–win situation that creates public and private value.

Investment and cost

GQTS is a government-driven project. Customs authorities and local governments in China made the initial investment for the platform and maintain it. All actors in the supply chain, including consumers, contribute to information sharing and use the platform free of charge. Business users only bear the cost of connecting their in-house system to the GQTS.

Chapter 7 Value for the Business and the Customs

7.1 Sources of public value

7.1.1 Supply chain visibility for all parties

The information sharing between supply chain actors and the government creates public value and makes the supply chain visible for all parties involved. Both the Cross-Border Trading Platform and the GQTS are government-led initiatives aimed at encouraging businesses to voluntarily share additional information to customs. However, the information flows are not limited to one-way transfers from businesses to the government. Instead, B2B, G2B, customer-to-business (C2B), and customer-to-government (C2G) information sharing play indispensable roles in these initiatives. In the two case studies, the government provided the platform and enabled information exchange among private-sector entities. In doing so, the government achieved its objective of improving risk management through integrating fragmented pieces of information provided by various public-sector entities. In return, these private-sector entities enjoyed benefits. Thus, supply chain visibility served the interests of both the public and private sectors.

In the case of the Cross-Border Trading Platform, customs is not only the main border control agency but is also the actor responsible for coordinating the efforts of other government agencies at ports. The Cross-Border Trading Platform plays the role of a regional information hub by integrating information from multiple sources—including the carrier, importers and exporters, and Shanghai Customs and the Port of Shanghai—in the process of cross-border trade. Therefore, customs has additional commercial information on logistics and on actors in the trade and supply chains. The importer and exporter also have access to more data from the carrier as well as from port and customs.

In the case of the GQTS, the platform has extended supply chain visibility to the final customer. As a data pipeline, the GQTS has made visible end-to-end quality-related information pertaining to the global supply chain. Such information used to be a black box for products that are either shipped in small batches or come from multiple sources; such products are common in B2B-to-customer e-commerce. Although many companies provide their own tracking information and QR code functionality to customers, because the information comes from company databases, companies can tamper with such data. By contrast, the GQTS data come from the customs database and are thus perceived by consumers to be more authentic and reliable. Moreover, C2G and C2B information sharing creates public value by being instrumental in the data pipeline.

The GQTS has made the supply chain more transparent, helping both businesses and the authorities identify and address quality risks. As a government-driven platform, the GQTS provides information-tracing services to customers as a pure public good, allowing customers to obtain detailed information on a given product and to submit complaints through the GQTS should a product be defective or counterfeit. Furthermore, the consumer constitutes a valuable source of information for both businesses and government authorities, and especially for upstream manufacturers, because they usually have little direct access to information pertaining to the final consumer. Consumer feedback constitutes confirmation or disconfirmation of a product's quality. Therefore, the authorities can rely

on consumer feedback to formulate regulations and police compliance, and businesses can use such feedback to improve internal quality control as well as identify counterfeit goods in the market. Furthermore, a QR code being scanned signals the completion of a sale for the manufacturer—helping the manufacturer identify whether a good is sold or is stored in inventory in some part of the supply chain. Businesses can use such data to optimise and coordinate supply chain operations, similar to how shared point-of-sale data are used.

7.1.2 Piggybacking and data reuse

As reflected in the case study, supply chain visibility allows all stakeholders to piggyback on each other's data for their own purposes. Specifically, piggybacking refers to the repurposing of existing data in the data flow. In the Cross-Border Trading Platform, businesses share ERP data with customs. Such data are originally intended to be used by businesses to manage supply chain operations, but customs repurposes such data for risk assessment and customs clearance. Furthermore, COCSO, the carrier, also repurposes information from the Cross-Border Trading Platform to strengthen internal compliance, such as implementing real-time monitoring and ensuring the independence of audits (Ma, 2018). In the case of the GQTS, customs uses the data for quality control, risk management, and customs clearance of imported products. Businesses also repurpose such data to conduct their own customer analytics and quality control, and consumers use such data to protect their interests. Such repurposing of data resulted in the formation of data collaboration partnerships between business and government in the Cross-Border Trading Platform and between business, government, and customer in the GQTS. In such data collaboration partnerships, supply chain visibility generates public value and benefits all participants.

The concept of piggybacking proposed in the project *IT for Analysis and Intelligent Design of e-Government* (ITAIDE) initially referred to customs piggybacking on the existing IT infrastructure of businesses, doing so to repurpose business data for policing compliance. Such piggybacking reduces costs for the government because the government does not have to invest in its own dedicated systems (Tan et al., 2011). Furthermore, as indicated in the case study, businesses can also piggyback on government platforms to repurpose data for commercial use. This reduces costs for businesses, which incentivises businesses to voluntarily share their data with authorities.

7.2 Value for businesses

7.2.1 Improving compliance

In both case studies, businesses voluntarily provided data to demonstrate their compliance to customs; in exchange, these businesses had a more streamlined customs-clearance process and lower risk of insufficient paperwork because such data had been provided prior to the arrival of a shipment. Such data also functioned as further proof of compliance during post clearance audits. A senior manager from SAIC Volkswagen stated the following:

> During the reauthorisation of our AEO status in 2019,[1] we showed our system to customs auditors, who said that our system served as verification of the consistency of our end-to-end data and our paperless transmission throughout the whole chain.

[1] Customs reauthorizes AEO status every 3 years in China.

Both case studies underscored the importance of traceability and auditability, which are goals held in common by customs and businesses that voluntarily share information.

Because they are sharing their data, such businesses demonstrate confidence in their current internal control systems; they must ensure both their continued compliance and the quality of their data. This information-sharing mechanism differs from AEO authorisation. Specifically, the AEO is a licence granted on the basis of a company's internal compliance infrastructure, and this mechanism grants a business simplified and prioritised customs procedures after authorisation. Thus, some AEO companies slacken internal controls after being licensed and fail the reassessment several years later. By contrast, because information is shared voluntarily on a continual basis, companies have an intrinsic incentive to ensure consistently strong internal controls.

In addition to the proof of compliance, which is shown to customs, useful tools and essential data sources are available to businesses through the information-sharing platforms. These can be used by companies to manage their operations through leveraging access to richer data on the supply chain. To serve this purpose, the Cross-Border Trading Platform is equipped with an internal control module, which is equipped with various functions, such as data gathering, tracing, querying, and analysis, in addition to displaying how long it takes for each stage of customs to be cleared. Operators can use this module to optimise their internal control infrastructure as well as make operations cheaper and more efficient through the use of B2B and G2B external data, which make the supply chain more visible. In the case of the GQTS, customer feedback on poor quality products can help brand owners improve their quality control. Similarly, e-commerce platforms can use such data to weed out manufacturers selling substandard products or traders who forge production certificates or sell counterfeits, thus bolstering the reputation of the e-commerce platform.

7.2.2 Reducing cross-border delays

Businesses voluntarily share commercial information with customs to facilitate trade when their goods cross the border. Customs clearance delays greatly affect the safety stock and logistical performance of a company, especially those in the just-in-time supply chain (Chung, Talluri, & Kovács, 2018). The interviewees underscored the importance of customs clearance being not only swift but also predictable (i.e., with low uncertainty as to when goods will clear customs). Specifically, long clearance times increase the cost of holding goods in transit, and uncertain release times increase the safety stock required. In the stakeholder analysis of the case study, the participants noted the benefits of fewer delays when their goods cross the border after voluntarily sharing more information with customs due to the improved supply chain visibility.

Specifically, the reduced delays at port were due not only to a streamlined customs procedure but also to the efforts of other stakeholders: trade involves not only customs but also many other stakeholders, such as the port (or airport) as well as public and private actors (Matsuda, 2012). According to the WCO Time Release Study, the regulatory procedure for imports at a destination county comprises four parts: (1) port (airport or land border) procedures, (2) customs procedures, (3) procedures required by other border agencies, and (4) business procedures. China Customs has recently made much effort to reduce the release time at port and has, since 2018, shifted its focus from customs release time (the second part) to overall release time (all four parts).

As indicated by the case study of the Cross-Border Trading Platform, if customs can coordinate the participation of multiple stakeholders, voluntary information sharing can be achieved in both B2G and B2B interactions. Therefore, by using the additional commercial information, customs can streamline clearance procedures, and an importer can pick up their containers as soon as they arrive because of simplified procedures and a supply chain that is more visible to importers, exporters, carriers, and the port. In the case of the GQTS, a more visible supply chain means that customs can access the quality-inspection reports of overseas inspection agencies, which simplifies business procedures and reduces the need to wait for quality-inspection results upon the arrival of goods.

7.2.3 Optimising supply chain operations

Information sharing is essential to achieving supply chain coordination and reducing the bullwhip effect. Participation in the voluntary information-sharing mechanism allows business participants to optimise their supply chain operations. Generally, the information shared includes that pertaining to inventory, sales (including forecasts), order tracking, and the production and delivery schedule (Lee & Wang, 2000). In global supply chains, supply chain optimisation is influenced by many factors, including the actions of border control agencies. Consequently, for compliance purposes, information sharing is extended to cover a wider range of requisite documents, but this increases the difficulty of data exchange among the increased number of stakeholders involved.

In both case studies, in return for voluntarily sharing the commercial data, businesses gain access to more supply chain data on the respective platforms; these data come from customs authorities and other businesses, allowing the supply chain to be better optimised. In the case of the Cross-Border Trading Platform, it allows the carrier, port, and importer and exporter to aggregate data. Such aggregation allows the importer to track the goods in real time while the goods are in transit as well as monitor port operations and customs-clearance status upon the arrival of cargo. The data help the importer undertake predictive monitoring as well as the advance arrangement of production or sales. With improved supply chain visibility, companies benefit by being able to make more optimal supply chain decisions, such as configuring the safety stock levels of parts according to their release time, which reduces costs. A senior manager from SAIC Volkswagen stated the following:

> We have a logistics department that may pay more attention to this. In fact, we consider supply chain transparency to be beneficial for optimisation. We want to aggregate more data to optimise inventory, reduce costs, and conduct intelligent decision analysis. For example, if the data analysis indicates that the release time of some parts is 2 days longer than that of other parts, I want to find out why and may prepare 2 days more stock for that part with the longer release time.

For the GQTS, it provides end-to-end traceability across the supply chain with the information channel extending to the final customer. All private-sector entities—including upstream manufacturers, traders, or downstream cross-border e-commerce platforms—can use the platform's data to improve their supply chain decision-making, such as that pertaining to quality control, supplier selection, or consumer analysis. The design of the GQTS platform is business friendly. For example, manufacturers used to find it difficult to notify customers of a recall of some specific batch of products from the global market. The recall notification module in the GQTS was thus designed to remedy this. A manufacturer can now use the module to contact users of a product to be recalled.

The two cases indicate that supply chain visibility greatly aids supply chain optimisation. In the voluntary

information sharing initiatives, the sharing of more data with customs does not straightforwardly entail more simplified customs procedures for the participant. In fact, legal requirements limit how far customs can simplify its procedures.

The two case studies indicated that trade facilitation for business involves not only customs but also businesses. Specifically, China Customs has done its utmost to provide trade facilitation for import and export enterprises to improve the business environment; further improvements must therefore come from businesses. In addition, the AEO programme can also provide special facilitation for qualified entities. Therefore, in both cases, customs has encouraged business participation through underscoring the commercial incentives afforded by improved supply chain visibility—a measure that goes beyond the streamlining of customs clearance such as the reduction of inspection rate or giving priority to inspection.

For government-driven initiatives, customs authorities should allow participants to benefit from improved supply chain visibility, specifically by allowing participants to flexibly and fully utilise the additional data to optimise their supply chain operations. This incentivises businesses to work with customs.

7.3 Value for customs

7.3.1 Enhancing data quality

For customs authorities, voluntary data sharing carries the primary benefit of enhancing data quality. Customs authorities have recognised low-quality data to be a major problem (Wang, Hulstijn, & Tan, 2016). Data quality is a concept that pertains to a data set's fitness for use (Wang & Strong 1995, 1996); being multidimensional, this concept entails that the purpose of having good-quality data varies between domains. The typical essential attributes of data quality are accuracy, reliability, consistency, completeness, and timeliness. The Word customs organization (WCO, 2015b) noted that customs authorities should request the right data at the right time and from the right source to better assess risk and facilitate legitimate trade. The case study indicated that voluntary information sharing by businesses can improve the quality of data had by customs. Such improvement occurs through aggregating information from multiple sources and through conducting prearrival risk analyses by verifying information against internal and external data sources in advance.

Information aggregation

The information in the mandated declaration on the transactions involved and on the international movement of an imported or exported good is insufficiently complete for accurate risk management. Supplementary data on trade and logistics, although present, are scattered throughout the various actors of a supply chain. Thus, the data available to customs officers were limited (Thibedeau, 2019). Therefore, from the perspective of customs, a primary purpose of voluntary information sharing is to aggregate data from multiple sources to make existing data more complete.

In the case of the GQTS, the platform remedies the problem of incomplete information in the case of goods that are imported in small quantities—such as those from cross-border e-commerce. With more complete information, customs can better ensure the quality of these goods. The GQTS—in establishing

a global data pipeline for cross-border e-commerce throughout the entire supply chain—has successfully integrated data on production, logistics, and consumer feedback as well as from quality-inspection reports. Specifically, the information on product quality in the inspection report, the information on production and logistics, and the information of customs clearance can also be used verify the source and quality of imported products. Furthermore, customer feedback provides the best verification of a product's quality. The detailed information comes from a wide range of sources along the entire global supply chain. The GQTS has expanded the scope and depth of data at customs' disposal.

In contrast to the GQTS, the Cross-Border Trading Platform constitutes a regional information hub that has no connection with companies abroad. However, the data on the Cross-Border Trading Platform are aggregated at not only the port level but also the global level. At a regional level, the Cross-Border Trading Platform has expanded the scope of business-provided data on both trade and logistics. The business-provided data integrated by the platform include the data initially shared between supply chain partners—such as the shipment data from the suppliers of SAIC Volkswagen—and the data shared by COSCO that were initially intended only for internal company use—such as those on the shipping route, port plan, booking data, and cargo flow direction (Ma, 2018). Through the Cross-Border Trading Platform, these data were voluntarily shared by COSCO and integrated with the customs clearance status provided by Shanghai Customs; this allows both customs authorities and businesses to track the location of a ship in real time. As for data integration at the global level, local importers or exporters provide customs with brief information on overseas supply chain partners. With such information, customs can better determine the trustworthiness of overseas supply chain partners and evaluate the overall security risk posed by the entire supply chain. With regard to the global level of data integration, information pertaining to overseas supply chain partners does not have to be obtained through a global data pipeline. Such information can also be furnished by local enterprises that voluntarily do so; although limited and not completely reliable, such enterprise-provided information plays an essential role in linking internal data with external data sources to improve the data analytics capabilities of customs authorities. In summary, with the information voluntarily shared in the Cross-Border Trading Platform by local companies, customs has access to more complete data on both supply chain actors and on the movement of goods.

Information verification

The case studies presented two scenarios involving information verification. In the first scenario, the voluntarily shared information was still within the scope of the customs declaration, but the format was such that automatic verification was easier. Using the traditional declaration, customs verified the authenticity of a declaration by comparing the data in the declaration form with those in other documents such as contracts, invoices, the packing list, and other requisite certificates or licences. However, the data in some of the documents—often in scanned or hard copies—were in an unstructured form. Although customs already had data from these documents on hand, automatic cross-validation was difficult and manual examination was often required. If enterprises can voluntarily provide structured data, even if only concerning key items, automatic verification becomes possible.

In the second scenario, the additional information shared was beyond the scope of the declaration, which meant that enterprises were not required to submit such information to customs or include it in the documents attached. Such additional information helps customs cross-validate information in more

commercial data fields against internal or external data. For example, in the Cross-Border Trading Platform, data from three data sources—customs declarations, additional trade data voluntarily shared to customs, and external data from banks—can be cross-validated to verify the actual transaction value. In the GQTS, customs validates data from three sources: cross-border e-commerce platforms (which furnish transaction and declaration information), logistics enterprises (which furnish logistics and warehousing information), and payment platforms (which furnish payment information). These pieces of information constitute proof of the product's authenticity and are thus useful for detecting counterfeits.

Information provided in advance

At present, many customs authorities require an advance manifest to be declared by the carrier (encapsulated in, for example, the 24 Hour Advance Manifest Rule) for customs to conduct a prearrival risk assessment, focusing especially on security risks. With such information, customs lock up the high-risk container before the declaration and before the container arrives at the terminal. However, information in the advance manifest is neither complete nor accurate enough for customs to conduct an accurate risk analysis. Therefore, customs must obtain more information from businesses in advance through voluntary information sharing.

The case studies indicated that customs established mechanisms for voluntary information sharing in part to access additional commercial data in advance of a shipment. In the case of the Cross-Border Trading Platform, the advance provision of data by businesses to customs allows (1) businesses to declare their goods in advance and (2) customs to conduct a risk assessment in advance. Similarly, in the GQTS, the advance collection of (1) the quality-inspection results of third-party institutions and (2) information pertaining to production and logistics allow customs to conduct a risk assessment in advance, which facilitates trade and shortens the waiting time of goods at the terminal.

7.3.2 Role in risk management

The provision of additional data by the private sector helps customs better manage risk, as is well known and as elucidated by the case studies.

First, businesses that voluntarily share their data exhibit a willingness and capacity for compliance, which allows customs to categorise these businesses as being low risk. These businesses should also have access to incentives and simplified customs-clearance procedures, which would allow customs to concentrate its compliance resources on high-risk entities. Customs' clients can be grouped into four categories based on where they fall on a risk continuum (Widdowson, 2005):

1. Those that are voluntarily compliant
2. Those that try to be compliant but sometimes fail
3. Those that avoid compliance if possible
4. Those that deliberately do not comply

Only businesses that are voluntarily compliant (the first category) voluntarily share their data with customs. Businesses that try to be compliant but fail (the second category) do not voluntarily share their data because they are afraid of being sanctioned should the shared data reveal wrongdoing. By implication, businesses that are even more noncompliant (the third and fourth categories) almost surely will not voluntarily share information with customs. In the two cases, participants in the Cross-Border

Trading Platform were mainly those with high credit in the enterprise credit management system of China Customs, and participants in the GQTS were mainly well-known brands.

Therefore, by drawing on reputation regimes under conditions of imperfect information (Kreps & Wilson, 1982), customs can screen low-risk businesses by their willingness to join the voluntary information-sharing initiatives. The mechanism of information disclosure is similar to that in AEO (Butter et al., 2012).

Second, because businesses that voluntarily share information are compliant actors, the following question is raised: can the voluntary sharing of additional commercial information help customs detect deliberate regulatory violations?

As indicated in the case study, whether a piece of shared information helps customs detect deliberate regulatory violations depends on the role in the supply chain occupied by the actor sharing it. Specifically, actors functioning as an information hub—such as a carrier or e-commerce platform—provide the most helpful information. For example, information provided by carriers helps customs identify suspicious shipping routes, and transaction data provided by e-commerce platforms help customs identify understated prices. By contrast, the commercial information shared by importers and exporters is not directly related to bad actors or smuggling, although it can be used to determine the proper range of risk indicators.

In the case of the GQTS, voluntary information sharing is decisive in helping customs not only detect but also reduce counterfeiting risks. The QR code–accessible information provided by manufacturers and brand owners indicates a product's quality, which allows noncompliant actors to be expelled from the market, thereby reducing counterfeiting risks. Customer feedback on the platform can also indicate which products are counterfeit.

Chapter 8 Conclusions and Recommendations

8.1 Conclusions

Although cross-boundary information sharing has been extensively studied in the literature, little attention has been paid to the interaction between businesses and the government. This study explored a type of business–government data partnership where businesses voluntarily share with customs—through the use of a new IT platform provided by the government—information that goes beyond the scope of a mandated declaration. The main research question had two parts: (1) *How is voluntary information-sharing to customs achieved* and (2) *What are the sources of value for the business and customs?* The first research question was answered through answering the sub-questions of *what to share? how to share? why share?*

The research questions were motivated by the pilot projects that have been recently initiated by several regional customs authorities in China. Two cases, the Cross-Border Trading Platform and the GQTS, were studied to answer the aforementioned questions. Although the platforms in the two cases differed in their objectives and architecture, both featured a business–customs data cooperation mechanism where businesses shared additional commercial data beyond those required by the customs declaration. Moreover, the GQTS illustrated the concept of a data pipeline (Hesketh, 2010) that also relies on voluntary information sharing by businesses. By contrast, the Cross-Border Trading Platform demonstrated an alternative approach of getting data from their source in the absence of a data pipeline infrastructure. The characteristics of the two cases were compared by using the DTI framework to assess the dimensions of architecture, process, and governance.

In the case study, the scope of data in voluntary information sharing was analysed to answer the first sub-question of *what to share?* We found that the data sources were expanded to include more parties upstream and downstream in the supply chain, and the shared data were more granular than those in the declaration. Subsequently, connections to business' IT infrastructure were analysed to answer the second sub-question, *how to share?* Customs was found to provide APIs and a web UI in both cases for the platforms to be more user-friendly and adaptable. Finally, the motivations of actors (customs authorities and businesses) were analysed to answer the third sub-question, *why share*? The incentives, costs, and security and privacy concerns entailed in voluntarily sharing information on the platforms were investigated.

As noted in the literature review, to solve the problem of poor data quality in the global supply chain, Hesketh (2010) proposed the concept of a data pipeline. Klievink et al. (2012) investigated this concept with respect to its potential benefits for businesses and government, noting that a data pipeline must be business driven; however, that study found it challenging to identify the economic drivers for businesses. By contrast, in this study, the government led both projects. Furthermore, the GQTS is a data pipeline, which involves more possibilities for business-government interoperability in implementing the data pipeline.

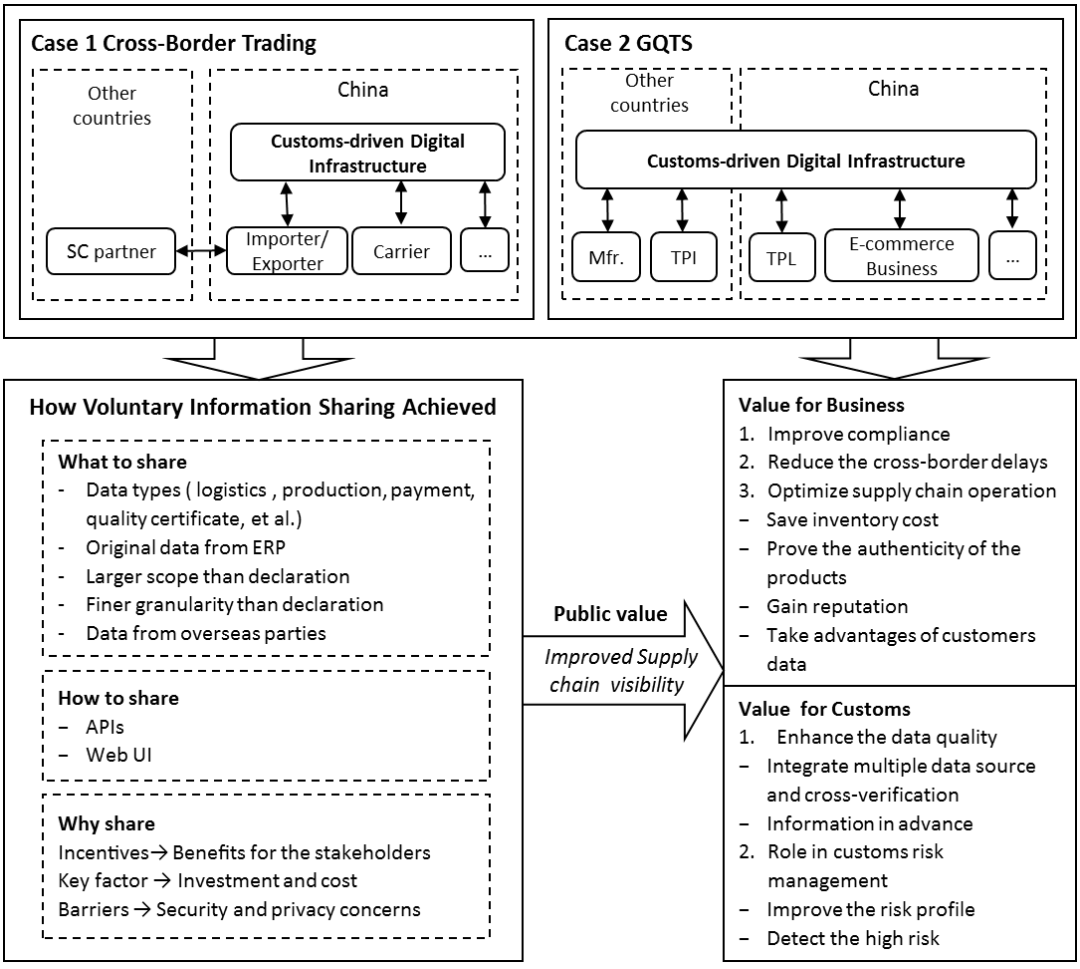
This study demonstrated that the sources of public value lie in supply chain visibility. Therefore, data interaction should not be limited to its B2G and G2G variants. B2B, G2B, C2B, and C2G information sharing also contributed to improving supply chain visibility, thereby generating public value. For

example, in the Cross-Border Trading Platform, the carrier and the port share additional location and voyage-related information to the importer and exporter (B2B), and customs provides more information on clearance (G2B). Furthermore, in the GQTS, customer feedback is sent to authorities and to supply chain partners (C2G and C2B) to ensure product quality.

Customs can still obtain data from overseas sources that are outside its jurisdiction through voluntary information-sharing mechanisms, albeit with some difficulty. The case of the GQTS indicated that with the right incentives, upstream companies abroad can be made to share their commercial data. By contrast, the Cross-Border Trading Platform illustrated the alternative approach of having local companies provide general information on overseas supply partners. With these voluntary information-sharing initiatives, customs enhanced data quality and improved risk management. Businesses benefit through having a means of improving internal compliance, reduced cross-border delays, and having more optimal supply chain operations.

Figure 9 presents the framework, including the flow of information, underlying the voluntary information sharing of each case study.

Figure 9. Framework of voluntary information sharing to customs.



8.2 Recommendations

In addition to a shorter release time, a more coordinated supply chain (from improved visibility) constitutes a source of public value. Traditionally, the relationship that businesses have had with

customs has revolved around compliance, avoiding penalties, and reducing the risk of supply chain disruptions, and business–customs cooperation has centred on supply chain security and trade facilitation. If customs has already done its utmost to facilitate trade, little more can be done to improve trade facilitation for businesses that voluntarily share information to hone their competitive advantage. Both customs and businesses must devise new means of reaping the benefits of supply chain visibility to create public and private value. For example, the Cross-Border Trading Platform, as an information hub, facilitates information transfer among actors in the supply chain, and the GQTS shares consumer information to the benefit of both customs and businesses. Businesses also gain from data cooperation with customs. For example, SAIC Volkswagen attempted to apply lean production principles to optimise their inventory, specifically by improving supply chain visibility. However, not all companies are fully aware of the benefits that data cooperation with customs bring in the context of the global supply chain.

Customs must devise means to better leverage the shared data to generate value. These shared commercial data should be integrated with internal and external data, such as data from other government agencies or from third-party commercial databases, to better assess risk and facilitate trade. However, at present, such data integration is difficult because the data come from different sources and in different formats. More work is required to achieve full use of these data resources.

Furthermore, voluntary information sharing involves data cooperation that is not subject to the strict requirements of a mandated customs declaration. IT platforms should be more flexible and scalable to be more adaptable. The GQTS architecture features three-level traceability. Factory-level traceability has the more ambitious aim of establishing an international data pipeline, whereas port-level traceability has more basic aims, which eases initial implementation. Both platforms in the case studies provide two options, APIs and web UIs, for connection because of the differences between commercial systems with respect to complexity and heterogeneity as well as upload frequency. The Cross-Border Trading Platform has a flexible scope of information sharing with required and optional items, and this reduces the barriers of data cooperation to attract more participants. The scale effect is important because commercial interest and public value are positively related to the number of participants of either the information hub or data pipeline. For customs, having more participants is desirable because having more information for risk assessment results in more accurate profiling. For businesses, having more participants is desirable because the larger quantity of provided data makes the supply chain more transparent.

8.3 Contributions and limitations

8.3.1 Theoretical contributions

With regard to its theoretical contributions, this thesis empirically elucidated the concepts of business–government interaction and the data pipeline. In particular, the GQTS was determined to exemplify the extension of the current data pipeline to the final consumer to ensure data integrity throughout the supply chain. Because research on data pipeline innovations has been centred on Western countries, this study's investigation of a data pipeline in the Chinese context provides a fresh perspective into voluntary B2G information sharing. The main theoretical contributions are as follows.

1. From business-driven to government-driven initiatives

The initiatives in both case studies were government driven and have yielded good results. This finding contrasts with those in the literature stating that data pipelines must be business driven because of

limitations in funding and in IT expertise and the government's inability to reach beyond jurisdictional limits (Klievink et al., 2012). In both cases, however, the government played a dominant role in coordinating stakeholders and ensuring the reliability of data in G2B and G2C data sharing. Similar to the piggybacking and repurposing of commercial data by government for regulatory purposes in business-driven projects, businesses can also piggyback on government platforms and repurpose the data for profit.

2. Incentives for businesses

In the existing data pipeline literature, the reported incentives for businesses have centred on logistics optimisation (e.g., reduced inventory and better logistics; Hesketh, 2010) and on the synchromodality of transport modes between transportation hubs (Klievink et al., 2012). The case study also indicated the aforementioned benefits to businesses. For example, in the case of the GQTS, customs can reuse the quality results from overseas third-party inspection agencies at arrival to shorten the release time. Furthermore, businesses can enjoy the following incentives from sharing data over the GQTS:

- Businesses improve their reputation in the eyes of the government with regard to the quality of their products.
- Businesses help reduce the flow of counterfeit goods masquerading as theirs.
- Businesses gain consumer trust with regard to the quality of their products, which increases sales.

3. Role of the end consumer in giving quality-related feedback

In previous studies, the data pipeline has (1) a scope extending from seller in the origin country to the buyer in the destination country and (2) the objective of 'getting data from the source' (Hesketh, 2010), which imply that information flows from the upstream to the downstream of the supply chain. However, information flow is two-way in the GQTS between the consumer and the source: customer feedback is sent to authorities and supply chain partners in a closed-loop information chain. Consumer feedback sent to the government (C2G) and to businesses (C2B) plays a significant role in the extended data pipeline and thus contributes to public value.

4. Role of coordinated border management in the data pipeline

The concept of a data pipeline was proposed for customs in the WCO's integrated supply chain management (ISCM) approach. In addition to customs authorities, other border control agencies have also called for seamless information exchange along the supply chain. The combination of data pipeline capabilities with the coordinated border management (CBM) approach was exemplified in the Floraholland case (Rukanova et al., 2017). The GQTS also illustrated the critical role of the CBM approach in the data pipeline. The GQTS was initiated by departments of the former China Inspection and Quarantine Bureau (CIQ) and was further developed in the context of the border agency integration of China Customs with the former CIQ. This analysis of how the data pipeline concept is implemented in the quality control of cross-border e-commerce in the GQTS enriches research on aligning data pipelines with CBM innovation.

5. Forwarding information of supply chain partners to customs

In 'getting the data from the source', data pipelines yield data that are more accurate than second-hand data, which can be filtered and altered (Hesketh, 2010). The GQTS is a data pipeline, whereas the Cross-Border Trading Platform, being a regional information hub, is not. However, companies at the

destination country voluntarily forward trade data 'from the source' (i.e., from companies at the country of origin) to customs, functioning as a proxy sharing second-hand data. Such data—albeit somewhat limited and not completely reliable because they are provided by local enterprises on their overseas partners—have still improved the analytics capabilities of customs. Considering the challenges entailed in building an international data pipeline, forwarding the trade data from the source to customs constitutes a feasible compromise before the establishment of a standard data pipeline.

8.3.2 Practical contributions

The practical contributions of the thesis lie in the elucidation of data-sharing mechanisms, the economic drivers, and the public value derived from data cooperation. Business can use the findings of this case study to make a more informed decision on whether they should join a data-sharing arrangement, specifically by better understanding what they stand to gain and how they can implement data sharing should they wish to do so.

8.3.3 Limitations

The limitations of this study are as follows. First, the two case studies are of limited generalizability: the initiatives are still regional pilots rather than general nationwide practices. How these initiatives perform over the long term and whether they can be implemented at a national level require further research. Furthermore, the benefits of voluntarily information sharing enjoyed by businesses depend on local customs policies, which vary within a country and between countries. Such variability also affects how a programme is designed and what the economic drivers are. Thus, because the data pipeline concept has an international scope, differences between countries and in shared interests should be considered. Furthermore, the cases herein were not compared with foreign ones, which makes the findings less generalisable to the global level. Future studies should compare different types of platforms (driven by business or government) with respect to the corresponding methods of governance and incentives. Second, only representatives from larger companies were interviewed — such as those from SAIC Volkswagen—in Cross-Border Trading, which may have biased the findings. As noted in the discussion on perceived benefits and costs, private-sector firms vary with respect to their IT capabilities and in the incentives that they stand to gain from data sharing, and these factors are affected by firm size. Thus, follow-up research can study companies of various sizes to obtain a more general understanding of incentives and barriers.

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