

Trade Facilitation for the Products of the Industry 4.0: The case of Customs Classification of Drone

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Abstract

Purpose – This paper investigates the implications for facilitating trade in the products of Industry 4.0. To identify the issues caused by the conflicts of policy objectives such as applying the tariff concession under the ITA and imposing the export control, by exploring the case of classification of drones.

Design/methodology – We adopted a single case study method to gain a deeper understanding of the complex and multifaceted issues of Customs classification in the context of facilitating trade in the products of Industry 4.0. This study employs the case of drones to explore how these issues of Customs classification affect trade facilitation. We ensured the internal validity of the study by confirming the pattern of the results with the existing theories.

Findings – Our main findings can be summarised as follows: the intrinsic nature of the products that converge several technologies causes issues in the classification. The inconsistency in product classification delays customs clearance by hindering the Customs risk-management system that pinpoints products subject to controls. To address the issues, therefore, we proposed fundamental reforms of Customs to empower themselves with management roles. Facilitating trade in the products of Industry 4.0 requires more enhanced Customs capability. Therefore, the reforms should include comprehensive capacity-building activities, such as changes in staff-trainings, promotion system, organisation and culture. Customs also need roles in robust designing of cooperative systems to compensate for the lacks of controls and to ensure concrete risk management for expedited Customs procedures. As well, by equipping the Single Window of Customs with crucial control functions of other ministries, Customs need to support the cooperation. The role of harmonising various pre-audits of other ministries with its own is another essential role that ensures predictability of clearance procedure.

Originality/value – There are scanty studies in the field of knowledge about what obstacles exist and what solution is available in the course of transforming to 'Industry 4.0'. In filling out the gap of knowledge, this paper is of academic significance in that it applies the research theory on trade facilitation for the specific cases of classification of the product of Industry 4.0 to verify its effectiveness and to extend the subject of the studies to the scope of Industry 4.0. It also has practical significance in that the results have provided implications for reforms of Customs procedures to facilitate trade in the products of Industry 4.0.

Keywords: Customs Classification, Export Control, Industry 4.0, Information Technology Agreement, Trade Facilitation

JEL Classifications: F10, F19, F50

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1. Introduction

The successful transformation of industries to 'Industry 4.0'¹ has recently been pointed out as essential to sustaining economic growth. Just as important as making the change, it has also been emphasised, is to position in the world market as a trading partner of products of Industry 4.0. For Korea, the position is imperative, since its economic growth has mostly been depending on exports². In this backdrop, there has been a strong demand for the knowledge on the ways to create an environment where the products of Industry 4.0 can easily be traded. However, there are scanty studies in the field of knowledge about what obstacles exist and what solution is available in the course of developing such an environment.

'Industry 4.0' is a terminology that has first been proposed for the economic development plan of Germany (Roblek, Meško and Krapež, 2016). Cyber-physical-system (CPS) based on the convergence of various technologies, data and knowledge have characterised the industry (Lu, 2017). The characteristics, on the one hand, have been a basis for rapid growth and widespread impact of Industry 4.0. However, on the other hand, they have caused difficulties in defining its scope and classifying its products. Thereby, governments' policy to facilitate trade in the products of Industry 4.0 often encounter confusions in pinpointing the products that require supports or controls.

This paper includes a follow-up study of 'the Information Technology Agreement for the Goods of the Industry 4.0 – focusing on the issues of Customs classification' (Yi Ji-Soo and Moon So-Young, 2019). In the previous study, we have explored the specific issues of classifying the products of Industry 4.0 for the Customs' purpose³. In particular, we have focused on how the classification influence the application of tariff concession under the Information Technology Agreement (ITA). To enhance the discussion on this, now we aim to navigate further the influences of the classification on facilitating trade in the products of Industry 4.0.

We take the case of classification of drones to identify the issues caused by the conflicts of policy objectives such as applying the tariff concession under the ITA and imposing the export control. Uniform and straightforward Customs procedures are the starting point for facilitating trade. However, it is often not probable for the products of Industry 4.0, including drones, because various policy objectives collide. This study employs the case of drones to demonstrate more specifically these problems against facilitating trade in the products of Industry 4.0 and seeks implications from the results.

This paper set three research questions. First, what are the issues of Customs classification for the products of industry 4.0? Second, how the issues of Customs classification affect trade facilitation of such products? Third, what are the implications for facilitating trade in the

¹ The 4th Industrial Revolution was the term first raised for economic development in Germany, but academic definition or scope has not been established (Lu, 2017). However, it is understood as a process to make manufacturing and consumption smarter by enhancing the operational efficiency of factories, cities, and products through the extensive convergence of information and communication technologies, such as the Internet of Things and cyber-physical systems (Davis, 2015).

² Exports contributes over 35% of Korean GDP. Retrieved on 11 October, 2019 from Korea Statistical Information System (KOSIS) webportal (http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_2KAA806).

³ This refers to the classification system under the 'International Convention on the Harmonized Commodity Description and Coding System', which went into effect in January 1988. Although the classification system under the HS Convention was created to unify the classification of products on the tariff table globally, it has become the basis for implementing the overall import and export regulations or promotion policies, including non-tariff measures, international agreements, and rules of origin, as well as tariffs (WCO, 2018a).

products of Industry 4.0? While exploring the answers to these questions, the academic significance of this study lies in applying the theory on trade facilitation to the specific case of Customs classification and Customs clearance of the products of Industry 4.0. By doing so, this study purports to verify the validity of theories of trade facilitation. As well, this study aims to enhance the scope of the subject on trade facilitation studies to the field of Industry 4.0. This paper also has practical importance in that we can find implications for establishing an environment that facilitates trade in the products of Industry 4.0.

This paper is composed as follows. The next section includes a literature review on diverse areas of studies relevant to Industry 4.0. It includes studies on Customs classification, the application of tariff concession under the ITA, imposition of export controls, and trade facilitation. Section III is devoted to constructing an analysis framework and methodology to analyse the drone case. The analysis results are summarised in section IV, and the implications are presented in the concluding section.

2. Literature Review

2.1. Principal Features of Industry 4.0

The term 'Industry 4.0' was used to describe a highly digitised manufacturing environment in which information flows between machines in controlled environments that minimise human intervention (Branco, 2018). Since then, the term has evolved into a concept for improving the country's industrial competitiveness through the digitalisation of industries. It changes the paradigm of the entire manufacturing process and business, based on the cyber-physical-system (CPS) in which the physical manufacturing process is closely connected to the computer, communication, and control system (Bagheri et al., 2015).

Through the interchangeability of information beyond the internal and external corporation, internet communications and CPS have resulted in the integration of various applications and software systems, improving efficiency and productivity in business operations, such as smart factories and manufacturing, smart products and smart cities (Romero and Vernadat, 2016; Stock and Seliger, 2015). In this process of developing more 'smart' products, the products of Industry 4.0 have the principal features of 'convergence of technologies' and 'rapid' development (Davis, 2015).

The process of making more efficiencies and productivities has been applied to the whole process of business; purchasing raw materials, manufacturing, and consuming. It is also applied to whole areas of industries from agriculture to aerospace. In doing so, Industry 4.0 is considered to be inclusive of almost infinite items and industries that are impossible to bound the scope (Lu, 2017).

2.2. Customs Classification of the Products of the Industry 4.0

2.2.1. *The HS Convention and Classification of Products*

The International Convention on the Harmonized Commodity Description and Coding System (the HS Convention) has been a basic system for classifying products and applies to 98% of the world's trade⁴. Although the HS Convention was initially designed to unify the

⁴ The HS Convention, which went into effect in January 1988 is used by 183 member countries of the World Customs Organization (WCO). Even non-member countries that do not join the WCO often classify items under this Convention. This is the basic classification system applied to the import and export of most countries (WCO, 2018a).

tariff tables of Customs, it has also been used as a basic framework for implementing policies on export and import (WCO, 2018a).

The HS Convention classifies the products into six digits numerical code. The first two digits of the code are called 'chapter', the four digits are called 'heading', and the six digits are 'sub-heading'. The HS Convention classifies products by material, function, and use. The 97 chapters further group those classifications, which comprise broader categories of 21 sections. The system has been updated with the appearance of new products or changes in the trade environment. According to the HS Convention, member countries to the Convention may set and publish tariff tables and other trade-related statutes and procedures at the level of six digits. Countries may subdivide the classifications of six digits code further under their legislations. Under the Customs Act, the Korean government publishes a 'Tariffs and Statistics Integrated Classification Table', using ten-digits classification codes for domestic use (WCO, 2018a).

Governments, international organisations and traders have used the HS classification for multiple purposes. It has been basic nomenclature not only for Customs tariffs but also for internal taxes, trade policies, monitoring controlled goods (WCO, 2018a). However, some other international conventions and control systems have different political approaches in classifying goods. This situation is common for the goods of the Industry 4.0, such as those cases with tariff concession under the ITA and imposition of export control. Under the ITA, the HS does not provide precise divisions of product groups that are eligible for the concession available. As a result, some IT products are classified base on their names (Joseph and Parayil, 2008). For the case of export control, governments are using a different classification system for those controlled items from the HS (Lee Sang-Ok, 2011).

2.2.2. Classification of Products and the Information Technology Agreement

The products of the industry 4.0 have often been classified based on Section 16 of the HS Convention, which classifies machinery or electronic equipment. In particular, the legal notes 3 and 4 of Section 16⁵ are basic guidelines to classify on multi-function machines⁶ or composite machines⁷ with 'converged technologies'. For example, traders refer to the notes in classifying drones that comprise of multiple functions such as aviation and digital camera. Under the notes, multifunctional machines shall be classified according to their principal functions. If the principal function under the notes is not determined, the product shall be classified in the last heading in numeric order among the headings that equally merit consideration⁸.

The Information Technology Agreement (ITA) has been implemented since 1997, accounting for 92% of IT product trade. The agreement has caused disputes related to the

⁵ Although this is not legally binding, the title of Section 16 defines the products as 'MACHINERY AND MECHANICAL APPLIANCES; ELECTRICAL EQUIPMENT; PARTS THEREOF; SOUND RECORDERS AND REPRODUCERS, TELEVISION IMAGE AND SOUND RECORDERS AND REPRODUCERS, AND PARTS AND ACCESSORIES OF SUCH ARTICLES.'

⁶ The notes of Section 16 define a multi function machine as 'machine-tools for working metal using interchangeable tools, which enable them to carry out different machining operations (e.g. milling, boring, lapping).'

⁷ In the notes, a composite machine is defined as 'Composite machines consisting of two or more machines or appliances of different kinds, fitted together to form a whole, consecutively or simultaneously performing separate functions which are generally complementary and are described in different headings of Section XVI.'

⁸ Rule 3 (b) of GRI. When goods cannot be classified by reference to 3 (a) or 3 (b), they shall be classified under the heading which occurs last in numerical order among those which equally merit consideration.

Customs classification for products of the industry 4.0. Since the tariff concession under the agreement applies to the limited scope of classifications⁹, controversies over the classification of products have continued. In particular, the decision on the ‘principal function’ of products that converge multiple functions such as the products of the industry 4.0 have frequently caused dissents. As well, the Customs authorities’ arbitrary and narrow interpretation on the scope of products for the tariff concession has worsened the situation, undermining the predictability of the Customs clearance procedures (Dreyer and Hindley, 2008; Grayston, 2011; Tasker, 2001).

2.2.3. *Classification of Products and Export Control*

Customs classification is used to identify the products subject to various trade agreements and other regulations on import and export. It is also used for the Consolidated Public Notice under the Foreign Trade Act¹⁰, where all the relevant regulations and requirements to import and export are publicly notified. The export control system of strategic items also utilises the classification under the HS Convention. Countries implement the export control system of strategic items based on their classification system. However, as the public is more familiar with the HS classification, the export control system is utilising their codes based on the matching with the HS codes (Kim Myung-Su, 2018; Lee Sang-Ok, 2011).

Strategic items include weapons of mass destruction (WMD), dual-use products (for industrial use), technologies, and software used for manufacturing, developing, and using WMD. The international export control system has been established based on four multilateral agreements, namely the Wassenaar Agreement (WA), the Nuclear Supplier Group (NSG), the Australian Group (AG) and the Missile Technology Control Regime (MTCR). Each group requires member states to manage the exports of the strategic items by clarifying the items and establishing a guideline. The member countries implement the control system by reflecting those agreements into their laws (Lee Sang-Jin and Yoon Nam-Kwon, 2005; Lee Sang-Ok, 2011).

Korea adopted the export permit regime for the strategic items in 1989, by revising the Foreign Trade Act. With the revision, the export controls, including notification and export permits of strategic items, and the Catch-all system, have been enacted¹¹. Strategic items under the Foreign Trade Act of Korea are listed in Annex 2 (Dual-Use List) and Annex 3 (Munition List). Double-use items are classified by a five-digit control number which is classified by item group and corresponding export control system. The military supplies consist of 22 categories. There are two ways to determine whether a product is subject to export control. First, exporters determine by themselves through the ‘YesTrade (strategic items management system of Korea)’. Second, they can apply for the pre-determination either to the Nuclear Safety and Security Commission or the Korea Strategic Trade Institute (KOSTI). An exporter of a strategic item should obtain the export permits and reports to the Customs office when declares (Lee Sang-Jin and Yoon Nam-Kwon, 2005).

Since the implementation of export control, commentators have pointed out that the differences between classifying systems of export control and the HS increase complexity and transaction costs of traders. A matching table between the classification system has been

⁹ There are two kinds of products list that covered by ITA, Attachment A is classified with the HS codes, but Attachment B is without HS codes because they cannot be classified.

¹⁰ Article 12 of Foreign Trade Act, Act No. 16422, enforcement on August 1, 2019. The Ministry of Industry, Trade and Energy.

¹¹ Section 3 of Foreign Trade Act, Act No. 16422, enforcement on August 1, 2019. The Ministry of Industry, Trade and Energy.

devised, but the table has been far from a perfect solution that provides clear guidance to traders (Lee Hee-Yong et al., 2007; Lee Kee-Hee, 2006; Lee Sang-Jin and Yoon Nam-Kwon, 2005; Lee Sang-Ok, 2011).

2.3. Trade Facilitation in the Context of Customs Classification

Trade facilitation has been a global concern since governments have recognised the expansion of international trade as a reliable driver of countries' economic growth. Trade facilitation refers to activities that make the flow of goods and related documents in cross-border transactions more efficient. It includes activities that harmonise the domestic laws and standards with the international regulations and norms, increasing the transparency and competence of Customs authorities where cross-border transactions take place (Wilson, Mann and Otsuki, 2004). Scholars have focused on the concept of trade facilitation as the process of optimising the trade costs by implementing simplified and uniform procedures for the international trade (Moisé, Orliac and Minor, 2011; Moisé and Sorescu, 2013; Roy and Bagai, 2005; Walkenhorst and Yasui, 2009; Wilson et al., 2002).

International consensus on the significance of trade facilitation has resulted in the Revised Kyoto Protocol¹² in the mid-1990s. Later in 1996, it was adopted as one of the four main topics at the WTO Singapore Ministerial Conference¹³. Despite controversies and difficulties over the WTO negotiations process, the concepts of trade facilitation as an agreement in 2014. The agreement has further enhanced the concept beyond border-related procedures to the extent of domestic regulations and infrastructure, and cooperation among related government agencies (Neufeld, 2014).

Governments have adopted comprehensive measures for facilitating trade for customs administration through equipping a chapter under the Free Trade Agreement (FTA). The chapter for trade facilitation commonly includes four factors when it covers Customs procedures. Expedited customs clearance, predictability of institutions, the capacity of customs administration, and cooperation among related ministries (Jung Moon-Hyun, 2019; Yi Ji-Soo, 2018).

From the perspective of trade facilitation, researchers often point out the uniformity of the Customs classification as an essential part, and it is the gist of the HS Convention (Chen, 2016; Tavares, 2006; Vermulst, 1994). The Convention has developed as 'multipurpose product classification system' that determines the rate of duty as well as the coverage of non-tariff barriers. Therefore, the uniformity in the system reduces the degree of complexity associated with trade and Customs procedure and saves the total transaction costs for the trade (WCO, 2018a).

Tavares (2006) has described reasons that the classifications do not guarantee the uniformity based on the E.U.'s reclassification cases. The WCO HS Committee revise the HS basically due to the introduction of new products. However, since the classification affects the application of various tariffs or non-tariff measures, the relevant stakeholders, including governments and traders, often have motives to induce reclassification. Grainger (2011) also cites conflicting interests among stakeholders as the biggest obstacle to reform border management procedures for trade facilitation.

¹² The International Convention on the simplification and harmonization of Customs procedures, known as the Revised Kyoto Convention.

¹³ Four issues (known as Singapore issues) include trade and investment, trade and competition policy, transparency in government procurement, and trade facilitation. As developing countries opposed the expansion of negotiation issues, only trade facilitation issue has survived.

3. Research Method

This article is a follow-up study of the ‘The Information Technology Agreement for the Goods of the Industry 4.0 – Focusing on the issues of Customs classification’ (Yi Ji-Soo and Moon So-Young, 2019). In the previous study, we identified issues of classifying products of Industry 4.0 when countries implement tariff concessions under the ITA. In this study, we aim to explore how these issues of Customs classification affect trade facilitation. By doing so, our ultimate goal is to find the implications for facilitating trade in products of Industry 4.0.

We adopted a single case study method to gain a deeper understanding of the complex and multifaceted issues of Customs classification in the context of facilitating trade in the products of Industry 4.0. In this approach, if the patterns of case study results are consistent with the arguments of existing theories, we assume that the internal validity of the study can be guaranteed (Yin, 2016).

We selected a specific single case of ‘drone’ for this study. Drones are one of four products selected in our previous study: 3D printers, HDMI-enabled monitors, smartwatches, and drones. All of these products are known as products of Industry 4.0. While people have disagreements over classifying them in the application of the ITA, drones have attracted the most diverse classification opinions, as shown in Table 1.

Table 1. Classification Options for the Products of Industry 4.0

Items	Classification Opinions	HS Code	Terms of heading
3D Printers	Classification by the materials used for the 3D Printers	HS8463	Other machine-tools for working metal or cermets, without removing material
		HS8464	Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials or for cold working glass.
		HS8477	Machinery for working rubber or plastics or for the manufacture of products from these materials, not specified or included elsewhere in this Chapter.
		HS8479	Machines and mechanical appliances having individual functions, not specified or included elsewhere in this Chapter.
HDMI-enabled monitors	Classification depending on whether it is used primarily for computers	HS8528.52	Capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71
		HS8528.59	Other
Smartwatches	Classification according to whether it can be operated alone without a wifi connection	HS8517.62	Machines for the reception, conversion and transmission or regeneration of voice, images or other data, including switching and routing apparatus
		HS9101	Wrist-watches, pocket-watches and other watches, including stopwatches, with a case of precious metal or of metal clad with precious metal.
		HS9102	Wrist-watches, pocket-watches and other watches, including stopwatches, other than those of heading 91.01

Table 1. (Continued)

Items	Classification Opinions	HS Code	Terms of heading
Drones	Classification based on the principal function ¹⁾ of the product	HS8525.80	Television cameras, digital cameras and video camera recorders
		HS8802.11	Helicopters: of an unladen weight not exceeding 2,000 kg
		HS8802.20	Aeroplanes and other aircraft, of an unladen weight not exceeding 2,000 kg
		HS9503	Tricycles, scooters, pedal cars and similar wheeled toys; dolls' carriages; dolls; other toys; reduced-size ('scale') models and similar recreational models, working or not
		HS9015.80	Surveying (including photogrammetrical surveying), hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances, excluding compasses; rangefinders

Note: Legal Note 3 of Section XVI of HS Convention.

Sources: WCO (2015/2018b); Civil and Industry Complaints reported to Korea Electronics Association in 2012, 2013, 2014, 2015, and 2018 and WTO (2019).

In particular, we navigated the issues of classifying drones. To demonstrate the reasons that product classifications are inconsistent, we assessed the cases of classifying drones in two different contexts. One is when applying tariff concession under the ITA, and the other is when imposing the export control¹⁴ over drones. In both contexts, the HS can be used to classify drones. However, under both situations, separate classification systems are being used with the System. This case enables us to explore the issues of classification of the products of Industry 4.0 that are neither uniform nor harmonious.

In assessing the influences of inconsistent classification, we have focused on elements of trade facilitation in Customs procedure. Among other elements that previous studies have suggested, we have included four elements. They include expedited Customs clearance; predictable Customs procedures; capacity-building of Customs; and cooperation among relevant government agencies.

In order to provide answers to the three research questions of this study, we designed an analytical framework for drone cases, as shown in Figure 1. To explore the answer to the first research question, we have examined the issues of classifying the products of Industry 4.0 from two different perspectives, as shown in Box (1) of Fig. 1. The analysis on the cases of classifying drones to apply the ITA, and to impose export controls will provide a salient explanation of issues the incongruous and inconsistent classification of the products of Industry 4.0 causes. By doing this, we also investigated the limitations of current methods under the HS in classifying the products of industry 4.0.

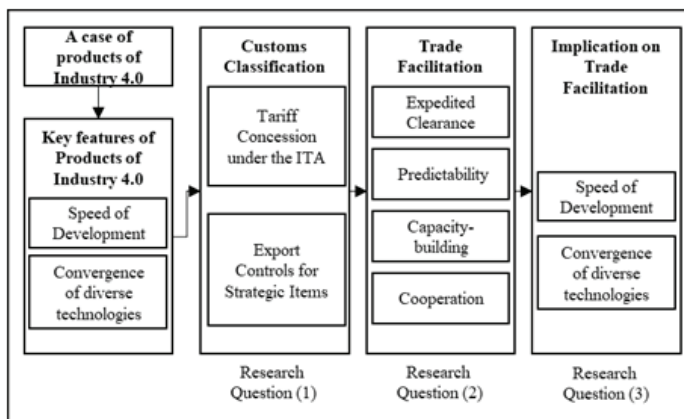
Box (2) of Figure 1 shows key factors of trade facilitation specific to Customs procedures that literature has provided (Engelschalk and Le, 2005; Grainger, 2011; Shujie and Shilu, 2009; Widdowson, 2018; Wilson and Otsuki, 2007). In exploring the answer to the second research questions, we have navigated the potential adverse impact on each part of those factors.

Based on the above analyses, we first suggested possible ways of overcoming the limitation

¹⁴ Drones are subject to the export control under 9A012 (IL9.A.12) (MT1.A.2) of Dual-Use Control List of the Wassenaar Agreement and the Missile Technology Control Regime.

of the HS in classifying the products of Industry 4.0. As well, we provided implications for facilitating the trade based on the main characteristics of products of Industry 4.0 listed in Box (3).

Fig. 1. Analysis Framework



We collected data required to analyse the issues of classifying drones from reports, opinions, research papers of WTO and WCO, and domestic notices and laws published by Korea Customs Service (KCS)¹⁵. Domestic civil complaints reported to KCS and the Korea Electronics Association (KEA) were also included. Data related to export control were analysed based on reports and documents of the Korea Security Agency of Trade and Industry (KOSTI), YesTrade¹⁶, Strategic Material Export and Import Notice of the Ministry of Trade, Industry and Energy. Data that require detailed interpretation and explanation was supplemented by performing brief interviews with staffs at KCS, KEA and KOSTI.

4. Analysis Results

4.1. Key Features of Products of Industry 4.0

According to the literature, the most distinctive features of products of the industry 4.0 are that they are 'convergence' of technologies that cross-industry boundaries and they create new products at high 'speed'. These features make them infinitely scalable and difficult to specify (Davis, 2015; Stock and Seliger, 2015; Vogel-Heuser and Hess, 2016). Drones are typical examples of those products, as they display two features of convergence and speed. In the 1930s, when the U.S. government first mass-produced drones, they used drones primarily for reconnaissance, combat, and anti-aircraft training. By the 2000s, the range of drone use was limited to military purposes. Since the 9.11 terrorist attacks in 2001, the United States has used drones as a counterterrorism strategy and drones have been utilised for attacks on terrorists and scout attacks since the mid-2000s (Lee Seung-Young and Kang Wook, 2019).

¹⁵ Harmonized System Korea (HSK), Customs Law Information Portal (CLIP, <https://unipass.Customs.go.kr/clip/index.do>).

¹⁶ YesTrade – an import and export control management system of KOSTI (<https://www.yestrade.go.kr/user/main.do?method=main>).

Table 2. The Convergence of Technologies for Drones and Expansion of the Application

Time	Utilisation of Drones
the 1930s	reconnaissance, combat, and anti-aircraft training
the 1940s	combat operations, including remote flight and explosive transport
the 1960s	missile attacks and surveillance missions
the 2000s	a counterterrorism strategy in terrorist and scout attacks
the 2010s	to create a wireless network in the telecommunication industry for food delivery in the catering industry as pesticide spraying device in the agricultural industry for facility management in the real estate industry disaster site support in the firefighting and disaster prevention field

Source: Lee Seung-Young and Kang Wook (2019).

The development of various related technologies has enhanced the industry fields that drones were utilised. For example, using a solar drone, Google has been working on a project to create a wireless network where no communication network is available. Starting from 2013, Amazon has been working on developing and commercialising Prime Air, which will deliver orders within 30 minutes by drone, from 2013. DJI¹⁷ has launched an agricultural drone with a spreading device. In Korea, they have been used for facility management and disaster site support.

Since the 2010s, the usage of drones has been exploded to wide ranges of industries. According to market research, ten million drone units were sold in 2017, but 22 million drones will be consumed by 2020. Also, the market will reach \$ 13billion and create 150,000 new jobs by 2025 (MarketLine, 2017). In the course of this market expansion, new types of drones will also be developed at a very high-speed, making them challenging to specify. Therefore, these features of drone have caused and will cause difficulties in Customs classification.

4.2. Issues of Classifying the Products of Industry 4.0

4.2.1. Customs Classification in Applying the ITA

At the newly enacted 'Act on the Promotion and Foundation of Drone Utilization'¹⁸, drones are defined as 'aircraft that can fly without the operator on board'. However, under the HS classification, the government have classified drones under a variety of names. The WCO HS Committee first considered the classification of drones at the International Classification Seminar held in Norway in 2014. Later, the classification was debated further at the 55th WCO HS Committee in 2015, focusing on the products of DJI. The most significant issue was defining 'the principal function' of drones under Note 3 of Section 16 of the HS Convention. Three HS codes were considered; HS8525 (digital cameras) for photographic and video shooting, HS9503 (toys) for a hobby, and HS8802 (other aircraft) for aircraft (WCO, 2015).

When defining the principal function of drones, the critical issue was to determine whether drones are eligible to the tariff concession under the ITA. Only when classified as a product of HS8525 (digital cameras), the tariffs on drones are eliminated under the ITA (Yi Ji-Soo and

¹⁷ DJI Technology Co., Ltd. is a Chinese technology company, and is a leading manufacturer of commercial drones.

¹⁸ Act No. 16420. Enacted by the Ministry of Land, Infrastructure and Transport on April 30, 2019. Enforcement from May 1, 2020.

Moon So-Young, 2019). In classifying drones, the WCO HS Committee has referred to other rules of the HS Convention. At the discussion of the Committee in 2015, drones' 'essential characters' were considered as HS8525 (digital cameras) on the grounds of Rule 3 (b) of GRI.

However, as for the subsequent models with enhanced flight capability, the Committee classified drones as HS 8802 (unmanned aerial vehicles). The Committee suggested that drones should be classified by 'the terms of heading' as defined in Rule 1 of GRI. Again at the 62nd WCO HS Committee in September 2018, notwithstanding this, drones were classified as digital cameras. The Committee highlighted that the flight capability of drones is limited, and the newly developed drones are only the upgraded version of the existing drones. As such, the classification of drones has varied according to interpretational perspectives, such as 'essential characteristics', 'terms in HS heading', or 'principal function', but mostly been affected by countries' interest in applying the tariff concession of the ITA.

Table 3. Changes in the Classification of Drones by Convergence of Functions

Subject matters	Classification Opinions	Ground of Judgement	Related Committees
DJI Phantom 2 Vision Plus	HS8525.80 (digital cameras)	Essential character Rule 3 (b) ¹⁾ and 6 of the GRI	55th WCO HS Committee in 2015
DJI Phantom 4 Pro Plus	HS8802 (other aircraft)	Terms of Heading Rule 1 ²⁾ and 6 of the GRI	61st WCO HS Committee in 2018
DJI Phantom 4 Pro Plus	HS8525.80 (digital cameras)	maintaining the consistency of the classification for the facilitation of trade	62nd WCO HS Committee in 2018

Notes: 1. Rule 3 (b) of GRI. Mixtures, composite goods consisting of different materials or made up of different components...shall be classified as if they consisted of the material or component which gives them their essential character, insofar as this criterion is applicable.

2. Rule 1 of GRI. ...for legal purposes, classification shall be determined according to the terms of the headings and any relative Section or Chapter Notes.

As drone's range of use has extended to construction, transportation, energy, agriculture, forestry, logistics, and mobile base stations, new drone models incorporating more technologies are being developed rapidly. The convergence of technologies on these new types of drones has made it challenging to determine the principal function and governments' classifications of drones have been inconsistent, as shown in Table 4. Besides, since the classification affects the tariff rate to be applied, the classification decisions are prone to misrepresent the principal function, deteriorating the uniformity of classification.

The situation is quite common for many other products of Industry 4.0 because they also converge diverse technologies. For example, 3D printers have been classified as 'a computer input/output device (HS 8471.60)', or 'a printer (HS 8443)'. Due to disagreement on the interpretation of the 3D printers, the HS Committee eventually decided to introduce a new code (under HS8485) for them. Classification of the HDMI-enabled monitors also caused long controversies. The monitor, therefore, firstly was classified as 'other monitors (HS8528.59)' and were not subject to ITA. Nevertheless, later they are again classified as computer monitors (HS8528.51) that is applicable for the tariff concession.

The unity in classifying products of Industry 4.0 is a very challenging goal. This inconsistent classification is owing first to the intrinsic nature of such products and second to the limitations of the arbitrary classification system under the HS. The products of Industry 4.0, in which several technologies are fused and rapidly developed, are difficult to classify as

defining a single technology that characterises those products are almost improbable. Even if a way of defining them is devised, it soon becomes useless as new technologies emerge and converge again.

The issues with the HS in classifying these products are more than complicated. First, since the HS does not set the criterion for ‘principal function’ clearly, arbitrary judgment is often caused. As a result, the classifications of those products differ, sometimes for the application of the ITA and the other times for exclusion of tariff concessions. Second, for the same reason, interpretations of product functions may differ depending on the culture or society, also resulting in arbitrary classification. Third, considering the rapid development of new products and expected disagreements about their classification, the current HS system, which is revised every five years, is not providing guidance appropriate for the speed.

Table 4. The Range of Use and Customs Classification of Drones

Industry Field	Usage	Customs Classification	Countries
Construction / Transportation	Used to inspect large structures such as towers, transmission towers, roofs, railways, and dams.	8525.80 (Digital Camera)	Korea, Germany, France
Energy	Utilised for asset inspection, geological map work, and emergency response.	8525.80 (Digital Camera)	Korea, Germany, France
		9015.80 (Geophysical instrument)	France
Agriculture	Used to obtain information on crop growth and growth environment and to spray pesticides for aerial photographs of forests, farms, and livestock.	8802.20 (Aircraft)	Korea
Photographing	Used for film, drama, entertainment, live field relay.	8525.80 (Digital Camera)	Korea, Germany, France
Delivery	Applied to urgent delivery in areas where transportation infrastructure is lacking, and to intra-city delivery with complicated travel routes.	8802.20(Aircraft)	Australia
Military	Used for various purposes, such as reconnaissance of areas of interest and operational areas, conducting disturbance operations, and destroying targets.	8802.11(Helicopters)	France
Surveillance/ disaster prevention	Firefighting activities, monitoring of disaster areas, traffic accidents/crime site police application	9015.80(Geophysical instrument)	France
Telecommunication	Replace satellites in areas without telecommunication networks	-	

Source: Customs Law Information Portal (2019) and National Information & Credit Evaluation (2019).

4.2.2. Customs Classification in Imposing Export Controls

Governments have introduced a product classification system for export control, called the Export Control Classification Number (ECCN). The number widely differs from the HS codes, since it is designed to check whether an export is subject to an export permit. In addition to the products subject to the number, exporters also need to obtain a license for the dual-use items under the 'Catch-all Control' when they export to the end-user of concerns. For this purpose, governments have provided a list of parties called Denial Party List¹⁹ with whom the governments deem doing business a danger to their interests (Lee Sang-Ok, 2011).

To decide whether permission is required, an exporter may check the ECCN on its own through self-assessment using the Strategic Material Management System web portal, YesTrade²⁰. However, since firms are less aware of the ECCN than the HS codes, they search for and verify the ECCNs with the relevant HS codes. However, since the ECCNs differs significantly from the HS codes, companies often encounter confusions. Some ECCNs do not have a matching HS Codes, and some do not specify the HS Codes. Furthermore, for dual-use items, the HS codes or the Customs procedures do not provide any screening process for the end-uses or end-users of concern. When the classification opinions vary several times, as the case of drones, exporters' determination on the export control may be more inaccurate. Therefore, the weak or unharmonious connection between the ECCNs and the HS is undermining the proper imposition of the control. As well, the current Customs procedure in place is not enough to compensate for the lack of control (Lee Hee-Yong et al., 2007).

Drones are a typical example that shows the adverse results caused by the weak connection between those product classification procedures. Drones are subject to the export control as ECCN 9A012 of Dual-Use Control List of the Wassenaar Agreement and the Missile Technology Control Regime. Using the HS codes, traders check the requirements of the export control. However, traders cannot use the HS code further for the following procedure of checking whether the drones require export permits. While the HS provides several codes for drones, ECCNs lists drones when searched with HS8802.20 (Aircraft) as shown in Table 5. Therefore, it is inevitable for trades to bear the burden of repeating the search for the ECCN of drones with multiple HS codes. The repeated and complicated procedures often motivate traders to avoid the burden by misclassifying drones as HS9503 (toys) that does not require an export permit.

Table 5. Classification of Drones by HS Codes and ECCN

Relevant HS Codes ¹⁾	Requirements for Export ²⁾	Relevant ECCN ³⁾
8525.80 (Digital Camera)	Strategic items subject to export permit	N/A
8802.20 (Aircraft)	Strategic items subject to export permit	9A012
9015.80(Geophysical instrument)	Strategic items subject to export permit	N/A
9503 (Toys)	None	N/A

Sources: Customs Law Information Portal (2019), Consolidated Public Notice under the Foreign Trade Act (n.d.) and YesTrade (n.d.).

¹⁹ The Denial Party Lists, also called denied party lists or restricted party lists, are the lists of organisations, companies or individuals that governments have identified as parties with whom the governments deem doing business a danger to their interests. The parties may be a terrorist organization, affiliated with such organization, or others who may pose threat to national security.

²⁰ <http://yestrade.go.kr/> a Web portal for export control. Ministry of Trade, Industry & Energy.

The problematic classification of drones is fundamentally threatening the proper operation of export controls. Due to the absence of uniform and consistent classification for drones, there is no accurate statistic data for the trade of drones when utilised for military purposes. However, as well known from the September drone attacks targeting Saudi oilfields, the military drones are being utilised for terrors, expanding their global market. The volume of the market is projected to grow from \$9.9 billion in 2017 to \$15.57 billion by 2027 (MarketLine, 2017). The more severe problem is that the military drone often involved terrors and accidents, causing civilian casualties. Table 6 shows the number of killed civilians by drone strikes of US forces in 2016. The numbers demonstrate the significance of the appropriate classification of drones which will base accurate statistics and appropriate controls on the trade of drones.

Table 6. Civilians and the Killed in Non-Warzone Countries by US Forces' Drone-strikes in 2016

Drone Attacks	Pakistan	Yemen	Somalia	Afganistan
Strikes	3	38	14	1071
Total People reported killed	11 - 12	147 - 203	204 - 292	1399 – 1597
Civilian reported killed	1	0	3 – 5	65 – 101

Source: Bureau of Investigative Journalism (2016).

4.3. Customs Classification and Trade Facilitation of the Products of Industry 4.0

The HS is designed not only for Customs tariffs but also for Customs procedures. The inconsistencies in the classification under the HS or utilisation of a system that is not harmonious with the HS directly affect the overall cross-border process and further the trade facilitation. The analysis of export control procedures of drones allows us to explore the influences of the inconsistency and the usage on trade facilitation of the products of the Industry 4.0. In illustrating the influences, we examined four factors of trade facilitation. 1) expedited Customs clearance, 2) transparency and predictability of the regime, 3) capacity of Customs and 4) cooperation among border agencies.

4.3.1. Expedited Customs Clearance

The literature on the trade facilitation proposes that risk management techniques enable expedited Customs clearance (Widdowson, 2005/2018). Risk management techniques begin with a system that can distinguish potential offenders from legitimate and exemplary traders. This system allows intensive inspection or regulation on the selective risk factors and at the same time, enables voluntary compliance to the legitimate trade. Therefore the system can reduce the overall administrative cost and ultimately ensure the speed of Customs clearance.

As such, for drones and other products with a high level of disagreement on classification, it is difficult to identify and selectively manage the subjects of risk management, or to operate voluntary compliance systems for legitimate exports. Therefore, requiring expedited Customs clearance for trade facilitation of these products can inevitably deteriorate the risk management of export control.

Inconsistent classification of products under the HS leaves a loophole in the risk management of the drone's export control.

4.3.2. *Predictability of Customs Procedures*

Predictability of Customs procedures is essential to facilitating trade. They enable efficient operation of Customs clearance based on the voluntary compliance of traders. Prior studies have recommended the operation of a pre-audit system for this purpose (Grainger, 2011; Widdowson, 2018). Under the pre-audit system, a company requests a legally binding decision from related government authority. The pre-audit system is applicable for cases in which traders can determine the classification of their products on their own.

The pre-audit for classification²¹ and the pre-assessment on strategic materials²² have been introduced per this purpose and contributed to enhancing transparency and predictability in both fields. However, those systems have limitations in applying for the trade in the products of Industry 4.0 that have a short lifecycle. Products with an inconsistent classification such as drones often require repeated applications for the pre-audits on both of the strategic materials and the classification. However, except for the time required to supplement the supporting documents, those systems require 15 days or 30 days for the decision. In the case of strategic materials, the export permit²³ additionally requires 15 days. Given the rapid development and short lifecycle of products of Industry 4.0, pre-audit may cause delays that impede the expansion of their trade. The opportunity costs of the pre-audit that companies cannot afford consequently halve the benefits of trade facilitation (Lee Kee-Hee, 2006).

4.3.3. *Capacity-building of Customs*

In dealing with the classification of drones, Customs has mostly focused on providing the tariff concession under the ITA. Under such circumstances, Customs did not show enough efforts to take consideration of other significant issues, including security, environment, and intellectual property. As a result, the Customs procedure for drone often ends up with chaos.

A common misconception that the capacity necessary for Customs is limited to the area such as tariff imposition or concession and gate-keeping of cross-border transaction restrains the role of Customs. (Mikuriya, 2005; Prowse, 2002; Widdowson, 2018). This unnecessarily narrow definition of capacity necessary for Customs has negatively affected Customs organisation and culture. They, only seeking its interest and are incapable of moderating the conflicting interests of other stakeholders.

Customs organisations do not have adequate research staff to gather and understand the needs of stakeholders related to the growing industry. Besides, the organisations do not necessarily have the expertise to coordinate the support for various ministries and control their policies. Furthermore, it is not sure if Customs organisations have the expertise to operate them through Customs clearance procedure. In the case of drones, Customs does not have an organisation in charge of fine-tuning the demand for export control with Customs procedures and designing cooperation procedures with the KOSTI. This inevitably limits the long-term institutionalisation of Customs roles to coordinate conflicting interests in the imposition of tariffs and the import and export control.

4.3.4. *Cooperation with other Border Agencies*

The HS is a primary system of Customs cooperation with other ministries. However, it

²¹ Article 86 (Prior Examination of Tariff Classification Applied to Specific Goods), Customs Act, Act No. 16098, enforcement in July 1, 2019. The Ministry of Economy and Finance.

²² Article 20 (Determination of Strategic Items, etc), Foreign Trade Act, Act No. 16422, enforcement on August 1, 2019. The Ministry of Industry, Trade and Energy.

²³ Article 19 (Public Notice of Strategic Items, Export Permission, etc.), Foreign Trade Act, Act No. 16422, enforcement on August 1, 2019. The Ministry of Industry, Trade and Energy.

cannot serve its role efficiently if the current perception that the role of Customs authorities should be limited to tariffs imposition and concession prevails. The HS classification of drones is meaningless in the export control system, not streamlining the classification procedures, public notification procedures and control procedure as a whole.

UNI-PASS, Korea's Single Window²⁴, was introduced to make a cooperation with other ministries more efficient by using information and communication technology. However, the evaluation is mixed as to whether Single Window has dramatically simplified the Customs clearance process. In the past studies, while traders are mostly satisfied with services related to the imposition of tariffs or refunds, the satisfaction with the cargo management system was not statistically meaningful (Lee Yea-Rim, 2019). As well, there are many regulatory and support procedures that are even excluded from the UNI-PASS, such as export permits for drone export control. The compliance program, which is a cooperative system with private companies, is also operated separately for Customs clearance and export controls for drones, creating duplicate procedures and costs.

In summary, a unified Customs process centred on the consistent Customs classification is essential to facilitate trade in the products of Industry 4.0 that have implications for various industries and sectors. However, for the products such as drones, for which the classifications are not uniform, the Customs clearance and control procedures are inevitably inconsistent and inefficient. Therefore, institutional reforms are a pressing concern for Customs. Through the reform, they need to share and process information with relevant ministries. Also, collaboration with ministries and private companies is a necessity.

4.4. Implications for Facilitating Trade in the Products of Industry 4.0

4.4.1. *The Methods of Classifying the Products of Industry 4.0*

Admittedly, retaining the uniformity is most crucial for classifying the products under the HS since the multiple inconsistent classifications of a product always end Customs procedure with chaos. However, as have been discussed earlier, limitations exist in pursuing the uniformity when classifying the products of Industry 4.0. As well, since the radical changes in the HS are not probable, there is only a couple of methods that we can suggest to overcome the limitation.

Above all, we propose to clarify the criteria for 'principal function'. Rule 3 (b) of the GRI requires that the principal function or 'essential character' be determined based on the nature of the material or component. Specifically, the principal function is to be determined according to the factors of the materials and components such as quantity, weight or value, or by the role in the use of the goods. We suggest ways to refine these factors, such as setting priorities in judgement or decision factors that fit the situation.

Besides, we want to emphasise 'consistency' in classifying the products of Industry 4.0. There may be differences in the interpretation of the principal functions, depending on culture or society, and the interpretation itself may change over time. However, reflecting all of these differences in the HS at the turn of the technology only adds confusion in the subsequent customs procedures as well as the imposition of tariffs. Therefore, it may be necessary to avoid overturning the matters decided by the HS Committee until a firm rule is established.

Finally, we must admit the fact that the speed of improvements in the HS cannot keep up with the rapid evolution of technologies. Since limits exist in defining every product and situation by the HS, Customs should play a central role in cooperating and communicating

²⁴ Article 226 (Certification and Verification of Permission, Approval. etc.) of Customs Act, Act No. 16098, enforcement in July 1, 2019. The Ministry of Economy and Finance.

seamlessly with relevant ministries and traders to make up the deficiency.

Therefore, in the context of facilitating trade in the products of Industry 4.0, Customs is required to play more enhanced roles in streamlining Customs procedures with the essential features of such products. In the preceding discussion, we defined those features as the convergence of technologies and rapid development speed. In discussing measures to facilitate trade based on Customs clearance procedures, we propose to identify the factors of trade facilitation that can be associated with such features. Accordingly, the measures to cope with the convergence of technology will be discussed from the perspectives of building Customs capacity and reforming the cooperative system. Also, we will discuss ways to expedite Customs clearance and improve the predictability of Customs procedures in response to the rapid development speed of the products of Industry 4.0.

4.4.2. The Convergence of Diverse Technologies

Since the products of Industry 4.0 is characterised by the convergence of technologies beyond the industrial boundary, determining their principal function is too challenging to make a uniform classification under the HS. This inconsistency confuses the Customs clearance and consequently hinders smooth trade flow. Therefore, the unity and consistency of classification are imperative for facilitating trade. However, for the cases where the uniformity cannot be guaranteed, we suggest a holistic approach to build and reform Customs' capacity and its systems for cooperation.

As researchers have initially asserted in the literature on capacity-building, Customs requires the management capacity to play a role in unifying Customs procedures by harmonising the conflicting interests of stakeholders (Honadle, 1981). In the era of Industry 4.0, the capacity building of Customs should not be limited to training of Customs officials. The capacity building should be expanded to include fundamental reform of promotion system, organisational structure and culture. They should include efforts to have appropriate research staffs to gather and analyse the needs of critical stakeholders in the industry and other ministries. As well, having a designated organisation to moderate the conflicts of interest and design cooperative Customs procedures is also critical to deal with stakeholders' demand.

We also need to reexamine Customs' cooperative systems with traders and other ministries. Under such a system, voluntary compliance systems for traders should be integrated and streamlined to provide substantial benefits to the participants. The Uni-Pass, the Single Window system, also needs to be upgraded to deal with the steps of requesting export permits for strategic materials and screening out end-users included in the Denial Party List. To compensate for the lacks of controls that may be caused by the inconsistent product classification, it is also essential for Customs to have careful and continuous communication with other ministries.

As such, the advent of Industry 4.0 requires a change in the perception of Customs roles. Facilitating trade in the products of Industry 4.0 is only feasible when Customs has enhanced management capacity and plays its roles in reforming its cooperative systems. The capacity-building activities, therefore, should not be limited to building up simple training courses. They should include institutional changes in staffing, career paths of staffs, and organisational structures. It should also be emphasised that the success of those activities depends mostly on the successful reforming of systems, organisations and institutions for cooperation with traders and other ministries.

4.4.3. Speed of Development

As discussed earlier, the expedited customs clearance and predictability of procedures are factors that facilitate trade in the products with rapid technological development. Commen-

tators have suggested the risk management system of two-track approaches as the measure enabling the expedited Customs clearance. While selective control of fraudulent cargo and traders is undertaken, the system ensures more straightforward and faster Customs clearance for legitimate trade. However, the inconsistent classification of the products of Industry 4.0 often confuses Customs' risk management system when Customs track down products.

As a countermeasure, we suggest reforms of Customs' risk management system. For a regulatory process that uses separate classifications system from the HS, an institution is required to share the results of discussion and decision of product classification under HS among the relevant agencies. This cooperative system will provide opportunities to create alternatives to enable the links between the HS and other classification systems. Besides, the customs' export clearance system should be improved to equip with the necessary verification of export controls to ensure the effectiveness of the controls. In particular, the export control system is strengthening its Catch-All regime to cope with rapid technological development. The regulation focuses on the end-user and end-use of the product rather than the product itself. Adopting the investigation procedures in the export customs procedures, such as Denial Party Lists search functions, is crucial in order to ensure the validity of the Catch-All regulations.

Customs pre-examinations and KOSTI's preliminary judgments also require a cooperative mechanism. Both programs aim to ensure predictability but are carried out in separate institutions without any information-sharing process. For the products of Industry 4.0 that frequently cause confusions in classification, those programs should be complemented by procedures to share the decisions and to consult process reforms.

5. Conclusion

This study aimed to find the implications for facilitating trade in the products of Industry 4.0 by exploring the classification cases of drones. In exploring the cases, we focused on three research questions. First one is about the issues of classifying the products of Industry 4.0 under the HS. We found that the intrinsic nature of the products that converge several technologies causes issues in the classification. The rules of the HS that categorise products by their principal function does not provide proper guidance when applied to the products of Industry 4.0. Those products have several functions that traders cannot prioritise. Therefore, such products often have multiple classification opinions, causing confusions when Customs selects the products eligible for tariff concessions or controls.

For the second research question, we explored the adverse influences that the inconsistent classifications may exert on trade facilitation. Here, we divided trade facilitation in Customs context into four factors. Expedited clearance, predictability of the Customs procedure, capacity-building of Customs, and cooperation with other stakeholders including traders and other government ministries. We identified that the inconsistency in product classification often delays customs clearance by hindering the Customs risk-management system that pinpoints products subject to controls. We also warned that under such circumstances, the results of Customs clearance is rarely predictable. Traders of products of Industry 4.0 often blame that the pre-audit for the classification is only a half-measure against such unpredictability because of its time-consuming procedure when considering those products' short life cycle.

We also pointed out that the limited recognition of Customs' roles often breaks the uniformity in classifying products and mitigating its adverse influences on trade facilitation. Customs authorities often focus on their capacity limited to tariff imposition or concession and do not take enough account of other pressing issues, such as security, environment, and

intellectual property. Customs often deem it natural not to play a proper management role in coordinating conflicting interests between imposing tariffs and controls. We also identified some weak points of Korea's Single Window that Customs has designed to cooperate with other ministries. The system, UNI-PASS, does not fully satisfy traders when applied to the issues other than tariff imposition. As well, it does not make enough contribution to simplifying procedures that various control systems require traders to follow. For cooperation with traders, several ministries have adopted multiple voluntary compliance systems. The repeated procedures of those systems even aggravate traders' burden of compliance.

For the last research question, we identified the implications for facilitating trade in the products of 4.0 based on our analysis of the products' principal features - the convergence of technologies and the high-speed of development. Due to the feature of converging multiple technologies, governments and traders often have discrepancies in classifying those products. For those cases where we cannot guarantee the uniformity of the classification, we suggested that Customs requires a management capacity to harmonise interest conflicts of traders and relevant ministries. Therefore, Customs' capacity-building activities should take a holistic approach to include not only training for Customs staffs but also fundamental reforms of promotion systems, organisation and culture. The cooperative systems of Customs also need an upgrade both to cover essential control functions and to simplify Customs clearance procedures by streamlining processes that other ministries require.

To facilitate trade in the products of Industry 4.0 that evolves at a high-speed, we suggested measures to ensure expedited Customs clearance and the predictability of the procedures. Problematic product classification often hinders the expedited Customs clearance because it often causes chaos in Custom's risk management system. We suggested strengthening cooperation with other ministries to compensate for the lack of controls based on institutionalised communication covering the issues of product classification. By doing so, the relevant ministries can have opportunities to prepare for alternatives to control products of concern. To ensure the predictability of trade in the products of 4.0, we proposed Customs to play the role of moderating and simplifying the multiple procedures of pre-audits that many ministries adopted. As well, sharing information on those pre-audits will reduce the discrepancies in the decisions that confuse traders.

This study is of academic significance in that it applies the research theory on trade facilitation for the specific cases of classification of the product of Industry 4.0 to verify its effectiveness and to extend the subject of the studies to the scope of Industry 4.0. It also has practical significance in that the results have provided implications for reforms of Customs procedures to facilitate trade in the products of Industry 4.0.

However, due to space constraints, our study has a limit in covering detailed solutions available, when exploring implications for facilitating trade in the products of Industry 4.0. Therefore, we missed some exciting discussions about the capacity-building activities, Single Windows, risk-management, cooperation system of Customs that the era of Industry 4.0 requires. Each discussion has the depth of study that require separate articles. Therefore, we decided to leave them as subjects of future studies.

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