WORLD TRADE ORGANIZATION

World Customs Organization

The role of advanced technologies in cross-border trade: A customs perspective

About the WCO

The World Customs Organization develops international standards, fosters cooperation and builds capacity to facilitate legitimate trade, to secure a fair revenue collection and to protect society, providing leadership, guidance and support to customs administrations.

About the WTO

The World Trade Organization is the international body dealing with the global rules of trade between nations. Its main function is to ensure that trade flows as smoothly, predictably and freely as possible, with a level playing field for all its members.

Acknowledgements

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Contents

Key findings

Blockchain and distributed ledger technology

- Blockchain and distributed ledger technology (DLT) can help to provide better transparency, immutability and accessibility of information and data quality, as well as the sharing of relevant information on border management procedures among all stakeholders.

- The greatest hurdles to the successful introduction of blockchain and DLT in customs processes is overcoming a lack of expertise and good practices, and the associated costs. For a broader uptake of blockchain by customs authorities, there needs to be more widely available standardized datasets which are used by both government agencies and authorized economic operators. Standardizing datasets would help to avoid the appearance of inefficient governance systems and to potentially prevent the proliferation of different blockchain solutions that are not interconnected.

Internet of things

- There have been positive developments in the use of the internet of things (IoT) by customs authorities. Members are experimenting with the IoT to fully automate border-crossings and customs procedures in national ports. An initiative includes the integration of X-ray scanners into a cross-border image exchange to analyse the results of multiple scanning stations centrally. The specialized training facility for X-ray systems operators and the unified training software for image analysis under that initiative have optimized human resource allocation and enhanced the quality of image analysis. Other projects include the use of radio frequency identification antennas or e-seals to ensure traceability of goods and means of transport.

- Thanks to IoT, customs authorities can benefit from better risk management, greater efficiency of customs clearance processes and improved analytics. For this to succeed, members need first to address the challenges of integrating information collected through IoT devices into customs operating systems. The different IoT devices need to exhibit compatibility and interoperability across a range of interfaces, without compromising data security and privacy.

Big data, data analytics, artificial intelligence and machine learning

- Customs authorities have embraced advanced analytical technologies. Around half use some combination of big data, data analytics, artificial intelligence and machine learning. Those who do not currently use them have plans to do so in the future. The majority of customs authorities see clear benefits from advanced technologies, in particular with regard to risk management and profiling, fraud detection and ensuring greater compliance.

- There is a need to establish a data strategy to ensure improved data governance and quality required. However, data protection laws can limit the extent to which data can be used. Better guidance on how to interpret such legislation in analysing data for customs purposes would help to prevent any excessive caution when designing projects and to promote the exchange of data between organizations and customs authorities. Resources will be required to address the obstacles and challenges to introducing these types of technology, such as the cost and the need for expertise and good practices.

1

Securing cross-border trade through advanced technologies

Advanced technologies have already begun to automate global supply chains. However, the scope and potential for using the latest technology to further facilitate cross-border trade is far greater and has been explored by international organizations, the private sector, academia and other stakeholders.

The World Customs Organization (WCO) and the World Trade Organization (WTO) have been examining blockchain and distributed ledger technology (DLT), the internet of things (IoT), and big data, data analytics, artificial intelligence (AI) and machine learning to identify how these advanced technologies can promote trade facilitation and assist customs administrations in fulfilling their objectives of ensuring, safety, security and fair revenue collection.[1]

The WTO sets rules in international trade and the WCO develops the relevant standards and tools relating to border formalities. They have a long-standing partnership on account of their complementary objectives: the primary purpose of the WTO is to open trade for the benefit of all; the mission of the WCO is to enhance the effectiveness and efficiency of customs authorities; and both organizations provide capacity-building and technical assistance aimed at facilitating trade and customs procedures.

The typical areas of cooperation are in customs valuation, rules of origin and trade facilitation. More recently, the WCO and the WTO have also embarked on numerous joint initiatives, such as ways to mitigate the effects of the COVID-19 pandemic and in the area of paperless trade and technologies.[2]

The *Study Report on Disruptive Technologies* (WCO, 2019) shows that a number of advanced technologies that have completely changed the way things are done (i.e. disruptive technologies) have had a significant impact on customs procedures. These technologies will continue to benefit the work of customs authorities in the future and include developments in blockchain, IoT, big data analytics, AI and machine learning, biometrics, drones, virtual and augmented reality, and 3-D printing.[3]

Typical areas of WCO and WTO cooperation are in customs valuation, rules of origin and trade facilitation.

Of these, three areas of advanced technology in particular play a significant role in the future work of customs authorities and in facilitating cross-border trade:

- blockchain and DLT
- IoT
- big data, data analytics, AI and machine learning

Blockchain and distributed ledger technology

A blockchain is a time-stamped, decentralized and distributed digital record (or ledger) of transactions in which the transactions are stored securely in a permanent and near inalterable way using various cryptographic techniques.

It is a continuously growing list of records (called blocks), which are chained to each other using cryptographic tools. Unlike traditional databases, which are administered by a central entity, blockchains rely on a peer-to-peer network that no single party can control. Although blockchain is technically one type of DLT, the two terms are used interchangeably in this publication.

Internet of things

IoT is the network of sensors and smart devices connected to the internet that can send and receive data and which are often found in vehicles, buildings and items embedded with electronics. IoT enables the tracking of products along the supply chain and can reduce the costs of global trade by increasing the efficiency of shipping and transport.

Big data, data analytics, artificial intelligence and machine learning

Big data analytics is the use of advanced analytic techniques on very large and diverse datasets (starting from terabytes) with different sources and degrees of complexity.[4]

AI refers to systems that change behaviours without being explicitly programmed, based upon data that are observed, collected and then analysed. It is a broad term that includes machine learning, deep learning, computer vision and natural language processing.

Although this publication explores these three areas separately, they are not mutually exclusive, and customs authorities often use them in combination. For example, blockchain, in combination with IoT, provides new ways to track the journey of products. It can be a powerful tool to promote transparency and traceability of supply chains.

Publication objectives

This publication is a collaboration between the WCO and the WTO. The objective of which is to gain a better understanding of how the latest advanced technologies can help customs authorities to contribute to trade facilitation and to shed light on the opportunities and challenges customs authorities face when deploying the technologies.

This publication aims to raise awareness and interest among the membership of both the WCO and the WTO. It serves an important source of information and as a basis for policy actions to ensure customs authorities can contribute towards paperless trade.

The publication will be of particular interest to WCO and WTO members in the process of implementing the WTO's Trade Facilitation Agreement (TFA), which aims at facilitating the release and clearance of goods, including through the use of electronic means to exchange data and documents relating to cross-border trade transactions. The TFA plays a vital role in boosting world trade and output and in facilitating trade by simplifying, modernizing and harmonizing the following:

- movement of goods (Article 9);
- release and clearance of goods (Article 7);
- processing time through the use of risk management (Article 7);
- single-window processes (Article 10);
- exchange of customs information (Article 12);
- measures for authorized operators (also known as authorized economic operators, AEOs) (Article 7).

Implementation of the TFA has already resulted in greater customs efficiency, more effective revenue collection and better access to new export opportunities, and it has resulted in improved transparency in customs practices, fewer documentation requirements and less red tape (WTO, 2021). This publication may further assist stakeholders to take informed decisions under initiatives aimed at facilitating and securing global supply chains.

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Customs Survey

The WCO and the WTO jointly designed 18 questions to include a chapter on disruptive technologies (see Annex), which was added to enhance the 2021 WCO Annual Consolidated Survey (ACS) and distributed to WCO members to provide a snapshot of the level of implementation by customs authorities of the three technologies mentioned above.

The questions captured the stages of adoption of customs projects using advanced technologies, and the reported benefits and challenges. The results of the ACS and the findings presented in this publication will also be used for the upcoming joint WCO–WTO publication *Study Report on Disruptive Technologies*, in 2022.

The ACS gathers information from WCO members to update a number of WCO tools, such as:

- member profiles in the *WCO Annual Report*;
- Reform and Modernization-Monitoring Activities and Projects (RAMMAP) and Single Window Interactive Map (SWIM) databases;
- *Compendium of the Authorized Economic Operators Programmes*, published annually;
- WCO Data Model.

The survey captures the stages of customs projects using advanced technologies and the reported benefits and challanges.

Out of the 183 WCO members, 124 responded to at least one, and in general to more than half, of the questions on advanced technologies. Table 1 shows the response rates according to the six regions commonly used by the WCO:

- East and Southern Africa (ESA);
- Europe;
- Far East, South and South-East Asia, Australasia and the Pacific Islands (Asia and Pacific);
- North of Africa, Near and Middle East (MENA);
- South America, North America, Central America and the Caribbean (AMS);
- West and Central Africa (WCA).

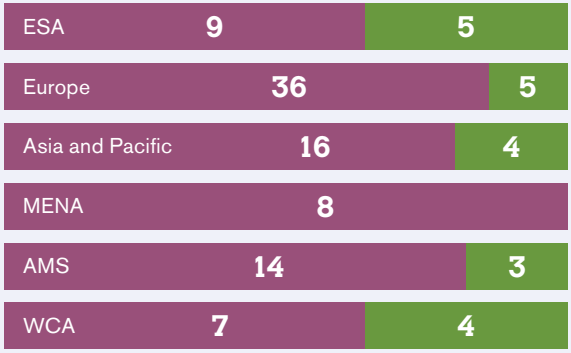
TABLE 1

Response rates to at least one of the questions on advanced technologies in the 2021 ACS, by WCO region

WCO region	Number of members that responded	Response rate
ESA	17	71%
Europe	41	77%
Asia and Pacific	23	70%
MENA	10	56%
AMS	20	61%
WCA	13	57%
Total	**124**	**68%**

FIGURE 1

A strategy is in place to adopt IT tools and information management



Note: Total respondents numbered 105. Figures in the bottom chart indicate distribution.

The ACS results presented in this publication reflect only the responses. Where no answer was provided, the non-response was not considered in the overall figure. The information provided in the responses was enhanced with the help of follow-up enquiries and any information to be found in public sources.

Automation and advances in the use of technologies in customs authorities are usually driven by dedicated IT strategies (see Figure 1). Of the 105 members that responded, 85 (81 per cent) have such a strategy in place. In the breakdown, all respondents from the MENA region have a national strategy in place, while the share was at least 80 per cent in Europe, AMS and Asia and Pacific.

Endnotes

[1] See Ganne (2018), Patel and Ganne (2020, 2021) and WCO (2019).

[2] For further information, see www.wto.org/english/thewto_e/coher_e/wto_wco_e.htm.

[3] For further information, see http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/ressources/permanent-technical-committee/215-216/pc0470e1b.pdf?la=es-ES.

[4] For further information, see www.ibm.com/analytics/hadoop/big-data-analytics.

2

Blockchain and distributed ledger technology

Blockchain and DLT are still in an experimental phase for many customs authorities, with around a third testing it through proofs of concept (PoCs) and pilot projects using mainly permissioned (i.e. private) blockchains. Only Argentina and Uruguay report full deployment of this technology.

Customs authorities hope that its use will allow for better transparency, immutability and accessibility of information and data quality, as well as the sharing of relevant information on border management procedures among all stakeholders. However, a lack of expertise and good practices, as well as the associated costs, currently pose the greatest hurdle to its introduction (Okazaki, 2018).[1]

Full deployment is also hindered by the lack of standardized datasets used by government agencies and AEOs, inefficient governance systems and the potential for a proliferation of different blockchain solutions that are not interconnected.

There are a number of projects and PoCs that are intended to bring improvements in the following areas:

- information exchange and interoperability at national and international levels (including at the level of customs unions);
- development of international single window interconnectivity;
- proper validation of certificates (including certificates of origin (CoOs), quality, sustainability and non-toxicity);
- sharing information on AEOs and within e-commerce environments;
- ensuring access to logistics-related information in view of tracking and tracing goods along global supply chains.

The advantages observed by customs authorities participating in these pilot projects include expedited processing, better data quality, transaction transparency, enhanced targeting and easier access to importers. However, customs authorities sometimes lack the incentive to join blockchain projects when there are insufficient participants to provide the information required.

Through blockchain, customs authorities hope to achieve greater efficiency and reliability in risk management, revenue collection and trade facilitation.

Despite initial hesitancy, customs authorities are reasonably optimistic of blockchain's potential. Indeed, through blockchain they hope to achieve greater efficiency and reliability in the areas of risk management, revenue collection and trade facilitation. They are also beginning to understand the importance of partnering early with industry to ensure that the projects realize the benefits of blockchain in the trading environment while simultaneously addressing any barriers.

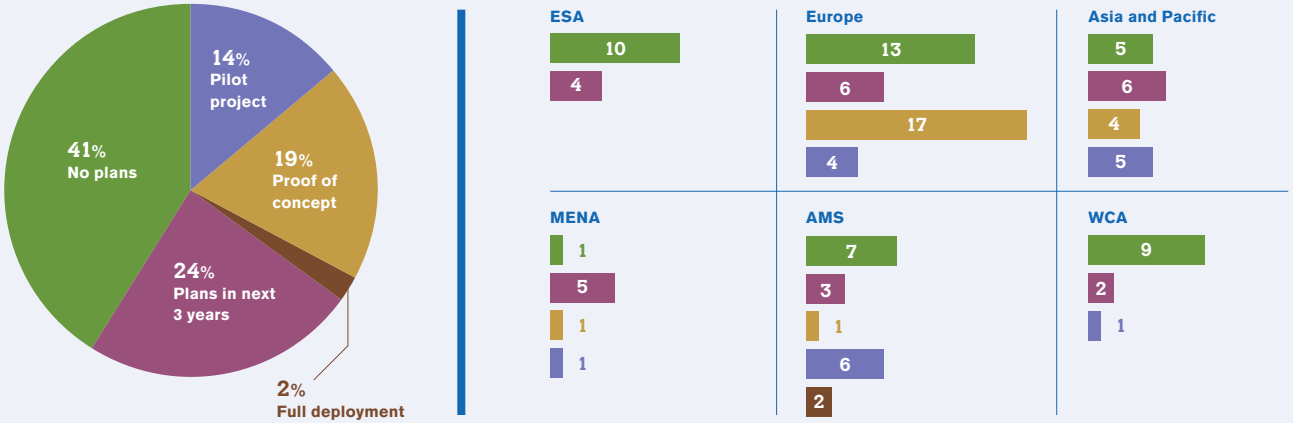
Stage of adoption

Blockchain technology has captured the attention of the majority of customs authorities (see Figure 2): 22 (19 per cent) are exploring its potential through PoCs; 15 (14 per cent) through pilot projects; and 26 (24 per cent) are planning to do so within the next three years.

However, only Argentina and Uruguay have fully deployed blockchain. The regional graphs below show that the greatest activity seems to be in the Europe, Asia and Pacific and AMS regions. Nevertheless, 26 customs authorities, from all regions, plan to introduce it in the next three years.

FIGURE 2

Stage of adoption of blockchain



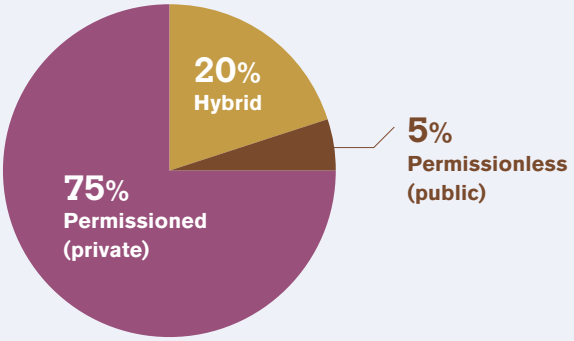
Note: Total respondents numbered 110. Figures in the charts on the right indicate distribution.

Three quarters of the 44 blockchains tested are private or permissioned (33), nine are hybrid and two are permissionless (see Figure 3):

- Private and permissioned blockchains allow only selected entry of verified participants.
- A hybrid blockchain is a combination of a public blockchain (accessible to all) and a private network that restricts participation to those invited by a centralized body and can control access to the modifications in the ledger.
- A permissionless blockchain, also referred to as a public blockchain, is a network open to everyone. Everyone can participate in the consensus process that the platform uses to validate transactions.

FIGURE 3

Types of blockchain in use



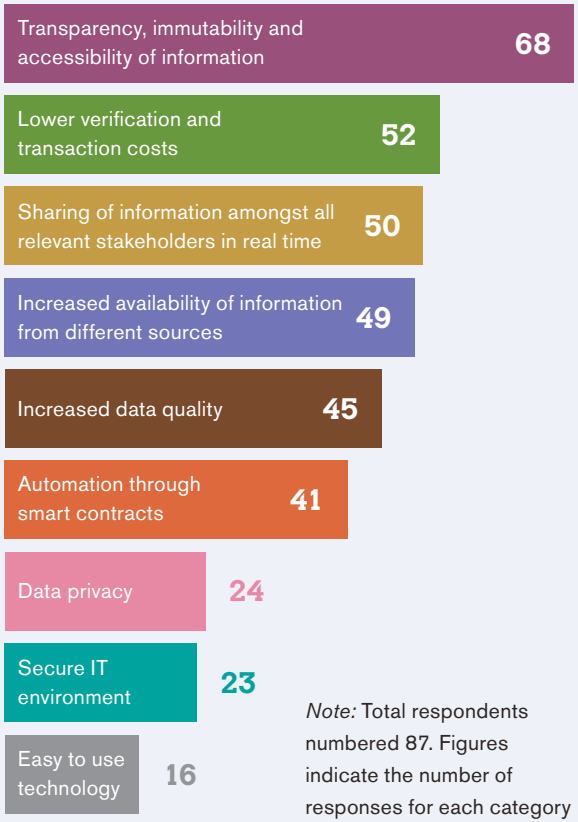
Note: Total respondents numbered 44.

Benefits

In terms of the benefits that customs authorities are looking to achieve, responses are diverse but generally focus on information availability and costs and data quality. Respondents usually opted for at least two of the benefits listed in the ACS (see Figure 4).

FIGURE 4

Main benefits of introducing blockchain



Note: Total respondents numbered 87. Figures indicate the number of responses for each category (respondents could give more than one answer).

Respondents also mentioned a general improvement in the efficiency of trade processes when using blockchain. Furthermore, access to transactional data from a trusted source is seen as a means to reduce processing time and to allow real-time approval from customs authorities.

Obstacles to adoption

The main obstacles to introducing blockchain and DLT technology respondents give include a lack of expertise, the cost, poor adoption by other stakeholders and the need for good practices (see Figure 5). Obstacles less often cited include: a lack of a standardized datasets; the absence of a government strategy; existing legacy systems; and a lack of trust in using data-sharing platforms.

Customs authorities hope that blockchain will allow for better transparency, immutability and accessibility of information and data quality, as well as the sharing of relevant information on border management procedures.

FIGURE 5

Main obstacles to adopting blockchain

Note: Total respondents numbered 95. Figures indicate the number of responses for each category (respondents could give more than one answer).

A lack of standards and the problem of energy consumption were also raised, as well as the fact that other reliable technology may be adopted by AEOs, which could subsequently marginalize the potential of blockchain and DLT.

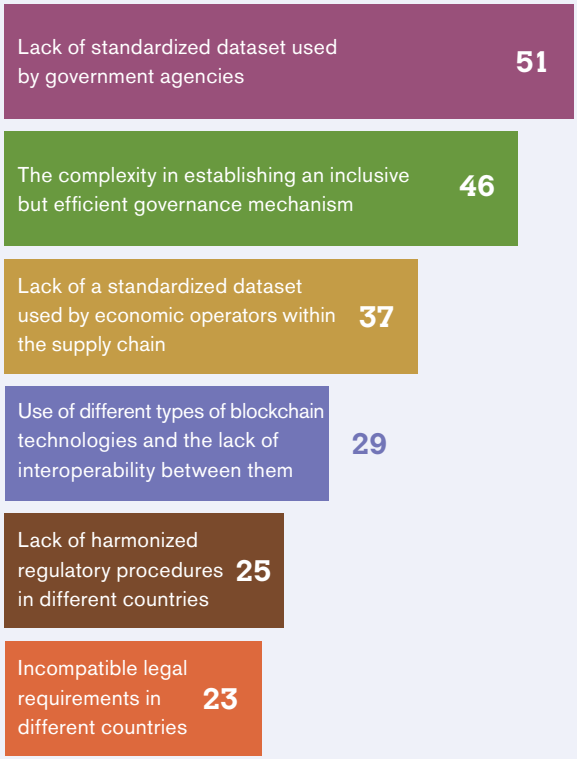
With regard to the challenges of deploying blockchain more broadly and efficiently, respondents mainly list problems of dataset standardization and the harmonization of both technical specifications and legal and regulatory frameworks (see Figure 6).

In particular, the absence of standardized datasets impedes not only blockchain deployment but also the introduction of any data-sharing solutions. The complexity of establishing an inclusive yet efficient governance mechanism is also high on the list of challenges cited by respondents.

Interoperability is a major concern for decision-makers seeking to develop blockchain solutions. Customs authorities might avoid using a blockchain platform that could limit their options of external collaboration in the future. Consequently, it will be necessary to build scalable solutions that can evolve not only within one single administration, but also, if required, within an extended ecosystem of many administrations. The proliferation of different blockchain solutions that are not interconnected is a major limitation to building scalable systems.

FIGURE 6

Challenges to improving blockchain efficiency



Note: Total respondents numbered 100. Figures indicate the number of responses for each category (respondents could give more than one answer).

Examples of use

Most of the projects aim to improve the exchange of information at the national level (among government agencies) as well as at the international level (see Figure 7). More specifically, respondents are looking to overcome the challenges of the e-commerce environment, including through improving e-certification, the single window and end-to-end supply chain interconnectivity. This will ultimately lead to better risk management and targeting as well as improved trade facilitation overall.

Most of the 44 projects and PoCs reported in the ACS are in Europe, Asia and Pacific and AMS (see below). In the ESA region, however, Mauritius is discussing with potential suppliers the implementation of a project to track CoOs using blockchain; and in the WCA region, members are waiting for the relevant capacity and knowledge to be developed before moving forward with blockchain.

The proliferation of different blockchain solutions that are not interconnected is a major limitation to building scalable systems.

FIGURE 7

Project areas

Note: Total respondents numbered 44. Figures indicate the number of responses for each category (respondents could give more than one answer).

Europe

In Europe, blockchain is used to collect value added tax (VAT), protect geographical indications and certify product origin. There are several ongoing pilot projects and PoCs being tested.

European Union

EU member States are exploring the use of blockchain to share VAT information between taxation and customs authorities. From 1 July 2021, companies opting for the Import One-Stop Shop VAT identification number are no longer required to register with the tax authorities of each importing EU member State to declare and pay the VAT due. Instead, VAT declaration and payment take place in one EU member State, and this information is then shared among the other EU member States.

Blockchain helps to ensure both the integrity of the information shared and the identity of the VAT contributors. In addition, blockchain can automate VAT payments via smart contracts, including the payment of VAT to tax authorities and transfers from tax authorities to companies, thus accelerating VAT collection and reducing payment delays.

SEED-on-Blockchain is a European Commission research project by DG TAXUD – the department responsible for EU policies on taxation and customs – to assess the technical and organizational feasibility and benefits in blockchain for customs and taxation applications. The first PoC demonstrated that even with limited knowledge of blockchain, it is feasible for DG TAXUD and EU member States to deploy and operate blockchain applications to share data. The European Commission is to expand the initial scope of the project in a second PoC to include backup and restore, and integration with the Identity Management Systems. The second PoC aims to integrate and address these issues.

The application employed by DG TAXUD replicates authorizations and reference data across EU member States, using a centrally managed message queueing system and a custom central replication application. The operating model employed was formed around these technologies, with the following inherent limitations:

- the need for implementing, operating and maintaining a central application for replicated business data;
- no reuse in sending, receiving, storing and processing the data;
- the need for conformance testing to verifying interoperability;
- the need for a centrally managed messaging system.

DG TAXUD assessed the suitability of blockchain to eliminate these limitations and established that there are technical and operational benefits in the short term, as the replication of authorization and reference data can be implemented without the use of a centrally managed messaging system or custom central applications.

The operational processes necessary for the installation, operation and maintenance of a blockchain network bring no significant complexity compared to any regular IT system. In the long term, blockchain offers the possibility of decentralizing the operating model and the governance of the European Union and can be provisioned to require no central authority for its configuration, maintenance and operation.

The EU-funded blockchain project TRICK (Traceability Information Management by Blockchains Interoperability)

provides an affordable and standardized platform for small and medium-size enterprises to collect product data on the approaches taken to promote sustainability across the whole value chain. In two pilot projects in the textile and perishable food industries, blockchain is being used to document the whole process, from raw materials to recycling, which forms part of a national strategy to support.

Italy

The "Made in Italy" initiative uses blockchain to certify high-quality manufacturing products and place products on the market that have already been certified at various levels, from sustainability certification, with materials from sustainable means, to chemical certification of non-toxicity and to CoOs of the goods.

In February 2019, the Italian Parliament passed a law that provides a legal definition of DLTs and smart contracts and recognizes their full legal validity and enforceability. Italy is one of the first countries to introduce legislation rendering smart contracts legally equivalent to traditional contracts for certain purposes (e.g. consensus formation, evidentiary value).

Nevertheless, the law establishes that smart contracts meet the requirement for the written form by having the interested parties identified digitally according to Agenzia per l'Italia Digitale (AGID) guidelines. The lack of international norms and technological standards of reference weighed on the AGID so much when developing the guidelines that it advises particular caution in relation to indications or options that could compromise the necessary technological neutrality of the rules to be adopted.

Georgia

A new blockchain initiative in Georgia issues preferential CoOs by the Georgia Revenue Service which display a QR code providing a link to the transaction on the Ethereum Blockchain. Customs authorities in partner countries can either scan the QR code or search manually to access all the data in the CoO as well as confirm that it was issued by the Georgia Revenue Service.

Asia and Pacific

In the Asia and Pacific region, blockchain is used to exchange customs declarations and documents as well as logistics-related information to track and trace goods and transport units throughout global supply chains.

Australia and Singapore

A blockchain PoC was conducted under the Australia–Singapore Digital Economy Agreement to achieve document interoperability for paperless cross-border trade. In collaboration with the Infocomm Media Development Authority, Singapore Customs, the Australian Border Force and private-sector participants, CoOs were issued in accordance with the TradeTrust framework.

These CoOs were then authenticated and their provenance assured to all in an entirely transparent manner through TradeTrust's reference implementation as well as on the Australian Border Force's digital verification platform, the Intergovernmental Ledger (IGL). The trial successfully tested the interoperability of the two systems and showed that TradeTrust removes the need for traditional approaches of using direct digital connectivity

to enable data exchange among supply chain participants, which are slow and expensive to build.

Similar to Australia, digital trade initiatives in many countries will form part of a broader suite of legislative and regulatory changes to facilitate a transition to paperless processes. A key lesson is the importance of partnering early and meaningfully with industry to ensure PoCs capture genuine benefits and barriers in the trading environment.

The Australian Border Force is now seeking government approval to implement the Intergovernmental Ledger to production quality and to conduct further PoC trials and pilot projects, with the goal of making it a permanent feature of Australia's trade practices.

Digital trade initiatives in many countries will form part of a broader suite of legislative and regulatory changes to facilitate a transition to paperless processes.

China and Singapore

China and Singapore customs authorities are developing an international trade single window blockchain to exchange information on clearance, and logistics and cargo status to improve the port business environment and trade facilitation.

Hong Kong, China

The customs authorities are conducting a PoC study in applying blockchain to a licence management system.

Indonesia

The customs authority aims to use blockchain and the TradeLens platform to simplify the exchange of goods, automate documentation and increase cooperation and communication. The platform connects supply chain partners (e.g. cargo owners, carriers, freight forwarders, logistics providers, ports and terminals, customs authorities) to a secure audit trail of millions of shipment events and documents with authorized parties.

Malaysia

A pilot project for AEOs is in a preliminary study phase. This project is being carried out in collaboration with the national R&D centre MIMOS, under the Ministry of Science, Technology and Innovation, to develop an alternative option to industries in addition to the current AEO service provided by the Royal Malaysian Customs Department. The new blockchain service will ensure a high level of system compliance while increasing efficiency in the supply chains of companies under the AEO programme, making them more competitive.

North of Africa, Near and Middle East

In the MENA region, blockchain is used to exchange customs declarations and documents, such as CoOs.

Morocco

The customs authority has launched a cooperation project with DHL and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to develop a blockchain platform to collect and share international transaction data on traders, express mail service, customs authorities and other stakeholders.

The aim is to simplify procedures and to enhance risk management, in particular with regard to customs valuation. The project is spread over two and a half years and is now at the design stage, preceding development and deployment.

Kingdom of Saudi Arabia

The customs authority is exploring with other customs authorities adoption of a common blockchain platform that would accelerate customs clearance by exchanging customs declarations and documents in real-time.

United Arab Emirates

The Federal Customs Authority and Dubai Customs have developed a cross-border e-commerce blockchain-based platform to facilitate and track commerce within the network of customs authorities, e-commerce companies, ports, couriers, third-party logistics, free-zone authorities and permit-issuing authorities. The platform was built in line with the WCO Framework of Standards for Cross-border e-Commerce. It helps to develop mutual trust, collaboration, automation and a fair e-commerce market, with benefits to all the stakeholders involved, including:

- end-to-end real-time visibility of orders;
- goods return issues solved by linking e-commerce orders and return orders with the customs declaration;
- increased efficiency by eliminating declaration preparation time;
- paperless transactions;
- controlling safety and security risks and increasing compliance;
- prevention of revenue leakages and improved valuation and classification of goods;
- reduced delivery time due to automated declarations, automated returns, refunds and automated low value goods declaration consolidation.

South America, North America, Central America and the Caribbean

In the AMS region, blockchain is used for a registration system of AEOs to facilitate the exchange of information on AEOs and container movements. One long-standing blockchain project is CADENA, which is being implemented by customs authorities in the Plurinational State of Bolivia, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico and Peru, with the support of the Inter-American Development Bank. CADENA has accelerated the processing of goods in destination countries, and the established information flow supports

not only customs authorities but also other stakeholders and systems that use the information.

As of August 2021, CADENA became fully operational, and customs authorities validated it with real data over a two-month period. The general benefits have been improvements to the operational implementation of bilateral or multilateral mutual recognition agreements (MRAs) and to the management of AEO programmes.

It has also contributed to strengthening the security of supply chains by ensuring that AEO information on certifications, suspensions and cancellations executed by a customs authority is shared in real time with customs authorities of MRA partners, which allows them to take appropriate action.

CADENA also provides the following benefits:

- point-to-point automation to exchange data through the digitization of AEO certificate status;
- a secure, reliable and traceable mechanism to exchange data on AEO certificates and to maintain an historical record of all shared information relating to each certificate;
- data integrity and access control though authentication of customs officers assigned to specific roles and authorizations;
- transparency of exchanged data;
- potential reduction of time and costs for AEOs by guaranteeing that the application of the benefits both at origins and destinations will be automatic from the moment they receive the AEO certification from customs authorities of MRA partners.

Mercosur's bConnect Project is fully deploying Blockchain Private Hyperledger Fabric 1.4 for Mercosur members' customs authorities and AEOs to exchange information while ensuring the integrity of any information shared and verifying the identities of those inputting information onto the platform. The platform makes sharing information by customs authorities faster, more efficient and safer, and includes Argentina, the Plurinational State of Bolivia, Brazil, Paraguay and Uruguay. The model is currently being reviewed and private data collection is being evaluated. Certain data could be shared by subsets of platform members, which could increase its use and the number of cases implemented through blockchain.

Canada

The Canada Border Services Agency (CBSA) is participating in pilot projects to evaluate the capacity of blockchain to provide a faster, more reliable and more transparent supply chain. These projects will run parallel to current CBSA processes, which means participants must follow established processes while also publishing events relating to each blockchain-based product.

The pilot projects are to evaluate the capacity of the blockchain solutions and determine whether the platforms could play a role in the CBSA's business processes. However, full integration is beyond the scope of the pilot projects.

The CBSA also participated in the pilot project TradeLens. Phase 1 took place in April and May 2019 with the monitoring of maritime container movements

from a foreign seaport arriving through a major Canadian seaport. Phase 2 of the pilot ran in June and July 2020, which included maritime shipments of any origin to increase the sample size and the complexity of types of movement (i.e. in bond, multi-port, transhipment, multi-modal).

The desired outcome for the CBSA was to determine whether there were any achievable, valuable benefits that blockchain could offer, in particular improved data quality and security, transaction transparency and increased availability of information. While there was an increase in the visibility and traceability of a container, additional data were limited or not available. According to the CBSA's assessment, the platform currently lacks the necessary number of participants (specifically cargo owners and vendors, customs brokers and maritime freight carriers).

Furthermore, since the information provided by stakeholders was voluntary (i.e. no legal or regulatory obligations), the amount of content and the quality of data were inconsistent and relied entirely upon the submitter's technical ability to provide such information and to do so at their own discretion. While the CBSA has an interest in the movement of containers and their origin provided by TradeLens, it is not truly the information that is required for it to conduct its core mission.

Border management requires more information than is currently available in TradeLens, such as importer declarations and manifest information that goes beyond what is required to enable the movement of goods.

The CBSA continues to participate in the monitoring of container movements through a large Canadian seaport and a container examination facility.

Guatemala

Guatemala is working on the development of a new maritime and air dispatch model based on blockchain, taking as a reference the Port Community Systems. The project aims to automate exports and to develop online services to exchange information with other customs terminals. The expected benefits include the following:

- simplification, automation and transparency in the entry and exit of goods;
- interoperability between all stakeholders of the national customs system (i.e. customs authorities and other border agencies, carriers, terminal operators, consolidators, importers and exporters);
- traceability, secure data exchange and real-time information on the logistics and customs clearance processes.

Currently, partners are being approached for support in developing a feasibility study and the definition of the Port Community Systems tailored to their national requirements. Once completed, it will be shared with all relevant stakeholders for their validation, after which the software would be developed then adopted.

Peru

Peru reported on the use of LACChain to exchange information with Pacific Alliance Countries. LACChain

is a global public–private alliance supported by the IDB Lab (the innovation laboratory of the Inter-American Development Bank Group) to promote integration and economic and social development among Chile, Colombia, Mexico and Peru by providing the infrastructure to develop interoperable blockchain applications in Latin American and the Caribbean. The founding members of LACChain identified a fragmentation and dispersion of the communities and blockchain networks, which limited the efforts being made to adopt this technology.

In addition to a highly fragmented environment with non-interoperable networks, there was also an absence of international standards and protocols, and a lack of collaboration between public, private and academic entities. Today, LACChain provides three infrastructures that can be used by projects and applications: a blockchain; a self-sovereign identity system; and tokenized money allowing the digital representation of legal tender. One application using the LACChain ecosystem is CADENA, as mentioned above.

United States of America

The United States Customs and Border Protection (CBP) conducted a PoC in September 2018 on the application of blockchain technology in the submission process for entry summary declarations under the Central America Free Trade Agreement (CAFTA) and trade with Canada and Mexico.

The assessment of the application and the policy and legal issues raised by the PoC found that the use of blockchain achieved improved communication between the CBP and traders, improved documentation of receipt and expedited processing, with the elimination of manual documentation requirements and duplicative data entry.

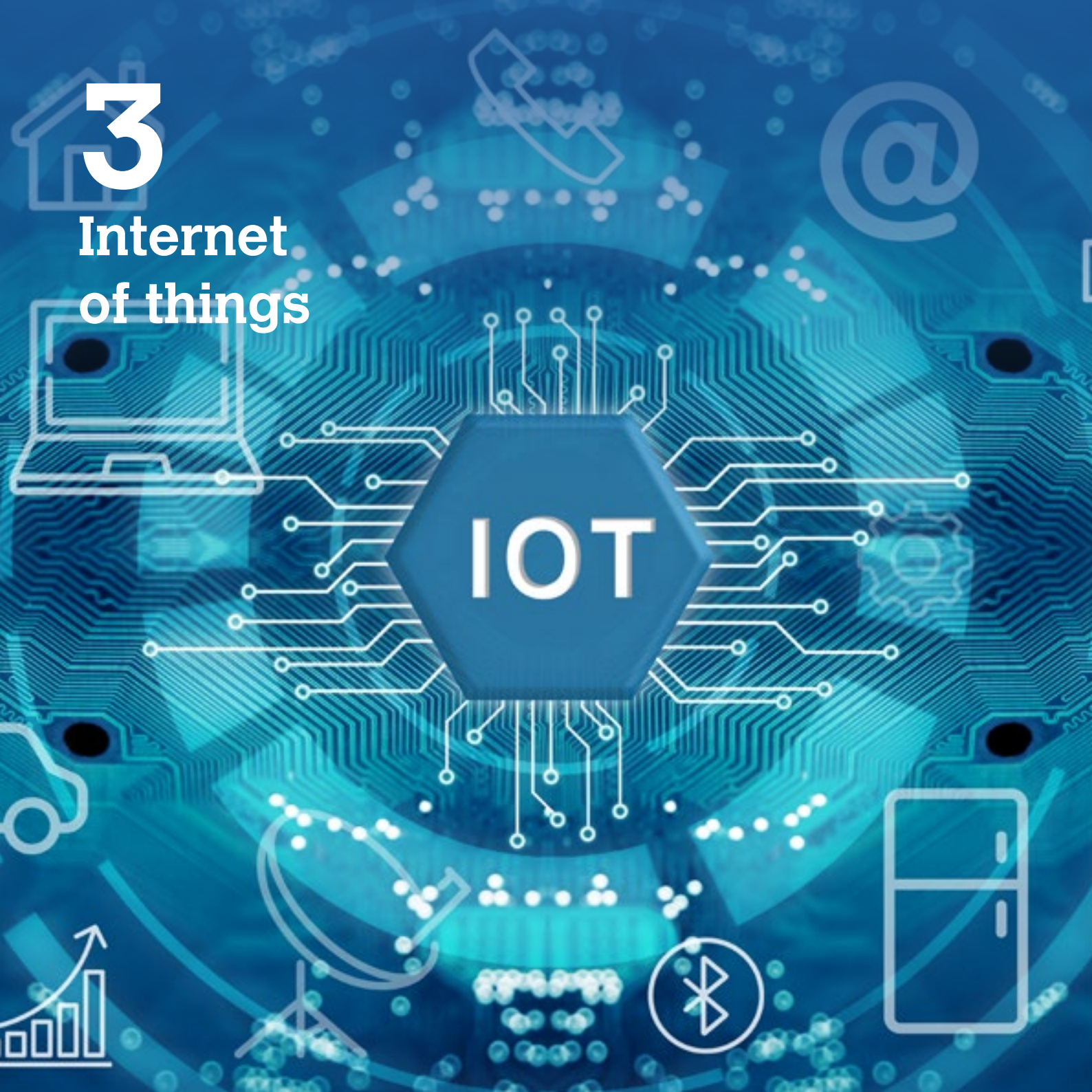
There was also easier access to back-up documentation, and since full data were received with the initial submission of the entry summary, potential issues were captured early on. Furthermore, in September 2019, the CBP conducted the intellectual property rights PoC, which tested a blockchain technology in facilitating shipments based on known licensing relationships (licenser and sub-licensee relationships).[1]

Endnotes

[1] See also http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/ressources/permanent-technical-committee/223-224/pc0542e1a.pdf?la=en and http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/ressources/permanent-technical-committee/223-224/pc_0542_annex_e.pdf?la=en.

[2] https://www.cbp.gov/trade/ace/whats-new-innovation

3 Internet of things



Members are experimenting with the use of IoT to fully automate border-crossings and customs procedures in national ports. Other projects have introduced centralized X-ray image analysis across multiple scanning stations and the use of radio frequency identification (RFID) antennas or e-seals to ensure traceability of goods and means of transport.

Thanks to IoT, members benefit from better risk management, greater efficiency of customs clearance processes and improved analytics. However, one of the greatest challenges is integrating information collected through IoT devices into customs operating systems and the lack of compatibility and interoperability of different IoT solutions.

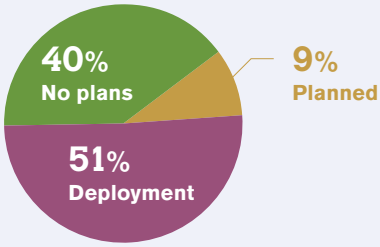
The information collected through smart devices is, in the majority of cases, not shared with other stakeholders. However, those who share often have multiple data-sharing channels and primarily share their information with other government agencies or customs authorities and, in a few cases, with the private sector.

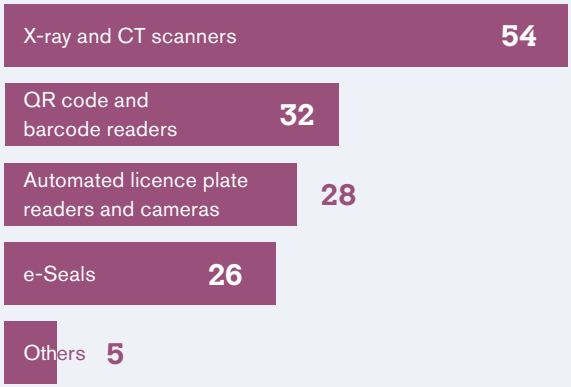
Stage of adoption

Half of respondents indicated that they use IoT in customs business processes, and 9 per cent plan to deploy them (see Figure 8). However, as many as 40 per cent have no plans to use the technology. Of the 72 respondents which deploy IoT, the majority indicated deployment of X-ray or computed tomography (CT) scanning, and significant numbers use QR code and barcode readers, automated licence plate readers and cameras, and e-seals.

FIGURE 8

Stage of adoption of the internet of things





Note: Total respondents numbered 94. Figures in the bottom chart indicate the number of responses for each category (respondents could give more than one answer).

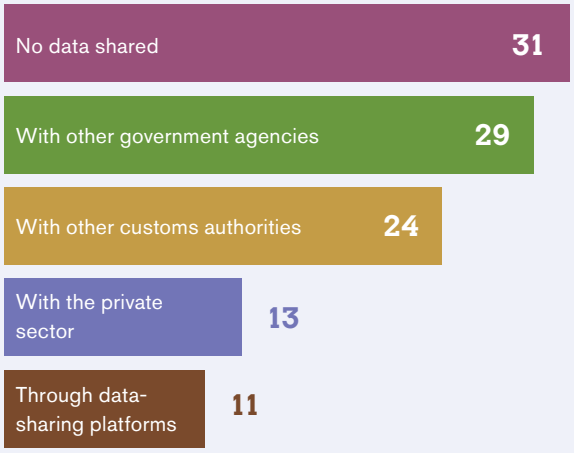
With regard to sharing information collected through IoT devices, 108 responses were provided by 78 members, which means that some customs authorities use multiple channels (see Figure 9). For those who share information, the majority only share information with other government agencies and customs authorities. A large number of respondents (31) do not share information with any stakeholders.

A number of members provided examples of their data-sharing solutions. One of them is Indonesia, which uses the National Logistic Ecosystem, which is a data-sharing platform for government agencies and the private sector to share trade documents and information relating to the flow of international goods. With the application programming interface, both domestic and global logistics platforms can share information (e.g. trucking, warehousing, shipping, forwarding).

The platform reduces duplication of documents and information and simplifies business processes through integrated inspection services, with single submissions, port services and permits. Another example is Italy, which is developing a model that will operate with other customs authorities, in particular through the use of passive RFID e-seals.

FIGURE 9

Sharing information with other stakeholders



Note: Total respondents numbered 108. Figures indicate the number of responses for each category.

Benefits

The main benefit of IoT for customs authorities is to enhance the volume and variety of data, which in turn helps to achieve improved risk management, greater efficiency in customs clearance processes, and better analytics (see Figure 10). One respondent mentioned the benefit of monitoring the integrity of transhipment cargo movement between entry and exit control points. Another emphasized the benefit of using IoT to standardize processes for the benefit of traders, enhancing port performance by reducing times for loading and unloading goods in port areas, linking innovative solutions already implemented by the customs authorities, and reducing manual procedures to improve security and legitimate trade.

FIGURE 10

Main benefits of introducing the internet of things

Note: Total respondents numbered 83. Figures indicate the number of responses for each category (respondents could give more than one answer).

Obstacles to adoption

Many respondents view the cost of introducing IoT solutions as a significant obstacle, along with integrating IoT into established processes and issues of compatibility and interoperability of different systems (see Figure 11).

Having the necessary knowledge to introduce IoT is a significant obstacle. Respondents indicate the lack of expertise and good practices, and the challenge of handling unstructured data. Legal issues, data security and privacy, as well as the lack of government strategy, were also mentioned.

FIGURE 11

Main obstacles to adopting the internet of things

Note: Total respondents numbered 82. Figures indicate the number of responses for each category (respondents could give more than one answer).

Respondents also emphasized that if two or more neighbouring countries introduce IoT solutions, then they could all reap the full benefits across borders. However, not all customs authorities are familiar with the technology, nor able to introduce it; rather, there can often be resistance to change. This lack of infrastructure is another obstacle to a more profound uptake of IoT technologies.

Examples of use

East and Southern Africa

In the ESA region, IoT is used to facilitate acquittal of transits through QR codes. Zambia uses QR codes for online acquittal of transits. In Eswatini, the barcodes generated by Automated System for Customs Data software (ASYCUDAWorld) are already one element in place to implement IoT.

Europe

The use of IoT is widespread in Europe and are either fully or partially integrated with automated systems for customs clearance. CCTV cameras, X-ray scanners, GPS tracking and licence plate readers are quite broadly used and integrated with customs processes at the national level, or even shared at the regional level.

Other projects include the use of geo-fence and telematics data for transferring information to customs authorities through smart phones and apps to recognize border arrivals (e.g. used by Switzerland).

Baltic States

The Baltic X-ray Images Exchange (BAXE) is implemented by Estonia, Latvia and Lithuania, and led by the latter's customs authority. BAXE was designed to address challenges such as the lack of interoperability of X-ray scanners produced by different vendors, disparities in software and user interfaces, and a lack of unified training software.

Since its adoption, 16 X-ray scanners in operation in Estonia, Latvia and Lithuania have been integrated into BAXE and two training centres have been established in Riga and in Vilnius.

The use of a single format by the three countries has enabled the exchange of X-ray images, which are then analysed centrally in Latvia, under a pilot project started in September 2019. The specialized training facility for X-ray systems operators and the unified training software for image analysis have optimized human resource allocation and enhanced the quality of image analysis.

There is also an automated licence plate recognition system between the Baltic States and Poland, and IoT is utilized in the corridor-as-a-service (CaaS) pilot project to experiment with fully automating a border-crossing. Sensor data identify vehicles by their licence plates and GPS at a specific northern border-crossing point.

Italy

The Customs and Monopolies Agency (ADM) is conducting a project to completely digitize customs procedures in

Italian ports for goods transported by both rail and road. The project, which involves all the main port institutions, is based on IoT, with special readers providing information to authorized stakeholders. A unique identification code is generated in a universally unique identifier format and issued by the ADM. The system, which is interoperable with the Port System Authorities, enables automatic tracking of vehicles and goods in the port area.

In addition to advantages for operators such as fewer requirements and submissions, the goal is to optimize the multimodal movement of goods to increase the competitiveness of the port system in the Trans-European Transport Network (TEN-T) and to attract new traffic flows by standardizing and simplifying customs processes and developing advanced services based on IoT technology, in cooperation with customs authorities and other port stakeholders.

Asia and Pacific

The Asia and Pacific region has a number of IoT projects using e-seals, QR codes and X-ray scanners.

Hong Kong, China

Since 2016, the Single E-lock Scheme (SELS) has connected the Intermodal Transhipment Facilitation Scheme of the Hong Kong Customs and Excise Department with the Speedy Customs Clearance of the mainland customs authority towards establishing a green lane to facilitate the flow of goods through a seamless clearance service.

One single e-lock and GPS technology accredited by both customs authorities are applied in the SELS under the principle of one single e-lock under separate monitoring. The GPS device is used for real-time tracking of the movement of the goods to ensure the security of transhipment cargo in Hong Kong, China.

Indonesia

The Customs Office of Tanjung Priok has electronically sealed containers to supervise the transfer of containers and to monitor the shipment history in real time with GPS. The sealed containers are all monitored in a dedicated control room. This initiative is to improve the performance of the Customs Office in facilitating the flow of goods out of the port.

In addition, it is hoped that the swifter flow through simplified customs procedures will create a conducive business and investment climate.

Malaysia

SmartCargo uses new cargo scanners which include a radiation portal monitor and AI and optical character recognition technology linked to the customs system. The licence plate and container number are run against stored customs declarations.

The image analyst reviews this declaration together with the scanned cargo image while the container is monitored for radiation, which will automatically alert the analyst, who then decides either to release the container or to send it for physical inspection. Ideally, this takes

place within one minute because of the interconnectivity of the different systems that generate real-time data.

Malaysia also has a project to use embedded certificate authority to authenticate a new tax stamp. When the QR code is scanned, the authenticity of the tax stamp is verified, which will lower the risk of counterfeited tax stamps.

Singapore

Singapore also uses e-seals to enhance the visibility and security of container movements beyond the checkpoints, and has an integrated command centre system to analyse X-ray images from multiple scanning stations.

Timor-Leste

In Timor-Leste, barcodes are built into the ASYCUDAWorld Single Administrative Document, among others, and are commonly used for the manifest, goods declaration, payments, container pass, and the release and exit of goods from controlled customs areas.

North of Africa, Near and Middle East

A number of projects in the MENA region use X-ray scanners and tracking solutions.

Jordan

Jordan is introducing electronic gates at airports. At the Queen Alia International Airport, in Amman, the government has introduced an automated immigration clearance system to reduce the time it takes for a passenger to pass through immigration to just a matter of seconds. The system uses two-factor authentication of e-gate ID cards utilizing RFID technology and biometric fingerprint verification of passengers. Registered travellers can bypass immigration through the automated booths.

United Arab Emirates

The United Arab Emirates has a number of IoT initiatives, such as X-raying cargo on the move and a container risk tracking platform which X-rays and monitors risks inside containers with scanners integrated into the customs risk and declaration management system.

The Dubai Customs integrated vessel tracking system uses marine traffic data to track vessels across the world and feeds the data into the internal risk and declaration management system. The marine traffic system uses IoT to collect data transmitted via an automatic identification system of receiving stations that form a marine traffic network. When a vessel enters a remote area out of the range of a receiving station, its position is identified with satellite tracking.

South America, North America, Central America and the Caribbean

The AMS uses IoT for goods inspection and tracking along the supply chain through X-ray and CT scanners, e-seals and licence plate readers.

Argentina

The Customs Transit Security Initiative (ISTA) uses e-seals for goods in transit, which allows the General Directorate of Customs (DGA) and the customs transport agent to respond immediately when accidents occur, providing security to the global logistics chain and a reduction in operating costs. The e-seals are placed on certain consignments upon arrival in Argentina, whose movement is tracked to the destination point and a record of all events during internal transit is generated.

In addition to cargo security and constant monitoring, the benefits of ISTA also include a simplified declaration process, reductions in cost, an agile logistics chains and improved operational compliance times. In accordance with WCO standards and in the spirit of facilitating and securing international trade, mutual agreements relating to the technology utilized by ISTA have been signed with countries in the region. Coordinated work with other customs authorities is being promoted to improve quality controls, for example by sharing scanned images.

Chile

Seaports have adopted licence plate readers integrated with customs authorities and port systems.

Guatemala

Customs authorities have requested X-ray scanners to control the loading and unloading of goods. RFID antennas have been installed to collect information on goods crossing the Pedro de Alvarado customs authority. More RFID antennas are to be introduced, which will ensure the traceability of the goods and means of transport.

United States of America

CBP is exploring the use of IoT to manage its extensive network of sensors. The objective is to improve domain awareness and to make the data available to a wider audience within CBP by using an IoT gateway. CBP is also looking at IoT to help to modernize the experience of cargo processing at the border, reduce time spent on inspections and increase the speed of passage. AI and machine learning will utilize data from IoT devices to gain deeper insights on the information gathered and better secure borders.

West and Central Africa

In the WCA region, IoT is used to track cargo in transit through e-seals and barcode readers (e.g. in the Democratic Republic of the Congo).

4

Big data, data analytics, artificial intelligence and machine learning

Around half of customs authorities use some combination of big data analytics, AI and machine learning, while the other half plans to do so in the future. The majority of respondents see clear benefits from the technology, where risk management and profiling, fraud detection, and greater compliance are the most prevalent.

There is a need to establish a data strategy to ensure improved data governance and management and quality required. The obstacles and challenges to introducing these types of technology include the cost and the lack of expertise and good practices.

There is a high demand for human resources with advanced technical skills that are often hard to find, such as data architects and engineers, and software and machine learning designers. Data protection laws can limit the extent to which data can be used.

A lack of guidance on how to interpret such legislation in analysing data for customs purposes often leads to excessive caution in designing projects and restricts the exchange of data between organizations and customs authorities.

However, there can be great benefits to customs authorities, such as the following:

- data mining for intelligence purposes and risk management;
- post-clearance audits and controls;
- developing AI-based models for interpreting X-ray images;
- enhancing efficiency in using financial and tax data more widely and strategically to improve compliance and performance in terms of public revenue collection and to fight against smuggling;
- designing chatbots to answer online public enquiries;
- classifying tariffs;
- revealing potential anomalies in high revenue areas (e.g. excise goods);
- detecting undervaluation and overvaluation anomalies.

A lack of guidance on how to interpret data protection laws restricts the exchange of data between organizations and customs authorities.

Stage of adoption

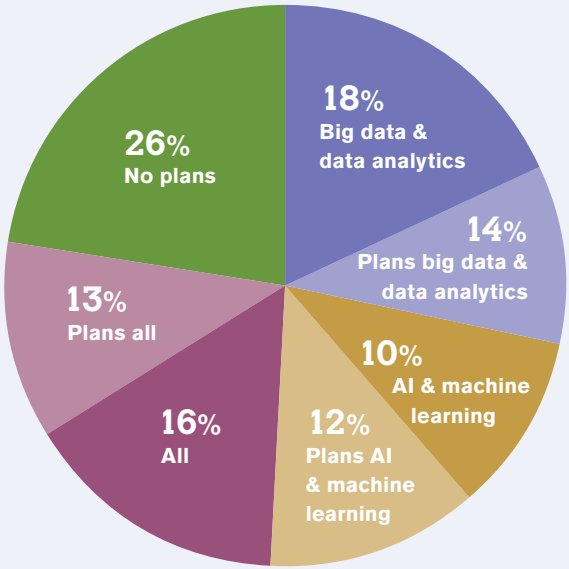
The ACS shows that 44 per cent of respondents use big data analytics, AI and machine learning (see Figure 12); while another 33 per cent have plans to introduce their use. A minority of respondents (23 per cent) have currently no plans.

Benefits

The main benefits reported are better risk management and profiling, fraud detection and compliance, customs audits and identification of anomalies (see Figure 13).

FIGURE 12

Stage of adoption of big data, data analytics, artificial intelligence and machine learning



Note: Total respondents numbered 94.

FIGURE 13

Main benefits of introducing big data, data analytics, artificial intelligence and machine learning

Note: Total respondents numbered 100. Figures indicate the number of responses for each category (respondents could give more than one answer).

Predicting future trends and improving trade facilitation and improving revenue collection also rank highly. However, fewer respondents reported improvements to container imaging and visual searches.

Some respondents reported a significant improvement in data quality when combining multiple commercial data sources with customs data. For example, Belgium is doing this to improve data quality and thus enhance the quality of data analytics and intelligence.

By integrating supervised and unsupervised learning models, it is possible to improve the performance of the assertiveness of the selection of transactions, either during processing or afterwards. Similarly, the incorporation of advanced selection models means that results can be interpreted more efficiently, which can then be fed back into the selection mechanisms, strengthening their performance. The models make it possible to reduce arbitrariness as a consequence of decisions based solely and exclusively on expert judgement.

The incorporation of advanced selection models means that results can be interpreted more efficiently.

Obstacles to adoption

The most significant obstacles to implementation reported were the lack of expertise and the costs (see Figure 14). Similar to perceived obstacles to the introduction of IoT, a lack of good practices, current legacy systems, a lack of use by other stakeholders (18 respondents), the absence of a government strategy as

FIGURE 14

Main obstacles to adopting big data, data analytics, artificial intelligence and machine learning

Note: Total respondents numbered 94. Figures indicate the number of responses for each category (respondents could give more than one answer).

well as legal issues are all obstacles. Respondents also cited data governance issues, data quality, information organization, roles and functions.

One respondent currently requests only a portion of the data it actually needs, while everything else is provided voluntarily by the carrier or service provider. Even for mandated data, such as advance passenger information collected by air carriers, obtain the necessary quality (i.e. timeliness, completeness) requires much effort. It can also be difficult to agree on a broad enough scope in data-sharing agreements required with third-party data providers, including within the government.

Properly using big data and machine learning in large organizations is not easy and often requires a shift in how to deal with data from a broader perspective, including having a data strategy and establishing a mechanism to ensure data governance and management. Such mechanisms can contribute to data of a higher quality and maximize the value of the information extracted (i.e. evidence-based decision-making, automation).

Respondents also observe that customs authorities may lose the golden opportunity to fully utilize the technology if they are not ready to manage the change. It has not been easy to train people with the appropriate skills. There is a high demand for engineers with advanced technical skills.

It can also be difficult to retain those profiles within teams due to a dynamic AI job market. Large-scale use of data and AI technology needs a new mindset in developing customs IT systems.

Integrating customs transactions data from multiple sources on a single platform and examining the big data from a 360-degree perspective require changes to current IT systems. In some cases, there will be legal obstacles to how freely the data can be used. Customs authorities face issues with legacy systems and may still rely on paper-based processing to a large extent.

Both customs authorities and data protection laws can limit the use of data for customs purposes. In EU law, there are the General Data Protection Regulation (GDPR) and the Union Customs Code. According to the definitions in the GDPR, nearly all customs-related datasets contain some form of personal data, whether directly or indirectly, that include names, addresses, phone numbers and company identification that could be traced back to a specific person or business. Those data fields are often unstructured or offer no easy way of excluding the personal data without losing the essence of the information.

In order to work with customs data, the choice is either anonymized data with minimal data protection constraints (but with less useful data) or personal data (in which case many provisions in EU and national legislation apply).

Most EU member States have pre-existing privacy laws they have had to adapt to comply with the GDPR, or even go beyond it. However, there is no clear guidance on how to interpret these laws together in the context

of analysing data for customs purposes. Such a lack of clear guidance and interpretation often leads to excessive caution when designing projects. It also strongly limits the cases for which an organization is able to exchange data with other customs authorities. In practice, the following often occurs:

(i) Data processing can only be carried out by certain categories of personnel (e.g. data miners, risk analysts, data managers).
(ii) Data can only be exchanged with other parties if an agreement (or a specific protocol) on the processing of the data has been signed. Negotiations can take a long time or sometimes even fail. The content must be modified and signed again every time a new objective is defined, or a new data source or category is added.
(iii) Internal procedures must be followed to make sure that everything is correctly documented, and that the data are protected (encrypted, and pseudonymized if it is not necessary to have the full data). Setting up the IT infrastructure dedicated to the exchange of data (i.e. servers) can only be done once the privacy process is approved by a dedicated data protection officer.
(iv) The data protection officer must validate all these procedures and documents before any further steps are taken.
(v) The explicit authorization of the data protection committee must be obtained in order to add external data containing personal data to the IT infrastructure.

Working with personal data is possible, but it is limited to specific use cases and requires much willingness, time and effort.

Ultimately, working with personal data is possible, but it is limited to specific use cases and requires much willingness, time and effort. The process is tedious and must be repeated every time a new element is incorporated. On the other hand, working without personal data is not much simpler, since excluding personal data also involves the processing of personal data.

One respondent raised the issue of how to manage expectations. There are limitations to what can be achieved with the legal and data quality issues of big data customs analytics. Making these limitations known to managers and policy-makers is key for moving forward.

Examples of use

Respondents provided many examples of how they use big data, data analytics, artificial intelligence and machine learning across a wide range of projects and cases. Table 2 summarizes the responses according to the type of technology.

TABLE 2

Example uses of big data, data analytics, artificial intelligence and machine learning

Post-clearance audits and controls	Refunds and drawbacks non-compliance
Automated targeting systems	Detection of prohibited goods
Tariff misclassification and non-compliance with tariff advice	Monitoring service delivery performance in real time
Misuse of concessions (including tariff concession orders, by-laws, free trade agreements and origin masking)	Providing historical insights into customs statistical information for future planning and forecasting
Detection of anomalies in high revenue areas (including excise equivalent goods i.e. alcohol, tobacco, petroleum)	Compliance risk scoring in commercial and trade activities
Detection of dumping and countervailing anomalies	Identifying low value courier and postal shipments to improve risk assessment
Detection of undervaluation and overvaluation anomalies	Identifying low risk individuals at borders
	Developing advanced analytics for AEOs

Examples specific to big data and data analytics

- Data mining for intelligence purposes and risk management
- Using financial and tax data to improve compliance and performance of public revenue collection and the fight against smuggling
- Analysing massive volumes of internet information to identify crime trends in intellectual property rights
- Data mining of imports
- Trade circumvention graph analytics
- Export and import data analytics
- Price recommendation data analytics
- Developing a data lake for consolidation and single truth of all customs data

Examples specific to artificial intelligence and machine learning

- AI-based models for interpreting X-ray images
- AI and machine learning for enhanced risk management processes (e.g. inspection results feedback loop, client segmentation, automatic assessment, upgrade of risk profiling)
- Chatbots for answering online public enquiries and for physical robots to answer enquiries from travellers at control points
- Cross-platform cyber patrols
- CT scanners with AI to enhance enforcement capabilities and customs clearance efficiency
- Automating repetitive manual procedures involving revenue protection (e.g. online research of market prices and deploying AI to assist in conducting intelligent filtering of research results)
- Using AI with Harmonized System Classification

5 Impact and ease of adoption of advanced technologies

The survey seeks to assess respondents' expectations of the positive impacts that technology will have on customs operations in the future.

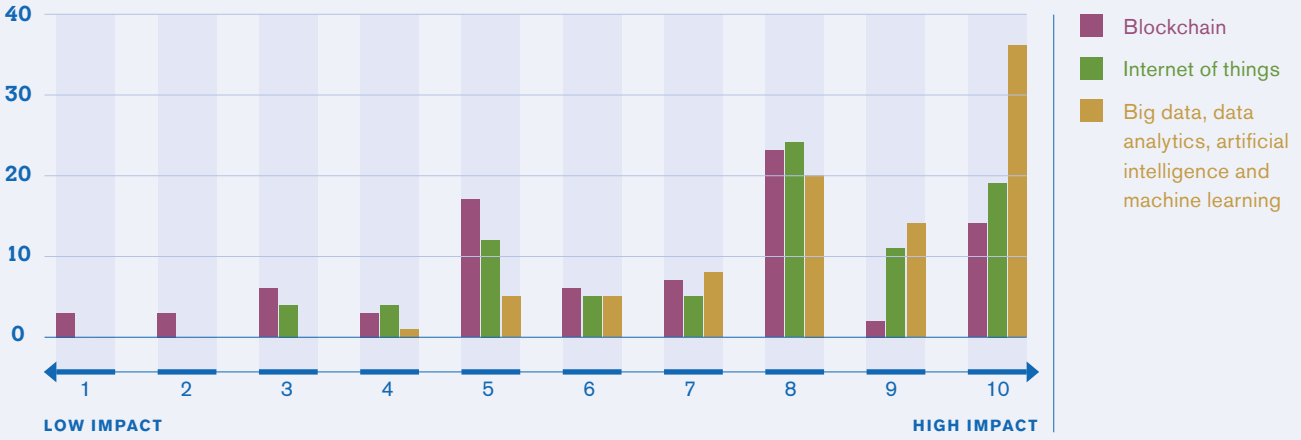
Big data, data analytics, AI and machine learning were considered to have the greatest future impact on customs operations. Out of 89 respondents, 36 gave it the highest mark of ten (see Figure 15).

Apart from one respondent, all others rated its impact at least a five. This shows a high level of confidence in a technology that has already been used for some time and the use of which is constantly increasing, in particular for improving the risk management capabilities of customs authorities.

Although blockchain has great potential, many challenges could hinder its use.

FIGURE 15

Impact of the three areas of advanced technology on customs operations



Although blockchain has great potential, respondents felt that many important challenges at the implementation level could hinder its use by customs administrations. The fact that such a large share of respondents gave it the lowest marking of five or less is a reflection of some hesitancy and lack of faith in its future use.

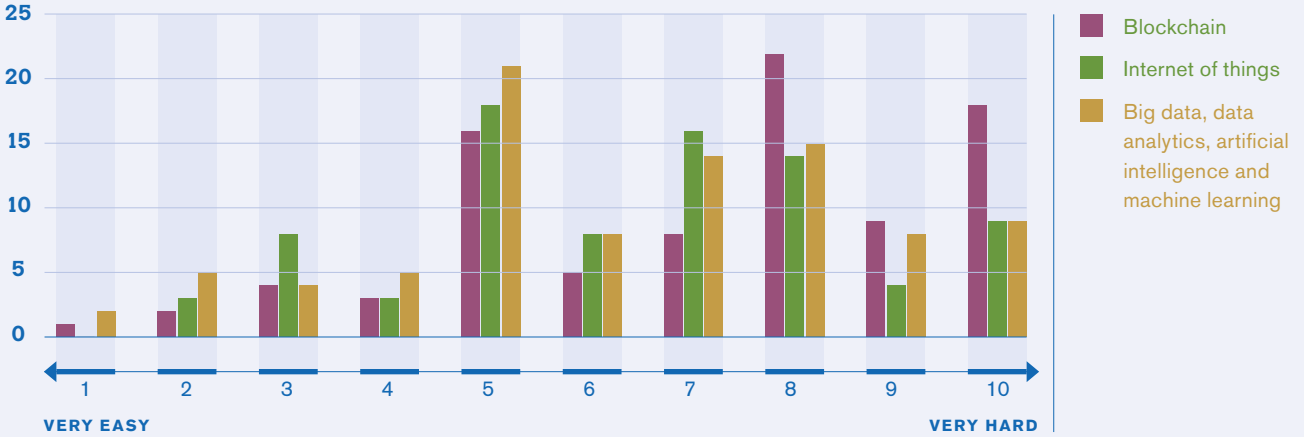
Respondents view IoT technologies similarly to blockchain. However, none gave the lowest marking, which indicates a higher level of confidence in the success of IoT projects.

Respondents appear more doubtful to the question of how easy it would be to adopt the technologies. Correspondingly, the scores are lower compared to the impact the technologies could have (see Figure 16).

Nevertheless, there seems to be more optimism for the ease of adoption of blockchain; whereas responses for both IoT and AI and machine learning were more evenly distributed.

FIGURE 16

Ease of adoption of these types of technology



6 Conclusion

The survey shows a high level of interest and activity in the testing and implementation of the three areas of advanced technology in customs authorities worldwide. Over half of respondents report using IoT, AI and machine learning, while only Argentina and Uruguay are currently deploying blockchain.

This collaboration between the WCO and the WTO is to gain a better understanding of how the latest advanced technologies can help customs authorities to contribute to trade facilitation and to shed light on the opportunities and challenges customs authorities face when deploying the technologies.

Information on numerous pilot projects and PoCs show the interest in expanding the use of these technologies as well as the confidence in the benefits they will bring to customs authorities in achieving their objectives and in supporting cross-border trade.

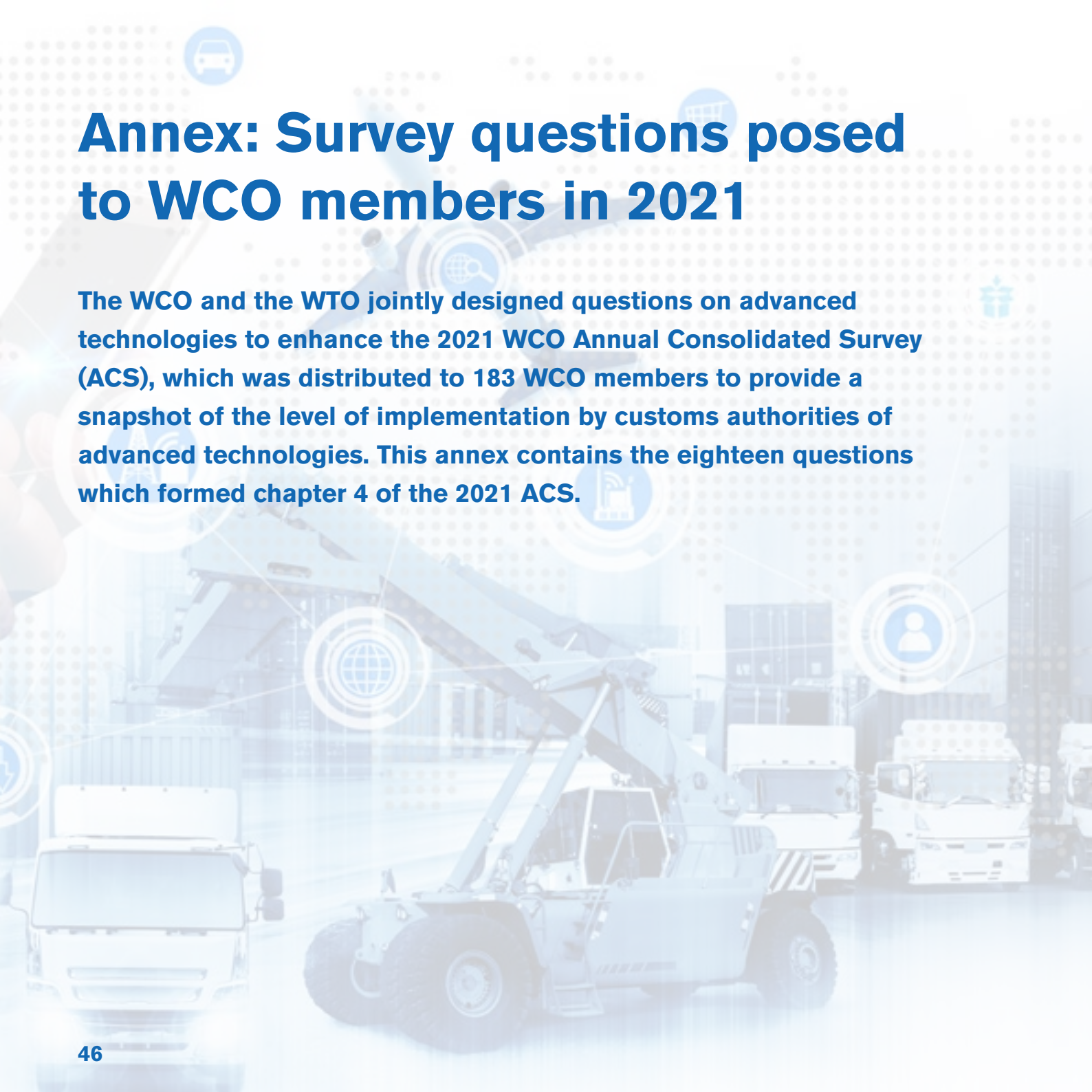
A number of common benefits are expected from the adoption of these three areas of advanced technology such as, *inter alia*, enhanced transparency of procedures, better risk management and profiling, and improved data quality, which will lead to greater efficiency of customs clearance processes and greater revenue collection.

The information contained here can form a basis for policy actions to ensure customs authorities can contribute towards paperless trade. The publication will be of particular interest to WCO and WTO members in the process of implementing the TFA, which plays a vital role in boosting world trade and output and in facilitating trade by simplifying, modernizing and harmonizing customs processes.

Customs authorities have shown a level of caution and an awareness of the obstacles and challenges of adopting these technologies such as cost, lack of expertise, the need for a government strategy and legal issues. This awareness is an important step in successfully reaping the benefits of the latest technology.

Annex: Survey questions posed to WCO members in 2021

The WCO and the WTO jointly designed questions on advanced technologies to enhance the 2021 WCO Annual Consolidated Survey (ACS), which was distributed to 183 WCO members to provide a snapshot of the level of implementation by customs authorities of advanced technologies. This annex contains the eighteen questions which formed chapter 4 of the 2021 ACS.



Question	Response	Guidance
Is there a strategy on adoption of IT tools and information management in place?	□ Yes □ No	Tick the appropriate answer.
Is your administration testing or using blockchain and distributed ledger technology?	□ Yes, pilot project □ Yes, proof of concept □ Yes, full deployment □ No, but it is planned in the next three years □ There is no plan	Please indicate whether there is/was a pilot project, proof of concept or a plan for (or realization of) full deployment of blockchain and distributed ledger technology.
If yes, do you use a permissioned (private), permissionless (public), or hybrid (combination of private and public) blockchain?	□ Permissioned (private) □ Permissionless (public) □ Hybrid	Tick the appropriate answer.
Please provide a short summary of the blockchain and distributed ledger technology project(s) and planned activities (up to 250 words per project).		Additional documents and links are welcomed.
What is the area of the project?	□ Automated customs declaration (e.g. import, export, manifest reporting, etc.) □ Single window environment □ Electronic certifications, permits or licensing □ e-Commerce □ Intergovernmental exchange of information at international level (e.g. transit interconnectivity, AEO MRA, advance electronic information, etc.) □ End-to-end supply chain interconnectivity □ Risk management/targeting □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.

Question	Response	Guidance
What is/could, for your administration, be the main benefits of introducing blockchain and distributed ledger technology?	□ Transparency, immutability and accessibility of information □ Increased availability of information from different sources □ Increased data quality □ Sharing of information amongst all relevant stakeholders in real time □ Data privacy □ Easy to use technology □ Secure IT environment □ Automation through smart contracts □ Lower verification and transaction costs □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.
What is/could, for your administration, be the biggest obstacles in implementing blockchain and distributed ledger technology?	□ Costs □ Lack of legal framework (please elaborate) □ Lack of expertise □ Lack of government strategy □ Lack of traction on the use of the technology by other stakeholders □ Existing legacy systems □ Lack of good practices □ Lack of trust in using data-sharing platforms □ Lack of a standardized dataset used by economic operators within the supply chain □ Other. Please indicate: Please elaborate:	Tick all applicable answers. Please elaborate on the legal framework and on any other points selected above.

Question	Response	Guidance
What could be the challenges for a blockchain system to function efficiently?	□ Lack of standardized dataset used by government agencies □ Lack of a standardized dataset used by economic operators within the supply chain □ The use of different types of blockchain technology and the lack of interoperability between them □ The proliferation of different blockchain solutions that are not interconnected one to another □ The complexity in establishing an inclusive but efficient governance mechanism □ Incompatible legal requirements in different countries □ Lack of harmonized regulatory procedures in different countries □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.
Is your administration using IoT? If yes or planned, please provide a short summary of IoT uses (up to 250 words per project).	□ Yes □ No □ Planned Summary of the project:	Additional documents and links are welcomed.
If yes, what smart devices and other equipment is your administration using to collect information on the goods moving across borders?	□ X-ray or CT scanners □ Electronic seals □ QR code and barcode readers □ Automated licence plate readers or cameras □ Other. Please indicate: Please elaborate:	Tick all applicable answers.

Question	Response	Guidance
Is this information shared with other stakeholders?	□ Yes, with other customs authorities □ Yes, with other government agencies □ Yes, with the private sector □ Yes, through a data-sharing platform □ No □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.
What is/could, for your administration, be the main benefits of IoT?	□ Lower labour costs □ Greater efficiency of customs clearance processes □ Enables better analytics □ Better risk management □ Help prioritize customs clearance □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.
Are there specific difficulties associated with the use of IoT?	□ Cost □ Legal issues (please elaborate) □ Lack of expertise □ Lack of government strategy □ Lack of traction on the use of the technology by other stakeholders □ Existing legacy systems □ Lack of good practices □ Compatibility and interoperability of different IoT systems □ Integration of IoT solutions with customs processes □ Handling of IoT unstructured data and the ability to transform the information collected from various sources in a format that can be analysed and automated □ Data security and privacy issues □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.

Question	Response	Guidance
Is your administration using big data analytics, artificial intelligence and machine learning? If yes or planned, please provide a short summary of how you use/intend to use big data analytics, artificial intelligence and machine learning (up to 250 words per project).	□ Big data analytics □ Artificial intelligence and machine learning □ Both □ None □ Planned for big data analytics □ Planned for artificial intelligence and machine learning □ Planned for both Summary of the project:	Additional documents and links are welcomed.
What is/could be for your administration the main benefits of big data analytics, artificial intelligence and machine learning?	□ Better risk management and profiling, fraud detection, greater compliance □ Improve revenue collection □ Facilitates customs audits and identification of anomalies □ Improve facilitation □ Improve imaging (e.g. container images) and visual search □ Predict future trends □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.
What is/could be for your administration the biggest obstacles in implementing big data analytics, artificial intelligence and machine learning technology?	□ Costs □ Legal issues (please elaborate) □ Lack of expertise □ Lack of government strategy □ Lack of traction on the use of the technology by other stakeholders □ Existing legacy systems □ Lack of good practices □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.

Question	Response	Guidance
What is/could be for your administration the biggest obstacles in implementing big data analytics, artificial intelligence and machine learning technology?	□ Costs □ Legal issues (please elaborate) □ Lack of expertise □ Lack of government strategy □ Lack of traction on the use of the technology by other stakeholders □ Existing legacy systems □ Lack of good practices □ Other. Please indicate: Please elaborate:	Tick all applicable answers. You may elaborate on any of the points selected above.
What do you think the impact of these technologies will have on customs operations (0 is very low impact, 10 is very high impact)?	□ Blockchain and distributed ledger technology □ IoT □ Big data analytics, artificial intelligence and machine learning	Rate each one from 0 to 10; 0 is very low impact, 10 is very high impact.
How easy/difficult will it be to adopt and implement these technologies in your administration (0 is very easy, 10 is very hard)?	□ Blockchain and distributed ledger technology □ IoT □ Big data analytics, artificial intelligence and machine learning	Rate each one from 0 to 10; 0 is very easy, 10 is very hard.

Abbreviations

ACS	Annual Consolidated Survey
AEO	authorized economic operator
AI	artificial intelligence
AMS	South America, North America, Central America and the Caribbean
Asia and Pacific	Far East, South and South-East Asia, Australasia and the Pacific Islands
BAXE	Baltic X-ray Images Exchange
CBP	United States Customs and Border Protection
CBSA	Canada Border Services Agency
CoO	certificate of origin
CT	computed tomography
DLT	distributed ledger technology
ESA	East and Southern Africa
IoT	internet of things
MENA	North of Africa, Near and Middle East
MRA	mutual recognition agreement
PoC	proof of concept
RFID	radio frequency identification
VAT	value added tax
WCA	West and Central Africa
WCO	World Customs Organization
WTO	World Trade Organization

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