How can Customs better leverage emerging AI technologies for more sustainable and smarter operations?

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Abstract

Technological innovation is happening at a faster pace than ever before, creating new opportunities as well as challenges for many industries. This research paper aims to contribute to the efforts deployed by many customs administrations to leverage artificial intelligence (AI)–driven technologies in order to support smarter operations and efficiency. It makes recommendations to identify the organisational processes that could benefit from AI and machine learning (ML)–based initiatives.

The result of this paper is a set of practical frameworks coupled with technical, organisational and policy recommendations, which form a coherent business innovation kit to assist customs administrations to successfully start or scale their digital transformation journey.[1]

1. Introduction

With the rapid digital transformation impacting numerous industries globally, sophisticated data-driven technologies are now becoming more accessible to business organisations. Such accessibility has created new opportunities for customs administrations to support their reforms and modernisation programs. However, the need to leverage those technologies also creates new questions such as:

- What are the existing customs business processes that can benefit the most from AI-driven technologies?

- What are the right data solution technologies customs administrations should invest in to achieve growth and success in their business?

- How can we integrate identified technologies into the existing processes and systems assets?

- Do customs administrations have the required expertise to obtain the full benefits of the considered technologies? Should they hire/consult experts or train existing resources?

- How should we roll out an effective change management process to maximise the likelihood of delivering the intended results and outcomes?

This paper makes a positive contribution to the efforts that many countries are undertaking to modernise their customs administrations.

The paper is comprised of three parts. The first part suggests a practical and simple guideline to map AI–driven technologies values with the key customs processes, challenges and desired benefits, which identifies relevant cases that could benefit from AI–based initiatives. The second part describes a framework

that enables customs administrations to design and frame new ways to pursue modernisation projects. This part emphasises the dimensions and the critical success factors for an effective implementation of new technologies in the context of customs administrations. Finally, the third part highlights the technical considerations and requirements and makes organisational and policy recommendations to ensure a successful implementation of AI technologies.

2. Methodology

In order to answer the above questions, comprehensive desk research was undertaken to review relevant works, studies and documents and to perform an in-depth assessment of 'international best-practice' surrounding the customs systems modernisation initiatives. The research also considered global innovation concepts and the experience of the author in implementing risk management systems for the use of Customs and trade, to propose practical guidelines for assessing needs and analysing, acquiring and integrating market emerging technologies to support customs operations.

The purpose of the paper is to propose simple and concrete frameworks—inspired from various business innovation concepts—that can assist customs administrations to effectively incorporate new technologies and achieve enhanced sustainability.

In this document,

- 'new technology' refers mainly to data solutions that embed AI capabilities

- 'sustainability' (or 'sustainable' business) is an approach to creating long-term value by taking into consideration how organisations such as customs administrations can thrive and grow their business while simultaneously solving some of the trade participants' biggest challenges.

3. Mapping AI technologies

Customs administrations create more data every day and aim to use this data to enhance efficiency in their processes. From pre-arrival information screening to clearance and post-clearance regulatory activities handling, incorporating AI-powered technologies can assist Customs to make sense of data, drive insights, automate accurate decision-making and generate a positive business impact.

In this section, different business innovation models (Osterwalder et al., 2014; Bocken et al., 2013; Martins et al., 2017) and customs literature are used to describe how to identify opportunities to create and capture value in the customs environment using AI technologies.

3.1 Defining the right business-use cases

A use case is a list of actions or steps typically defining the interactions between a role (a human or another system) and a system to achieve a goal or create a value for a stakeholder or group of stakeholders.

To define the right use cases that can be supported by AI projects and achieve meaningful and sustainable improvement of customs performance, a holistic view and analysis of the value creation chain for all stakeholders is required. This involves understanding the tangible and intangible value flows between stakeholders and identifying relationships, interactions, and opportunities for greater collaborative value creation that is mutually beneficial (Bocken et al., 2013). The business-use case definition process is shown in Figure 1.

Figure 1: Business-use case definition process

Define your key stakeholders

Select the targeted beneficiaries

Ideate and define use cases (iterative process for each intended beneficiary)

Prioritise use cases

Identifying stakeholders and intended beneficiaries

The starting point of defining the right use cases is to identify the stakeholders in the trade ecosystem that might be impacted by the introduction of an AI initiative. Common examples of stakeholders' networks may include:

- internal audience (such as main organisational functions and officers)

- supervisory ministry (on behalf of the government)

- direct customers (mainly importers and clearing agents)

- other trade participants (exporters, suppliers, shippers and other logistics providers)

- other government agencies (such as other cross-border regulatory authorities)

- key international organisations (such as World Customs Organization (WCO), World Trade Organization (WTO), regional development banks)

- the community (consumers and society).

The next step is to identify sub-groups of stakeholders (the main beneficiaries) who are in need of, or likely to benefit most from the AI project(s) and understand their profiles. They are directly connected to the project's ultimate success or failure (Hsiao & Tran-Thien, 2020). For example, if the envisaged technology solutions aim to support a secure, trusted and facilitated trade environment, the most important and direct beneficiaries might be Customs internal job functions, the local traders (importers and clearing agents) and society.

Understanding the beneficiaries' profiles to generate relevant ideas (use cases)

With the target beneficiaries identified, it is then important to consider exactly how AI applications or technologies will improve their experience. As with any modernisation initiative, the introduction of an AI technology-based project 'shall be carried out in consultation with all relevant parties directly affected,

to the greatest extent possible' (Revised Kyoto Convention, RKC – Chapter 7). This will assist in gaining an understanding of the direct beneficiaries, their needs, their current processes and their habits.

Preliminary desk research should be undertaken to review relevant documents such as reports, procedures, existing studies, documented best-practice, blueprints and roadmaps to gather the first use case ideas. The next step will be to conduct ideation workshops in small groups with the key stakeholders (internal and external). Selecting the right people and involving them effectively are determinants for the success of the ideation sessions and there are important factors to consider for their selection:

- Participants should be familiar with the topic of the session to maximise their level of contribution. It is important to give them time to prepare for the session.

- Their areas of expertise and their goals should be linked with the topic(s) of the session. Participants who have a deep understanding of the challenges in question will be better equipped to find successful use cases.

- There should be cognitive and functional diversity among the participants (e.g. different business lines, different experiences) to allow for different ideas to flourish and to generate out-of-box perspectives.

- Decision-makers should be involved to ensure successful outcomes.

The ideation workshops should begin with a briefing session to share the vision of the initiative in values-based terms, to introduce key notions and tools that will be used and present practical use case examples.

There are many tools that can be used during workshops to define the customers' profiles and generate relevant use cases. A good example of such tools is the value proposition canvas (VPC) designed by Osterwalder et al. (2014), which helps managers and business analysts identify the customers' major activities (jobs-to-be-done), the performance bottlenecks (pains) they face when trying to accomplish those jobs and the value (gains) they perceive by getting the job done (see Figure 2). Workshops can also incorporate aspects of 'design thinking'[2] to encourage ideation.

Figure 2: Customer profile map
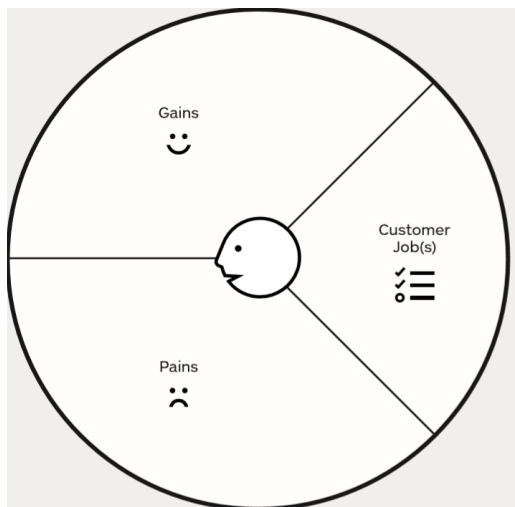
Source: Osterwalder et al. (2014)

The following example 'Box 1' illustrates how VPC can be applied to describe a specific group of job functions in Customs. As conditions differ significantly across countries, the selected items in the example may not be fully relevant to all customs administrations.

Box 1: Personas: *Law enforcement & trade facilitation jobs functions*

Key activities/Jobs to be done

Ensure and monitor collection of all customs duties and taxes that are due

- Protect national borders from illegal entry and exit of prohibited goods

- Protect citizens against threats (such as contaminated food, unsafe goods, fake medicines and other counterfeit products)

- Ensure relevant information is available, up-to-date and easily accessible to the trade community

- Provide effective and quality services to individuals, commerce and industries, importers and exporters

- Facilitate legitimate trade and promote voluntary compliance

Pain points & barriers

- Sophistication of fraud (tax evasion and avoidance, smuggling of drugs, dangerous, harmful and prohibited goods, money laundering, and trade in counterfeit goods)

- Increasing demand for rapid movement of goods and calls for shifting from physical to more audit-based controls undertaken away from the border posts

- Limited resources and skills to perform customs functions efficiently and effectively

- Insufficient customer-oriented service culture to interface with traders and build new partnerships

- Trade undertaken by the informal sector and in second-hand goods are substantial and the reliability of their commercial invoices tends to be poor

- Ongoing risk of corruption given the nature of the jobs performed by customs staff

Gains/perceived value

- More disciplined and structured approach to managing risk and customs operations

- Customs staff well-trained and empowered with tools and methods to deliver quality service to traders and to tackle illicit trade more effectively

- Trusted agency for state revenue generation and for national safety protection

- Built-in accountability mechanisms reduce both the opportunity and incentive for corruption

- Stimulated voluntary compliance

- Promotion of foreign direct investments (FDI)

From this example, several use cases can be generated. The relevant ones should outline, from the users' point of view, the important capabilities that can be supported by systems to relieve the identified pains (barriers) and/or realise the gains (or value). The right use cases should address the current and future challenges faced by customs administrations.

These ideation sessions in small groups are an iterative process that should be performed for each of the selected beneficiaries to define ultra-targeted value proposition content and generate exhaustive use cases.


Assessing and prioritising the relevant use cases

The best way to assess and prioritise use cases is to test their desirability across the intended beneficiaries. This can be achieved by mapping for instance the beneficiaries' profiles and motives in a manner to identify the use cases that enable shared value creation for all stakeholders. A simplified version of a value mapping tool[3] is an example of available instruments that can be used by customs organisations to consider this multiple-stakeholder value perspective when prioritising use cases. This tool was developed to assist in sustainable business modelling and aims to assist in:

- Identifying conflicting use cases that create a positive value proposition for one stakeholder and a negative one for another stakeholder. It is important to avoid or redefine conflicting use cases to avoid resistance during the project implementation stage and its ultimate failure.

- Emphasising opportunities for use cases redefinition and alignment in order to reduce negative outcomes and improve the overall value for the stakeholders' network.

Figure 3 shows an adapted version of the value mapping tool that can be used by Customs to prioritise business use cases.

*Figure 3: Simplified value mapping tool for Customs*
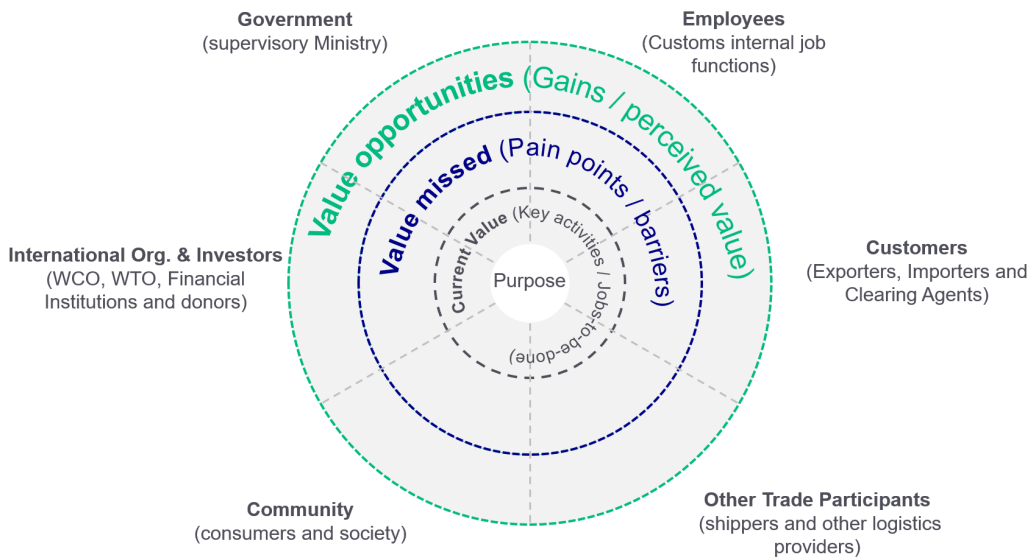
Source: Adapted from Bocken, Rana and Short (2015)

The alignment activity allows for the identification of the desirable use cases that answer important needs and offer greater alignment between key stakeholders' interests. Desirable use cases maximise the chances of getting stakeholders on board during the implementation step.

The desirable use cases also need to be feasible. The next step is therefore to assess the feasibility from a technical, financial and practical perspective. Dimensions such as data availability, knowledge requirements, legal feasibility and stakeholders' acceptability must be considered. Retained use cases should be realistic and should consider the country's capacity to implement, the time and investment that are required, and the level of stakeholder and political support that is needed. It is important to provide a basic assessment grid, elicit uncertainties and assumptions when discussing the results with the whole group in order to avoid subjectivity on the prioritisation. Figure 4 shows a simplified use cases prioritisation scheme.

Figure 4: Simplified use cases prioritisation scheme
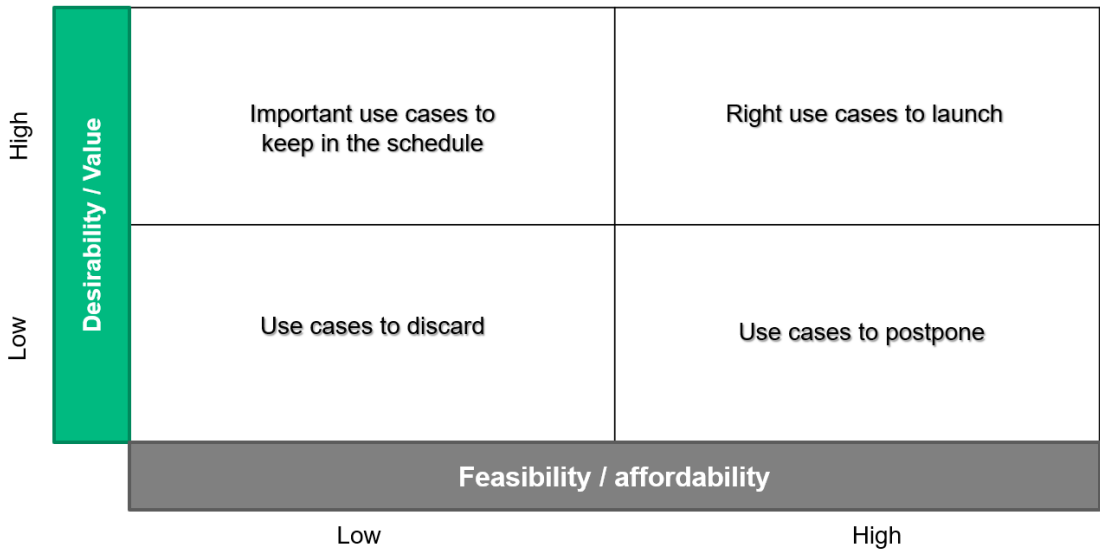
4. Selecting the right AI technologies

With the targeted beneficiaries identified and the right use cases selected, it is then important to support them with the appropriate technology solutions.

Generally, emerging technologies incorporation can help customs administrations in the following areas:

- Improved effectiveness in executing internal core processes: increased revenue collection, speed, better non-compliance risk mitigation, improved team accuracy and efficiency, and decreased costs.

- Automation of routine and time-consuming tasks: increased speed and efficiency, reduced manually introduced errors, less repetitive work and improved employee satisfaction.

- State-of-the-art governance: real-time operational and team efficiency monitoring, enabled trust and transparency over customs operations, and performance appraisals driven by data.

- Image and competitive-edge enhancement: online and easy access to relevant information, delivery of beneficial digital services to trade, impartial and transparent risk management – driven controls, use of modern channels (such as mobile platforms and social medias) to interact with Customs, report concerns and provide feedback, and strong engagement of the trading community.

- New revenue streams development thanks to the commercialisation of some digital services that the trade will be willing to pay for.

Table 1 outlines examples of disruptive technologies that can be customised and adopted by customs administrations to change their work conditions, and the relation they have with traders.

Table 1: Disruptive technologies

Technology	Examples of technology applications
AI – machine learning	• AI-based risk management • PCA and assisted case management • Automated container images processing and objects recognition • Cargo tracking geodata analytics • Advanced predictive business intelligence (BI)
AI – natural language processing (NLP)	• Automated classification of products • Optical character recognition (OCR) and data storage • Advanced BI with text mining and NLP capabilities • E-Customs platform with imbedded chatbots that provide 24/7 customer service
AI – robotics	• Repetitive tasks automation and human-like cognitive abilities • Data robot – powered recommendation engine that produces dynamic suggestions • Computer vision and automated object counting for visual inspection • Virtual workforce to automate routine business processes
Blockchain	• Trade traceability and end-to-end visibility • Smart contracts • Blockchain-based e-commerce • Container track & trace • Electronic certification/authentication of LPCO • Identity management (unique personal identity, tax identification number)
Internet of things (IOT)	• Cargo-tracking devices (such as RFID, GPS sensors, etc.) • Geo-fencing technology to secure containers • Smart port logistics processes (connected devices for logistics, traffic management) • Other automatic identification systems linked to GPS.

Before determining the required technology in which to invest, it is important to ensure that it is not only a good fit for the business needs, but also the implications, risks and rewards are understood. The introduction of innovative technologies within Customs needs to be managed from both technical and human perspectives—not only from an internal Customs perspective but also from the external stakeholders' viewpoint.

5. Adopting AI technologies

Technology adoption refers to the successful selection and integration of new technologies in Customs business and its spread to a general use and application so that greatest impact and most benefits are realised for Customs, the local business community and society.

5.1 Framework for emerging technologies adoption

The following section defines conceptual frameworks, inspired from business model innovation concepts, that emphasise the key components influencing the successful incorporation of AI-based technology in the customs environment. The first framework (Figure 5) identifies conceptual interconnected blocks that show at macro level the process from value proposition to value capture that should guide emerging technologies adoption initiatives.

Figure 5: Conceptual interconnected blocks for value creation and value capture
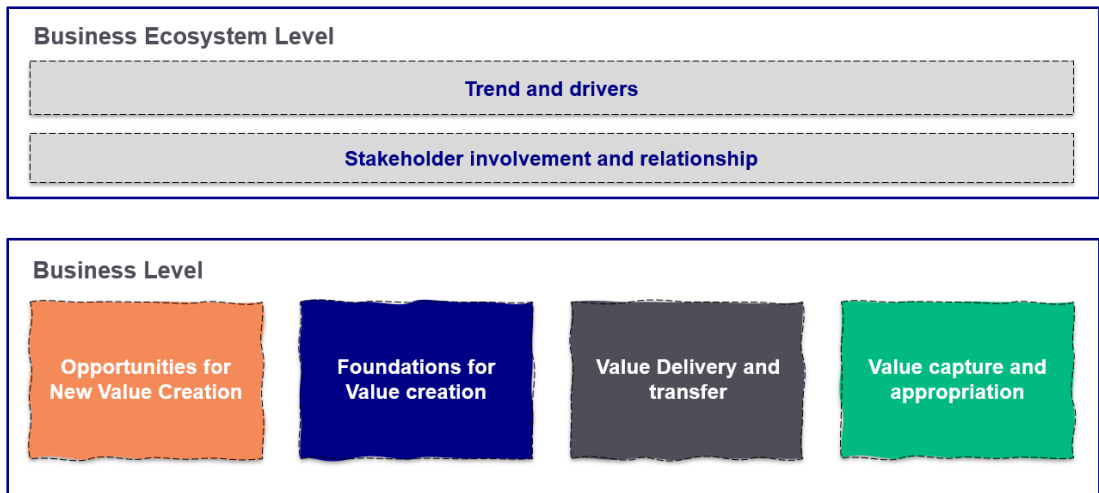
*Source*: Adapted from Bocken, Rana and Short (2015)

At the **business ecosystem level**, the analysis of the business environment and scanning of the current industry trends can be leveraged by Customs to open new streams for value creation and value capture. For example, in the past some activities such as performing risk targeting using predictive models were extremely challenging because of the specific skill that is required to run it and the need to constantly rebalance the model weightings in order to reflect risk trends. Today, this can be easily automated due to sophisticated and intuitive data-driven technologies. On the other hand, an ecosystem typically brings together multiple players of different types in order to create, scale, and serve markets in ways that are beyond the capacity of any single organisation. This provides an opportunity for Customs to create partnerships and maximise opportunities to create new value.

At the **business level**, the process for creating and capturing the value for Customs is defined as follows:

- Opportunities for new value creation: the way of identifying and assessing the spectrum of broader opportunities is described in section 3. It encompasses the beneficiaries' segments profiles analysis, the right products/services selection to map each segment and the definition of the value offering.

- Foundation for value creation: refers to the resources (internal capacities and skills, partners and suppliers), the business activities and interactions, the technology and product features and the investment (cost) required to produce outputs and outcomes.

- Value delivery and transfer: concerns the output (products/solutions), the distribution channels and the onboarding and acceptance strategy.

- Value capture and appropriation: refers to the impact linked to the technology adoption and demonstrable value generated (or return on investment).

Figure 6 breaks down this high-level framework into a more detailed and logical prototype that specifies the key dimensions to consider for an effective AI technologies adoption governance. This canvas prototype is illustrated using the customer profile example developed in box 1 of section 3—AI technology adoption initiative to support a secure, trusted and facilitated trade environment—to make it practical.

Figure 6: Framework for adopting AI technologies in the customs environment
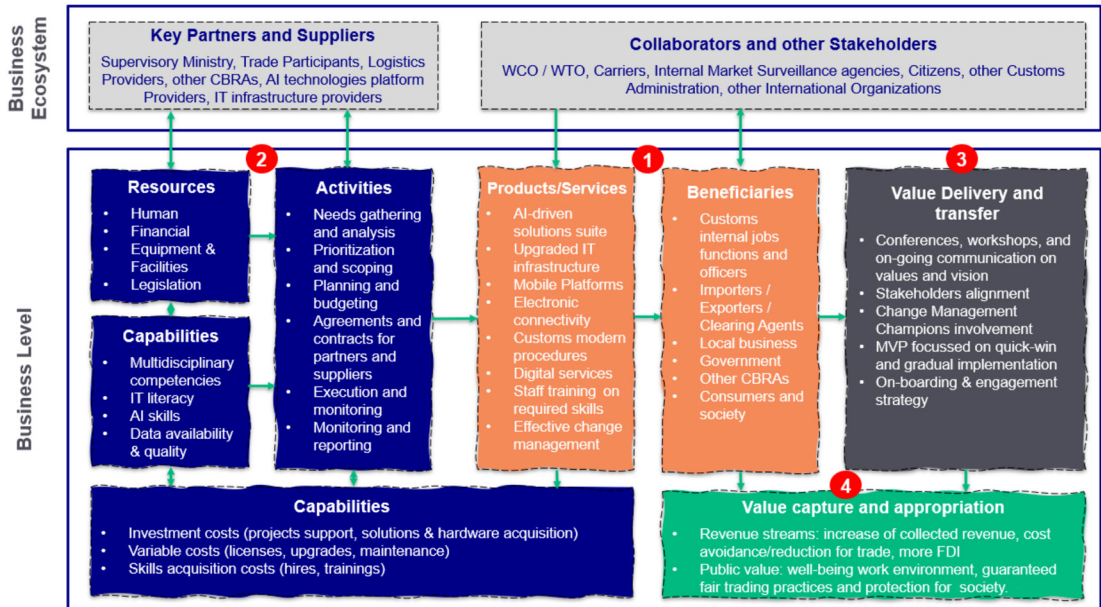
Source: Adapted from Martins, Mota and Marini (2019)

The particularity of the proposed canvas is its customer-centric approach.

1. The model starts from the customer segment profile (jobs, pain points and delights) to identify fit-for-purpose innovative solutions. It answers the following primary questions:

   • Who are the targeted audience(s)?

   • What are their characteristics?

   • Who are the most important beneficiaries?

   • What value (products and services) can be created for each beneficiary segment?

   • What beneficiary problems are being addressed?

2. It reviews the internal capacity (human, skills, equipment, facilities and data) versus the affordability to achieve the value proposition internally and the cost structure. It also focuses on leveraging the business ecosystem to build smart partnerships to ensure successful value creation and maximise the return on investment. It answers the following guiding questions:

   • What resources (profiles and essential skills) are important to achieve the value proposition?

   • What data do we have access to?

   • In what volume and quality?

- Can the current data format be used as it is?

- What processes/projects are important to realise the value proposition?

- What key activities need to be performed?

- Who are the strategic suppliers?

- Who are the key partners?

3. It then uses value delivery streams that accelerate time to value (using the Minimum Viable Product approach) and facilitate continuous communication, easy adoption and feedback. The following guiding questions can be used at this step:

- How is the value (products and services) provided?

- Which channels engage more and are most cost effective?

- Who are the champions (main influencers)?

- What needs to be considered in terms of usability and user-friendliness of the technology to engage more?

- Whose role will be affected by the new technology?

4. Finally, it connects the delivered solutions with the value appropriated by the beneficiaries enabling the fulfillment of their expectations, values, and interests. Questions to be considered are:

- Which needs, expectations, values, demands, and interests are being met?

- How does the beneficiary make money or capture other forms of value?

- What kind of public value is delivered?

5.2 Key considerations when adopting AI technologies

It is recognised that AI represents huge opportunities for organisations like Customs to automate business processes and make their operations smarter. However, many customs administrations are failing to adopt AI because they are still uncertain about how to approach it. These are key considerations in unlocking the benefit of AI.

Need for political commitment

Because AI adoption requires investment and disrupts the way Customs does business, customs executives should act as champions and be responsible for validating the AI initiatives, approving the selection of the use cases that will be considered, mobilising resources and enforcing decisions.

AI-savvy workforce empowerment

A successful AI adoption in any organisation will require the development of both technical and managerial capabilities.

The management of AI technology also involves new managerial skills such as judgement-oriented skills, creative thinking and experimentation, data analysis and interpretation, and in-depth domain expertise. For example, fraud-targeting AI applications may reduce the time that managers spend looking for risk patterns but increase the requirements for interpreting the outputs combined with their expertise and ethics and drawing the final decision.

At the technical level, AI requires new technical job categories such as the next generation of machine learning engineers and AI products managers.

Customs administrations that have been best at adopting AI are using multiple paths for talent acquisition: internal talent upskilling and reskilling, new talent hiring, management and promotion.

Building on solid digital foundations

AI works best when it has real-time access to large amounts of high-quality data. Therefore, it is critical to determine if the current IT systems and processes (information digitalisation and storage, paperless, accessibility, level of quality, computing capability, and security) are sufficient to adequately support the selected AI initiative.

Personal data protection and privacy

AI requires access to important volumes of data. Customs policy makers need to carefully assess whether existing data access laws should be updated to maximise the benefits of AI. For example, when it comes to personal information, appropriate protection and privacy laws, data anonymisation requirements, and similar policies that balance privacy concerns against the benefits of AI must be considered.

Integration of AI technology with existing legacy systems

In general, a legacy system that runs on heavily outdated software code does not work with modern application programming interfaces (APIs), making it impossible to connect with latest technologies.

Adopting AI technologies may imply updating existing components or rewriting part of the legacy code into a modern stack. This provides new interface to the legacy system, making it easily accessible to the modern AI software components.

Black-box effect and usability

It is difficult for people to trust AI tools that make important decisions in an opaque way without transparency about the rationale behind the decisions. Because AI systems will assume responsibilities that used to be performed by humans, it is important that people understand how these systems make decisions. The lack of transparency—the black-box effect—increases adoption resistance (Kafando et al., 2014).

Good AI solutions should have user-friendly and intuitive interfaces that allow Customs end-users (generally non-technical personnel) to understand the logic behind the complex AI algorithms to quickly build their user experience and efficiently capture the expected value.

6. Conclusion

In the current economic environment defined by globalisation, significant trade growth and an exciting digital disruption in the supply chain, the use of AI-based technologies is a critical enabler for cross-border regulatory agencies (CBRAs) to transform themselves in order to be more data and insight-driven organisations, and more resilient to a changing business environment.

Incorporating AI technologies and implementing the associated processes and procedures has the potential to help Customs radically reinvent their business models. However, in order to achieve the full potential, it is important to strategically involve all key stakeholders in a holistic approach to needs identification in order to define the use cases that address the most important challenges faced by Customs and the trade. The effort should primarily focus on use cases that offer the greater alignment between key stakeholder interests and that can be supported by cost-effective and reusable AI technologies. A strong strategy endorsed by a comprehensive and practical framework is the key to making the right investments for transformation.

From experience, successful integration of AI-technologies in the customs and trade environment depends on key considerations and requirements such as:

- The organisation's capacity to leverage partnerships and collaboration to co-create and scale AI-driven solutions within the customs environment.

- The need for political commitment to set and communicate a vision and drive organisational change.

- A solid digital foundation able to set up the proper data supply chain required to feed AI models.

- The development of both technical and managerial capabilities to effectively capture the value unlocked by AI technologies.

- The effective management of the technical and legal concerns related to AI technologies adoption.

AI promises huge benefits and many organisations, such as customs administrations, are just beginning their journey. This paper outlines critical success factors for successful AI experimentation in the customs environment and provides simple canvases to ensure ease of understanding and use. However, this paper does not intend to capture all factors that affect AI adoption and customs modernisation initiatives. Further research is recommended to test, refine and enhance the proposed tools in order to develop a more complete and robust AI – adoption framework for customs administrations.

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Notes

1   The analyses and views expressed in this research paper are those of the author, who remains solely responsible for any errors and/or shortcomings

2   Design Thinking is an iterative process that is used to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. It is a five-stage process which involves empathizing, defining, ideating, prototyping and testing.

3   A novel value mapping tool was developed to support sustainable business modelling, which introduces three forms of value (value captured, missed/destroyed or wasted, and opportunity) and four major stakeholder groups (environment, society, customer, and network actors).

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