II. Holistic use of technologies for Smart Customs of the future

2021 has highlighted the critical role that Customs play in enabling global trade. To make the global supply chains of the future more efficient, Smart Customs have to minimize Customs clearance time and costs, while intelligently managing inbound and outbound goods and vehicles. Disruptive technologies such as IoT devices are enabling autonomous equipment to drive effective monitoring of cargo and tracking of journeys.

IoT sensors like smart seals can be embedded at critical checkpoints in vehicles and containers to detect fraud and other crimes, including tampering in containers and cargo that is not moving along approved routes, thus making cross-border movements safer and faster. Customs administrations are then able to focus on using artificial intelligence to automate supply chains and processes, carry out risk profiling, and identify priority cargo, and high-risk and low-risk shipments, thus ensuring better facilitation and controls.

Another example of Smart Customs is image recognition used in X-ray screening machines and detectors, cargo and vehicle inspection systems, explosives and drug detectors, wildlife trafficking detection or dangerous liquid detectors – all can use IoT to track and communicate data.

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Robotic process automation (RPA) and low code automation allow for rapid deployment, and this was urgently needed during the pandemic. RPA can help to speed up Customs processes such as data verification, mimic a human worker by adapting to changing circumstances, or detect and resolve common errors that would otherwise take up considerable time and human resources. RPA allows for automation of simple, repeatable tasks at high volumes, with much greater accuracy than humans can provide.

Cyber security issues

Cyber security technologies are crucial when designing, procuring, implementing and operating secure systems for the Smart Customs of the future. This is particularly important given the trend of convergence of physical security and IT infrastructure as increasing volumes of data need to be processed and moved to digital platforms. Technology, workforce, and budget planning should bear cyber security in mind. Field communications, video surveillance, ground sensors and actuators, remote and mobile video surveillance systems or GPS have to be protected from potential attacks that could put the integrity of any field operation at risk, and possibly endanger lives.

This means verifying all endpoints. That includes not only contractors, partners, and guest devices, but also apps and devices used by employees to access work data, regardless of device ownership.

Identity

Identifiers, such as usernames, can be replaced with IDs that are self-owned, independent, and enable data exchange using blockchain and distributed ledger technology to protect privacy and secure transactions. The benefits of decentralized identity are the elimination of redundancy and increased trust in an ecosystem, since there is a single source of truth.

Identity technologies such as biometric scans and touchless identity verification can play a role in a post-pandemic scenario as they can decrease the risk of disease transmission and provide a quicker throughput of passengers through given checkpoints due to less time being taken.

Data collaboration

Data exists in Customs environments in various formats on various types of repositories on different clouds as well as on various Customs on-premises infrastructures. With the growing data landscape, two of the most common capabilities required to manage as well as extract value out of Customs and trade data are data cataloguing and data warehousing. Integrating these two capabilities gives Customs authorities the freedom to query data on their terms.

By design, Customs have multiple stakeholders, each with its own infrastructure and formats, but it needs to exchange significant amounts of data in real-time. This involves gaining transparency along the supply chain.

The evolution of trade in a digital world could be represented by intelligent connected trade windows where, with real-time data collaboration achieved, new services would be unlocked enabling better capacity utilization, new value creation, cost optimization, and trusted transactions through Distributed Ledger Technology (DLT) and application programming interface (API) data integration, which provide supply chain visibility.

Secure data sharing, analytics and governance

Secure data sharing enables big data sets to be shared and updated while ensuring that data governance rules are adhered to. Sharing technologies allows data access to be given to new partners without requiring them to set up new infrastructure. Data duplication is reduced or eliminated.

Once stakeholders, assets and processes have been digitalized it becomes critical to enable data collaboration between all these entities to generate insights into trends, challenges and gaps, as well as capacity usage and profitability. Insights can then enable the automation and optimization of processes. An important building block is the ability to perform risk profiling. With a risk scoring for each economic agent, the processes related to Customs clearance and trade facilitation could be automated.

Artificial Intelligence: machine learning and cognitive services

Cognitive services for Customs agencies help improve compliance and facilitation by enabling Customs officers to make better decisions. Data analytics – for example, automated selectivity rules – has become an increasingly important tool for Customs agencies. ML capabilities help solve general problems such as analysing text for emotional sentiment, analysing images to recognize objects or faces, converting speech (audio) to text, translating the text into many languages, then using the translated languages to get answers from a knowledge base. Applying various AI components can significantly enhance Customs operations. Visual search and facial recognition technology, behavioural and predictive analytics, revenue collection models, classification of products, Customs audits, risk-based targeting, analysing container images from X-ray scanners, logistics monitoring, identifying high-risk passengers and vehicles etc. can all be tailored for use in Customs and border management.

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HPC as the next maturity level in terms of big data processing in real time

High-performance computing (HPC)[5] is a complete set of computing, networking, and storage resources integrated with workload orchestration services for HPC applications. It includes next-generation machine-learning tools to drive smarter simulations and empower intelligent decision making. HPC allows for automated machine learning, auto scaling cloud computing, and built-in DevOps which translates into big data processing in real time through the incorporation of intelligence and building and training new AI models faster. It allows the running of very complex algorithms for risk profiling, prediction of cargo positioning, as well as image recognition and detection of different anomalies in cargo scans.

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Modern DevOps: microservices

Microservices are an architectural approach to building applications where each core function, or service, is built and deployed independently. Microservice architecture is distributed and loosely coupled, so one component's failure will not break the whole app. Independent components work together and communicate with well-defined API contracts. Customs can build microservice applications to meet rapidly changing business needs and bring new functionalities to market faster.

Microservices provide many benefits over monolithic architectures. They can remove single points of failure (SPOFs) by ensuring issues in one service do not crash or impact other parts of an application. Individual microservices can be scaled out independently to provide additional availability and capacity. DevOps teams can extend functionality by adding new microservices without unnecessarily affecting other parts of the application.

Using microservices can increase team velocity. DevOps practices, such as Continuous Integration and Continuous Delivery, are used to drive microservice deployments. Microservices complement cloud-based application architectures by allowing software development teams to take advantage of several patterns such as event-driven programming and auto-scale scenarios.

5 HPC is a discipline in computer science in which supercomputers are used to solve complex scientific problems. HPC dramatically reduces the time, hardware, and cost required to solve mathematical problems critical to core functionality. On the other hand, quantum computing is a fundamentally different approach to computing than the type of computing we do today on laptops, workstations, and mainframes. It will not replace these devices but, by leveraging the principles of quantum physics, it will solve specific and often very complex problems of a statistical nature that current computers struggle to solve.