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Applying emerging technologies in social security

Summary report 2017–2019

Technical Commission on Information and Communication Technology

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Technical Commission on Information and Communication Technology, International Social Security Association
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1. Introduction

The application of ICT is enabling the implementation of increasingly comprehensive social security systems throughout the world as well as the transformation of social security services.

Social security institutions are progressively applying emerging technologies, such as analytics, big data, artificial intelligence, blockchain, biometrics, among others. Although the potentials of these technologies have not yet been fully tested nor explored, , they are already enabling relevant outcomes in key social security areas such as addressing error, evasion and fraud as well as developing proactive approaches and automated solutions to improve social services.

Across 2017–2019, the ISSA Technical Commission on Information and Communication Technology addressed these issues by adding three new chapters in the *ISSA Guidelines on Information and Communication Technology*. It also carried out an assessment of an innovation pilot of blockchain to implement the traceability of international data exchanges.

This report presents the findings of the work of the ISSA Technical Commission on ICT during the 2017–2019 triennium. It covers the new chapter of the *ISSA Guidelines on Information and Communication Technology* as well as some preliminary results and forward-looking topics that were discussed at the 15th International Conference on ICT in Social Security, held in Casablanca in April 2018.

2. Background on emerging technologies

2.1. Big data and analytics

Social security data, which cover lifelong events of insured persons and beneficiaries, constitutes the basis for social security operations and decision making. The 2016 report *Managing social security data* described developments in the area of data management in social security.

The so-called data-driven innovation (DDI) is enabling social security institutions to improve products, processes and organizational methods. It can also meet global social policy challenges in areas including health and the social protection needs of vulnerable populations. In recent years, the accumulation of institutional data in addition to external data obtained through inter-institutional collaboration is enabling the development of big data systems.

The pairing of analytics and big data allows social security institutions to take advantage of their increasingly large databases to perform sophisticated analyses ranging from detecting unusual phenomena to developing predictive models.

Data analytics can support social security institutions to improve their administrative effectiveness and efficiency by enabling them to understand the past, trace the cause of events, predict what are likely to happen, and suggest actions that could be taken. Institutions could apply data analytics in a wide diversity of areas, including healthcare, detecting and preventing error, evasion and fraud, proactive social policy and programme design, actuarial projections, improving service delivery, among others.

Data analytics is mainly based on an institution's data and could potentially include external ones which, after ensuring quality, are analysed in order to gain insights using various analytic approaches, in particular:

- Descriptive analytics, which tries to answer "What happened?". It provides an understanding of the past transactions that occurred in the organization.
- Diagnostic analytics, which tries to answer the question "Why or how did it happen?". It involves an understanding of the relationship between relatable data sets and identification of specific transactions along with their behaviour and underlying reasons.
- Predictive analytics, which tries to predict "What, When, where can it happen?" based on past data. Forecasting techniques can be used to predict, to a certain extent, the future outcome of an activity. These predictions can be applied to inform and influence proactive measures.
- Prescriptive analytics, which recommends a range of possible actions as inputs such that outputs in future can be altered to the desired solution. In prescriptive analytics, multiple future scenarios can be identified based on different input interventions.

In turn, big data analytics leverages on very large volumes of data usually going beyond individual institutional transactions. Big data is characterized by the 4 Vs: Volume, Variety, Velocity and Veracity.

For instance, a potential source of big data would be medical home devices monitoring patients' vital signs. Big data analytics requires a revisit of data analysis techniques in fundamental ways and at all stages, from data acquisition and storage to data transformation and interpretation. In particular, the task of collecting and analysing data is at the heart of the big data analytics pipeline.

In spite of the potential of big data, there are also a number of challenges and drawbacks, notably: data source fragmentation in siloed government systems, poor data quality and inconsistencies across silos, the impact of analytical processing on the performance of operational systems, and trade-offs between providing up-to-date information and not interfering with operational systems. This last issue can be addressed by real-time computing techniques which enable analytical processes to be applied to transactional databases and systems, without impacting the performance of operational systems (van Leent, 2018).

A new chapter of the *ISSA Guidelines on Information and Communication Technology* provides recommendations on the adoption of Analytics in social security.

2.2. Artificial Intelligence

Artificial intelligence (AI) aims to interpret events and to support decisions as well as to automate actions. AI systems make decisions when predictions are sufficiently accurate, and the risk of error is sufficiently mitigated.

While AI initially used logic-based techniques, it evolved to using techniques that leverage big data, such as machine learning. In fact, in terms of the underlying technical disciplines, AI is an “umbrella” area which continues to evolve such that the boundaries of AI are not quite clearly defined.

In fact, there is a continuum of data-driven innovation techniques ranging from business intelligence, analytics and some approaches of AI. In particular, machine learning is a type of AI extending predictive analytics which can be used to refine predictive models over time (van Leent, 2019).

Advanced machine learning algorithms are composed of many technologies used in unsupervised and supervised learning (such as deep learning, neural networks and natural-language processing) and guided by lessons from existing information. Thus, machine learning allows AI applications to become progressively more accurate in predicting outcomes, without being explicitly programmed by learning autonomously from previous applications and outcomes. This enables recommending interventions that have proved to be successful under similar circumstances in the past (van Leent, 2019).

The selection of AI techniques should be based on the adequacy to the actual case scenario. For instance, while *Deep Neural Networks (aka Deep Learning)* are appropriate for text and image analyses and processing IoT data, other techniques such as rule-based systems or traditional machine learning enable solving a number of other problems.

The large spectrum of AI application ranges from low-intelligence scenarios like rule-based automation to higher-end intelligence capable of non-deterministic and evolving decision making. More concretely, AI can be broken down into five levels of sophistication (Gartner 2018):

- Reactors, which are based on simple rules but can respond to some limited changing contexts (e.g. basic drones).
- Categorizers, which can recognize types of objects and can deal with them through simple actions within a controlled environment (e.g. warehouse robots).
- Responders, which enable support for others’ needs by figuring out questions and situations (e.g. driverless cars, personal assistants).
- Learners, which are capable of solving complex problems by gathering information from multiple sources (e.g. IBM Watson applications).
- Creators, which may be initiating a paradigm shift. As the application of creators may have an important impact on humans’ relationship to technology, they require profound thought before development.

The application of AI in social security is promising but also challenging.

AI application could not only automate processes but also augment human capabilities for decision making by providing high-performance information classification and prediction functionalities. In this veine, (van Leent, 2019) points out that AI currently stands for "augmented intelligence" for social security agencies.

Some expected trends on AI are:

- Improve communication among persons by improving natural-language processing through contextual interpretation.
- Deepen and broaden integration with IoT applications, such as home movement detection sensors for long-term care.
- Further improvements on autonomous agents and intelligent devices.

Key success factors for AI application are data availability and quality, understanding the nature of developing AI solutions as well as skilled staff. While AI outperforms humans in certain complex cognitive functions such as image recognition in radiology, it requires huge datasets for training the systems (Lake et al., 2017). In addition, AI's "business logic" is based on the representation of a decision model rather than on a procedural algorithm. In this line, model testing – which requires large datasets - also constitutes a key factor and challenge for AI application.

From a business application perspective, the greatest challenge to AI success is the operationalization of AI as part of an automated business decision-making system.

In addition, the transparency and "explainability" of the AI application constitutes an important issue especially in regard to decisions which impact on people and/or involve relevant risks (e.g. economic, environmental, etc.). However, there is a trade-off between explainability and accuracy/performance in AI techniques because black-box models are more accurate than interpretable models. Briefly, the former provide a lower number of false positive and negatives than the latter. This trade-off could be tackled by assessing the need for explainability when selecting techniques and by enabling business stakeholders to choose (explainable versus accurate). In any case, stakeholders should always have visibility into training data.

Finally, there are other security and data protection issues which also constitute relevant challenges for AI applications. While security threads may involve poisoning/contaminating training datasets, complying with data protection regulations may be compromised if data is used for purposes other than those for which it was collected.

The formidable power unleashed by AI has limitations in the scenarios to which they could be successfully applied and the types of problems which could be tackled. Firstly, the critical requirements for quality data may constitute a barrier for applying AI in scenarios without enough quality data (e.g. new types of images or IoT information). Similarly, weaknesses in HR capacity for preparing and training the AI systems may also constitute a barrier for such application. As regards the nature of the problems that could be tackled, AI may be able to tackle narrow types of problems. However, when the application areas are broader, the use of AI may not be feasible, especially when this requires interpreting a totally unknown environment. Furthermore, AI may not be capable of considering contextual elements that were not included in the training.

Finally, compared with humans, AI lacks "judgement criteria" and intuition capabilities, which are usually based on long time experience, broad contextual information and on non-linear reasoning. In addition, it is not capable of exercising critical or ethical judgment or exercise empathy.

2.3. Blockchain

A blockchain is a type of distributed ledger that is shared across a number of nodes of a business network. In a blockchain system, business transactions are permanently recorded in sequential, append-only, tamper-evident blocks in the distributed ledger following the transactions' chronological order. All the validated transaction blocks are linked each other; thus the name of blockchain. (Yaga et al., 2018)

Blockchain's distributed ledger is neither stored nor managed by a central authority. Instead, a copy is stored by each user running blockchain software and connected to a blockchain network—also known as a node.

Transactions in a blockchain system correspond to interactions between parties, for instance, a transaction could be a way of recording activities occurring on digital or physical assets. The result is transactions that cannot be altered or reversed, unless the change is agreed to by all members in the network in a subsequent transaction.

The so-called *assets* are the objects involved in transactions and can be tangible and physical, such as cars, homes, or strawberries, or intangible and virtual, such as deeds, patents, and stock certificates.

Participants in a blockchain system may be individuals or institutions, such as a business, university, or hospital, for example. Participants agree that a transaction is valid through the so-called "reaching consensus".

Consensus is the collaborative process that the members of a blockchain business network use to agree that a transaction is valid and to keep the ledger consistently synchronized. Consensus ensures that the shared ledgers are exact copies, and lowers the risk of fraudulent transactions, because tampering would have to occur across many places at exactly the same time. Cryptographic hashes ensure that any alteration to transaction input would indicate a potentially compromised transaction input. Digital signatures ensure that transactions originated from senders (signed with private keys).

The key features of blockchain technology are the following:

- Ledger – the technology uses an append-only ledger to provide full transactional history. Unlike traditional databases, transactions and values in a blockchain are not overridden.
- Shared data – the ledger is shared amongst multiple participants. This provides transparency across the node participants in the blockchain network.
- Distribution – the blockchain is distributed and replicated among the participants and nodes.
- Immutability of blockchain transactions - Once a transaction is added to a blockchain ledger, it cannot be undone. Immutability allows senders, receivers, and any interested party to be able to verify that data have not been altered.
- Secure – blockchains are cryptographically secure, ensuring that the data contained within the ledger has not been tampered with, and that the data within the ledger is attestable.

Business rules are in the so-called *smart contracts*, which are computer code running on top of a blockchain containing the rules under which the parties to that smart contract agree to interact with each other. If and when the pre-defined rules are met, the agreement is automatically enforced. Smart contracts have properties of contractual agreements but should not be confused with legal contracts.

There are different types of blockchain ledgers: permissioned and permission-less. In a permission-less blockchain network anyone can read and write to the blockchain without authorization. Permissioned blockchain networks limit participation to specific people or organizations and allow finer-grained controls.

Blockchain is being applied mainly in the following types of business areas: distributed financial transactions; Product traceability and anti-counterfeit, Land titles, voting; and Interoperable and shared health records. Organizations are mostly using blockchain for shared record keeping especially by health providers and asset tracking in government applications. Nowadays, the key features making blockchain usable in industry are the distributed ledger technology and the Immutability (shared single version of truth).

Some fundamental limitations and drawbacks of blockchain are: (i) data management is highly limited as blockchains are append (write-end)-only ledgers and don't enforce integrity constraints, which have to implemented by the solution developers; (ii) fecentralized nodes must download entire blockchain ledger and continue using a copy of it, and every node has to validate every transaction and come to a consensus before a transaction is finalized

Blockchain may be used differently depending on the context and types of functions. Distributed Ledger technology (DLT) should be used when multiple entities want to share a single version of truth and there is single authority controlling the transactions. In turn, blockchain features beyond DLT are justified in cases that need public distributed consensus with no central authority. Finally, blockchain DLT could be combined with Internet of Things (IoT) and AI to implement systems involving health-monitoring.

3. Application scenarios of emerging technologies in social security

3.1. Data-driven innovation: Analysing and predicting by using large data volumes through analytics and big data

A growing number of social security institutions have been applying analytics and big data to address relevant social security functions.

Addressing evasion and fraud have some of the main applications of analytics. Social security institutions are applying discovery and profiling techniques for detecting evasion and fraud in contribution collection as well as in the delivery of benefits, particularly in detecting complex fraud operations. In addition, institutions are developing their capacity on business intelligence and analytics as reported by the National Social Security Administration of Argentina, Public Authority for Social Insurance of Oman, Social Security Administration of the United States, Dataprev of Brazil.

Furthermore, big data and analytics for developing preventive approaches as well as for improving programmes and services.

Table 1 summarizes some experiences. The global and regional reports on challenges provide further detailed descriptions.

Table 1. *Application experiences of analytics and big data*

Approach	Projects	Institutions
Discovery	Detection of complex fraud manoeuvres and no-take-up Analysing beneficiaries' "itineraries" for service improvement	National Family Allowances Fund. France
	Detecting evasion and fraud in contribution collection	Federal Administration of Public Resources, Argentina Social Insurance Bank, Uruguay General Treasury of Social Security, Spain Central Agency of Social Security Bodies, France
	Detecting complex fraud operations involving registration, contributions, and benefits delivery.	National Social Security Institute and General Treasury of Social Security, Spain
	Detecting Fraud in Unemployment benefits	National Employment Office, Belgium
	Detecting fraud in Temporal disability benefits	National Social Security Institute, Spain
	Detecting fraud in Work Injury and accidents claims	National Employment Accident Insurance Institute, Italy
	Detecting fraud in family benefits	Department of Human Services, Australia
	Detecting Fraud in registration, contribution collection, Occupational diseases and Unemployment	General Organization for Social Insurance, Saudi Arabia
Prevention	Institutional Big Data system covering insured persons and beneficiaries developed in the context of a Digital Transformation programme. System's capabilities range from fraud detection to supporting the prevention of chronic diseases especially diabetes mellitus and hypertension.	Mexican Social Security Institute, Mexico
	National Big Data system covering Health and Social Security data, supporting health preventive measures	National Health Insurance Service, Korea

Source: Innovative practices carried out by ISSA members (2017–2019).

3.2. Artificial intelligence applications: Improving customer services through intelligent assistants

Beyond analytics, the emerging use of AI in social security institutions is enabling the automation of more proactive and automated social security services.

A growing practical application of AI consists of developing of "chatbots", which are intelligent assistants to support self-e-services. The so-called chatbots are robot software capable of dialogue with customers in order.

Chatbots enable to respond to users' inquires on specific topics in an autonomous way simulating a human behaviour. They are available 7/24 and they adapt to users' preferences.

Chatbots have to analyse and understand user's questions in free natural language as well as to manage the conversation flow. The implementation involves training an AI system using knowledge based with the contents for the responses and very large dataset with potential questions and responses.

Practical experiences include a chatbot called "Julieta" implemented by the Superintendency of Occupational Risks of Argentina to respond questions about work injury benefits while the Social Insurance Bank of Uruguay (BPS) implemented one to respond about the domestic workers scheme.

Finland's Social Insurance Institution is starting to apply AI in two ways: (i) improving customer services by combining e-services with intelligent chatbots and developing quality person-based services, (ii) using AI-based image recognition to automate administrative processes by recognizing documents.

The General Organization for Social Insurance of Saudi Arabia launched an experimental use of intelligent chatbots, and the Auxiliary Unemployment Benefits Fund of Belgium is exploring how to apply AI and deep learning systems to assist staff with case management decision-making on benefit claims.

Applications of machine learning (ML) in social security administration are reported in (van Leent 2019). They include predicting customers' debt risks by an Australian government agency and proactive eligibility assessment by an UK government for additional social security benefits among vulnerable population receiving households benefits.

3.3. Enhanced e-services leveraging on digital identity, biometrics and e-government

The combined use of web and mobile technologies, digital identity, biometrics and e-government is enabling the development of a new generation of value-added personalized customer services.

The Ministry of Labour and Social Protection of the Population of Azerbaijan, the Social Insurance Institution of Poland and the Norwegian Labour and Welfare Service have developed this type of web portal.

Responding to the need to provide the right services to the right person, institutions are increasingly adopting digital identity as well as biometric technologies, which are also enabling the extension of social security coverage.

Table 2 summarizes some experiences. The ISSA global and regional reports on challenges provide further detailed descriptions.

Table 2. *Application experiences of persons' identification through Biometrics and digital identity*

Approach	Projects	Institutions
Biometrics	Validate the identity and perform a proofs-of-life of pensioners	National Social Security Administration of Argentina National Social Security Institute of Mozambique
	Biometric technologies and smart-cards into the contribution collection and benefits management	National Social Security Fund of Gabon
	Biometric smart card is used to pay benefits to ten million beneficiaries	Social Security Agency, South Africa Social Insurance Institute, Côte d'Ivoire. National Social Security Fund, Guinea. National Social Security Institute, Democratic Republic of Congo
	Facial and voice recognition technologies to perform beneficiaries' proof of life (pilot)	Social Insurance Bank, Netherlands
Mobile contract-based ID	Mobile money systems like M-PESA and M-TIBA	Kenya, Democratic Republic of Congo, Egypt, Ghana, Lesotho, Mozambique, Nigeria, South Africa, and United republic ofTanzania
ID in SIM cards	implement secured online transactions	Ministry of Labor and Social Protection of Population of Azerbaijan. Auxiliary Unemployment Benefits Fund, Belgium, KELA, Finland. Security Organization, Iran

The ISSA global and regional reports on challenges provide further descriptions of this type of application experiences.

The growing development of e-government systems covering several organizations enhance social security services by providing coordinated public services. The most common coordination scenario involves: digital identification, data quality and validation, health insurance systems, one-stop shop for contributors and for beneficiaries facilitating the interaction with various public and private services.

Table 3 summarizes some experiences. The global and regional Challenges reports provide further detailed descriptions.

Table 3. *Social security services enhanced through e-government*

Experience	Country
The Crossroads Bank for Social Security (CBSS) coordinates and implements the e government strategy in the social sector of Belgium. It involves 3,000 public and private organizations at the federal, regional and local levels.	Belgium
One-stop shop for social assistance benefits involving multiple institutions – the Unified Subsystem for Electronic Application and Assignment of targeted state social aid (VEMTAS).	Azerbaijan
Inter-institutional services for unemployment and health/disability benefits, notification of deaths as well as changes in beneficiaries' civil status.	Kazakhstan
Data integration between the Public Authority for Social Insurance and related government agencies enables the electronic extraction of all information related to employers and employees	Oman
Inter-institutional services for personal identity validation.	Morocco
Comprehensive e-Government system covering all the public services based on the X-Road framework. It includes digital identity and e-services for public administration services.	Estonia

3.4. Blockchain application for implementing inter-organizational coordination

Still in the early stages in the social security area, blockchain is enabling the implement large-scale services involving very diverse partners, such as pharmacies, doctors, and medical service providers.

For example, GOSI of Saudi Arabia is piloting the use of blockchain to implement sickness certificates and data exchange among the Gulf Countries. Belgium is using blockchain to re-engineer its health insurance paper-based information flow.

One of the most important experiences in the application of blockchain to public services has been developed in Estonia, which implemented new medical records and e-prescriptions using this technology. In particular, the e-Prescription coordinates doctors prescribing medicines with pharmacies delivering them through a highly-secured, paperless and traceable system.

An application of blockchain for international data exchange was prototyped by IBM Spain through a project of the ICT TC led by the National Social Security Institute of Spain in the context of the activities of the ISSA Technical Commission on ICT for the triennium 2017–2019. This prototype uses blockchain to implement traceability controls of international data exchange in a fully distributed and highly secure way without a centralized service.

The IBM prototype showed the feasibility of the approach and provided insights for developing a blockchain-based operational data exchange approach including distributed traceability. International data exchange enables institutions to efficiently implement social security agreements as well as to enforce integrity controls related to the life status of beneficiaries receiving payments. A reliable and secure traceability control is necessary to determine the information requests made by one institution to another and whether these were responded to within the agreed time periods.

3.5. Digital transformation and innovation capacity

Although there is a growing number of success stories, the adoption of technologies in social security institutions is always complex and challenging. In particular, it requires strategic visions on how to develop a digital journey in the medium and long-term aligned with the institutional goals. This approach, called Digital Transformation, involves the institution's decision makers, in particular the CEOs. As discussed in the 2018 ICT Conference in Casablanca 2018, CEOs and senior management are increasingly leveraging on ICT to carry out strategic institutional transformations and to develop innovation capabilities.

Digital Transformation involves (re)defining aspects of the institutional governance through Digital Governance frameworks.

There are relevant examples in Canada, Cabo Verde and Estonia. In Finland, the Social Insurance Institution is currently implementing a strategic transformation of its ICT platform and operational model that provides proactive services by adopting cutting-edge technologies (e.g. artificial intelligence). The general approach is to improve institutional capacity by using cutting-edge technologies to carry out strategic transformations.

Box 1 synthetises the INPS's journey to Digital Transformation: The case of Cabo Verde. A detailed description can be found in the INPS report.

Box 1. *INPS's journey to Digital Transformation: The case of Cabo Verde*

Cabo Verde as an insulate country consists of 10 islands, 9 of which are inhabited, with approximately 557,000 residents and more than 1 million in the diaspora.

The National Social Insurance Institute (INPS) have been using ICT as a strategic enabler for the development of Social Security in Cabo Verde. Briefly, in the last years, technologies have enabled the INPS to achieve a deep transformation mainly concerning:

- Overcoming geographic barriers through a national network interconnection.
- Improving the quality of services by optimizing business processes through re-engineering projects and coordinating with the financial system in order to facilitate the collection of contributions as well as benefit payment.
- Improving the quality of data and efficiency of key processes by integrating institution's core business databases (i.e. Master Data strategy) as well as by integrating identification processes of beneficiaries and contributors through an "Integration by default" strategy.
- Establish evidence-based decision making processes based on quality databases and using business intelligence tools. This enabled to identify error and fraud cases.

These transformations involved of top management in the alignment of technology with the strategic plan.

Leveraging on these developments, the INPS is now carrying out a strategic plan 2017-2021, which focuses on the extension of coverage and the quality of the services. The main ongoing activities are:

- Digital identities through an integration a mandatory national secured personal ID card
- Data exchange at national and international level by using secured web services.
- Enhancing customer services by improving e-services through chatbots .
- Developing a new generation of decision support systems with enhanced data analysis and processioning unstructured data.

One of the key challenges identified by the INPS in its Digital Transformation journey concerns the development of innovative approaches and institutional transformation without putting the service operations into risk.

The INPS's report concludes on the key role of technologies for carrying out innovative transformations in social security institutions as well as on the importance of an appropriate strategic planning for the technology adoption.

Source(s): Report on INPS's journey to Digital Transformation: The case of Cabo Verde (2019).

4. Conclusions and perspectives

The projects carried out by the ISSA Technical Commission on ICT in the2017–2019 triennium focused on the application of emerging technologies in social security.

On the one hand, it elaborated three new chapters to the ISSA Guidelines on ICT to address highly relevant topics for social security institutions – analytics, e-health and implementation of business processes – in addition to a full review of the set of guidelines.

In addition, the Technical Commission on ICT provided standards and tools for international data exchange as well as an innovation pilot of applying blockchain for controlling the traceability of such exchanges. A detailed description is presented in the report (IBM, 2019).

Furthermore, the activities completed during the triennium, notably the International Conference on ICT in Social Security held in Casablanca in April 2018 and the forums of the technical commissions, enabled the validation of the results as well as enabling a preliminary discussion of new topics to be developed in the future.

These outputs all serve to underline the key role of emerging technologies in social security and the importance of developing institutional capacity to adopt them. While the intensive application of cutting-edge and emerging ICT may constitute a success factor, these also involves risks and challenges.

Therefore, institutions should have well-defined strategies and structured plans aligned with institutional objectives to carry out technology adoptions and Digital Transformation. Guided by a deep-seated culture of innovation, the progressive adoption and innovative use of new technologies and the continuous value-added role of well-trained staff to enhance service delivery and offer a smart approach to address emerging challenges.

Future projects to be developed include: developing further the standards and tools for international data exchange in coordination with a new ISSA working group, performing a deeper analysis of AI capabilities for social security and pre-defining application models for different scenarios, developing guidelines on cyber security through a collaborative project with the ITU, and developing more innovation pilots.

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