Digital Future Society

Where emerging tech meets government

Automated decision-making systems and distributed ledger technologies in public innovation

A programme of

GOBIERNO DE ESPAÑA
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO DE ASUNTOS ECONÓMICOS Y TRANSFORMACIÓN DIGITAL
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Digital Future Society

About Digital Future Society

Digital Future Society is a non-profit transnational initiative that engages policymakers, civic society organisations, academic experts and entrepreneurs from around the world to explore, experiment and explain how technologies can be designed, used and governed in ways that create the conditions for a more inclusive and equitable society.

Our aim is to help policymakers identify, understand and prioritise key challenges and opportunities now and in the next ten years in the areas of public innovation, digital trust and equitable growth.

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Digital Future Society

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Executive Summary

Where emerging tech meets government

Government agencies around the world are looking to emerging technologies to help make public services more efficient, cost-effective, secure and transparent. Many are experimenting with **distributed ledger technologies (DLT)** and **automated decision-making systems (ADMS)** in hopes that these technologies will increase or renew trust in government processes, as well as in public institutions more generally.

Potential and existing **use cases for ADMS and DLT run the gamut of government services.** Either or a combination of both can be used to profile taxpayers, allocate treatment for patients in a public health system, sort the unemployed and disburse welfare benefits, automatically identify children vulnerable to neglect, detect welfare fraud, determine whether an emergency services call is fraudulent and even pass sentences in criminal justice systems.

However, the speed at which distributed ledger technologies like blockchain and artificial intelligence systems like ADMS are changing society mean that **policymakers have little time or space to clearly articulate the conditions for a successful society driven by these technologies.** Moreover, the proliferation of algorithmic decision making and permanently stored record keeping, particularly when applied in a public services context, presents a risk of eroding human agency as the primary force behind the decisions that shape our everyday lives and realities as citizens.

While governments have a key role in offering improved public services, they also bear the responsibility of safeguarding citizens from the potentially harmful consequences of emerging technologies. A major challenge for policymakers lies in **distinguishing hype from reality** and making sense of competing narratives around each technology and its impacts. On one hand, policymakers must become savvier about emerging technologies in order to leverage the many opportunities each offers to improve public services. On the other, they must know enough to regulate emerging technologies effectively and understand their implications in order to educate citizens about and safeguard them from potentially harmful consequences.

As a key output of the Digital Future Society programme, this report explores how public sector organisations can strike the right balance between leveraging the many benefits that emerging technologies have to offer while ensuring that the risks and potential downsides are adequately addressed. After looking ahead to 2030 to imagine possibilities, the key takeaway remains that **policymakers must act now** to anticipate and shape digital futures in ways that ensure societies can benefit from emerging technologies within equitable and ethical boundaries.

Our work attempts to answer the following research question:

How should governments address the socio-economic challenges and leverage opportunities of emerging technologies in the public sector?

The 14 recommendations developed throughout the course of our work can be grouped into three broad categories:

Focus on key oversight and regulatory actions

When governments use emerging technologies to make or assist with decisions, they become subject to public oversight. Public administrations must therefore have adequate oversight bodies in place both transversally (cross-departmental) and sectorally (within departments).

Invest in internal capacity building

Policymakers and government departments must possess sufficient technical knowledge and expertise that enables them to understand and evaluate whether emerging technologies like ADMS and DLT are the best way to solve a given problem while meeting citizens' needs.

Create mechanisms for citizen redress and support

A third aspect of government responsibility in the use and governance of emerging technologies in public services is providing easily accessible redress, support and transparency mechanisms so that citizens can understand, appeal and seek remedy for consequences that are erroneous, harmful or illegal.

The recommendations are summarised below and explained in detail in Section 4 of this report.

Focus on oversight and key regulatory actions

- Invest in adequate oversight bodies, or create new ones where they do not exist
- Use a sector-specific approach to oversee, audit and monitor emerging technologies at all levels of government
- Consider how regulatory goals and standards could be achieved using technical code as well as legal code
- Government as the expert customer: build ethical, transparent, inclusive design criteria into the public procurement process
- Support the creation of local demonstrators that can test ethical, legal, regulatory and technical standards for each technology and its applications

Invest in internal capacity building

- Measure and invest in internal expertise
- Prioritise knowledge exchange and coordinate policy responses across departments
- Bring rights-focused organisations on board and appoint an ethicist-in-chief
- Start developing technology-specific governance tools or use existing frameworks, such as algorithmic impact assessments for ADMS
- Invest in third party, non-profit academic research on the use of ADMS and DLT in public services

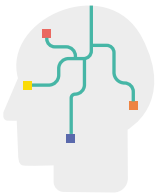
Create mechanisms for citizen redress and support

- Invest in transparency efforts that inform and prepare citizens
- Ensure newly automated public services are designed with and for the public they are meant to serve
- Create easily accessible recourse and redress mechanisms
- Provide a way for citizens to opt out or around digital public services through an analogue alternative

The fact that **emerging technologies move faster than government ever can or will** is a constraint we must accept in our quest for positive change. Nevertheless, there is value in understanding how emerging technologies can do a better job of meeting human needs within ethical boundaries. Contributing to the transparent and ethical use of emerging technologies in government involves unpacking these issues and presenting them in ways that policymakers can easily understand and act on. The 14 recommendations outlined in this report are actionable, achievable and based on the current state of the art of ADMS and DLT, both technically and in terms of the regulatory and institutional landscape.

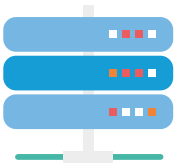
This report is the result of the work carried out by the Digital Future Society team in collaboration with leading experts on artificial intelligence and distributed ledger technologies. It presents the outcomes of core working group discussions and contributions, desk research, and interviews with key informants from industry, academia, non- governmental organisations, and public entities whose day-to-day work involves emerging technologies in the public sector.

Glossary



Artificial intelligence (AI)

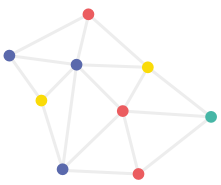
In its most basic form, artificial intelligence is **a system that makes autonomous decisions**. AI is a branch of computer science in which computers are programmed to do things that normally require human intelligence. This includes learning, reasoning, problem solving, understanding language and perceiving a situation or environment.[1] Since AI is an extremely large, broad field, this report focuses on AI systems specifically designed to take decisions within a government or public services context.



Automated decision-making systems (ADMS)

Algorithmically controlled, **automated decision-making systems (ADMS)** or decision support systems are procedures in which decisions are initially—partially or completely—delegated to another person or corporate entity, who then in turn use automatically executed decision-making models to perform an action.

In keeping with the definition proposed by AlgorithmWatch[2], this report considers ADMS as socio-technological frameworks that encompass a decision-making model, an algorithm that translates this model into computable code, the data this code uses as an input—either to 'learn' from it or to analyse it by applying the model—and the entire political and economic environment surrounding its use.



Blockchain

Blockchain technology is a method of sharing and storing information on a distributed ledger where identities and transactions are cryptographically protected.[3] Essentially, it enables multiple parties to agree on a single source of truth without having to trust one another. The technology facilitates agreement and aligns incentives using consensus algorithms, and stores information in an immutable chain of blocks. In theory, blockchains reduce the need for intermediaries or central authorities such as banks or government agencies to coordinate or verify transactions. Blockchains are a type of distributed ledger technology.

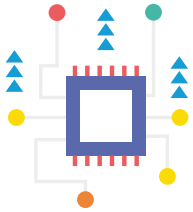
[1] Future Today Institute 2019

[2] Algorithm Watch 2018

[3] Future Today Institute 2019

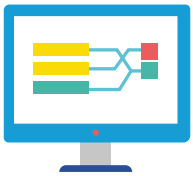
Distributed ledger technology (DLT)

A method of sharing and storing information on a **distributed ledger** where identities and transactions are cryptographically protected. Blockchains fall under the umbrella category of DLT, but not all distributed ledgers use blockchain technology. Other types of distributed ledger technologies include a Directed Acyclic Graph or a DAG. Unlike blockchains, DAGs do not use miners[4] or blocks (cryptographically linked sets of transactions).[5]



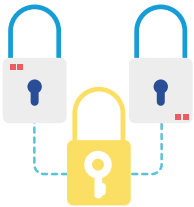
Emerging technologies

New technologies that do not currently have a critical mass, but which may have the potential to create new, and disrupt old industries.[6] They may raise **ethical questions** or have a **structural impact** on public services if deployed.[7]



Hash function

A cryptographic hash function is a one-way mathematical function that takes any input and produces a **unique** alphanumeric string. In blockchain technology, hash functions are used to condense information into blocks, and can be used to assign a unique identifier to any digital file or asset.



Immutability

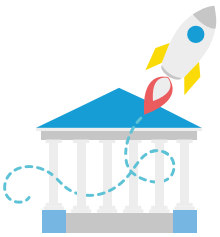
A primary characteristic of blockchains in which the record of transactions **cannot** be changed or deleted in order to prevent backdating, which is why blockchains are sometimes referred to as "digital granite".

[4] Blockchain systems replace the central administrators with consensus algorithms and network miners, who are responsible for verifying pending transactions.

[5] Future Today Institute 2019

[6] Rotolo et al. 2015

[7] GOV.UK 2018

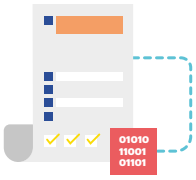


Public innovation

The creation and implementation of practical ideas that achieve a public benefit.[8] According to the OECD, these ideas have to be at least in part **new** (rather than improvements), **implemented** (rather than simply remaining ideas) and **useful**.[9]

Internal public sector innovation can apply to the organisational structure of the public sector itself, such as improving the way data is stored and shared across government bodies. External public sector innovation means changing how public services are provided, for instance, producing personalised services for the end-user.[10] Public innovation can take place at any governmental level: city, regional, national or supranational.

According to the European Commission, "successful public sector innovations and their synergistic effects do not only create better services, they also **increase trust and legitimacy in government** that in turn enables governments to take on new challenges and initiatives [....]"[11]



Smart contract

Smart contracts are **self-enforcing agreements** where the terms are built directly into code and issued on a blockchain.

Token

A token is a **digital identity** for an asset, something that can be owned.

[8] Mulgan 2014

[9] Innovation Policy Platform 2013

[10] Powering European Public Innovation 2013

[11] Idem

Introduction

How to use this report

Although the wheel and the printing press brought about revolutionary changes in commerce and communication, algorithms are now being tasked with making many of the decisions that were once the sole domain of humans. The development of emerging technologies powered by algorithms and smart contracts is happening faster than any government's ability to fully understand, use and regulate it. As old laws clash with new technologies, the citizens to whom governments are accountable are often the ones left to deal with the negative and potentially harmful consequences, however unintentional.

We begin from the observation that **policymakers and governments around the world are ill-prepared to deal with new challenges that arise from emerging technologies**, especially when they are deployed in the context of public service delivery. Although we have begun to see calls for proposals for new regulatory frameworks, these new rules, regulations and policies are unlikely to succeed if the broader social and ethical implications of emerging technologies are not accounted for.

This observation opens a Pandora's box of questions related to how public administrations should meet the challenges ahead: Are new laws and oversight institutions needed? Where should governments invest time and resources? How can governments best support citizens affected by these new and profound changes?

Audience

The further technologies evolve and proliferate, the more we need to reflect on the role of the key players in the design, use and governance of those technologies: private companies and public sector institutions, both of whom have a responsibility to act.

The aim of this report is to inform and offer insights primarily to policymakers - anyone working within governments worldwide who must write or carry out rules, governing frameworks and regulations that intersect with technology, and especially those who face the decision of deploying emerging technologies in a public innovation context.

The contents of this report can also be useful for emerging technology creators and providers that work closely with governments in deploying such systems. It sheds light on how to overcome challenges specifically faced by public sector clients in order to ultimately benefit citizens: the users of the platforms and products powered by these technologies whose lives are impacted by the outsourcing of such decisions.

Scope

The focus of this report is on the deployment, use, governance, and socioeconomic implications of emerging technologies like ADMS and DLT. To ensure our work remains relevant for policymaking purposes, we focus on the challenges and opportunities of deploying these technologies in public services rather than on the technicalities of the systems themselves.

Why include both ADMS and DLT in one report?

While these technologies are still in early development stages, both have broad and far-reaching implications with the potential to impact society in unprecedented ways. Secondly, DLT and ADMS technologies share some application areas especially relevant to the public sector, which will be described in Section 2 of this report. Both rely on data and computer power, and their implementation and regulation within the realm of public innovation brings up similar challenges as well as the potential for large scale adoption, disrupting existing systems, and creating new ways to offer public services. Broadly speaking, blockchains and AI are two of the technology areas prioritised by governments across the world in terms of research, development and investment.[12]

Why DLT and not blockchains?

Although a more recognisable buzzword, the term "blockchain" refers to a subset of distributed ledger technologies (DLT), and can be misleading as there are several kinds (public, private, federated, permissioned, permissionless etc.). Experts warn that many governments that claim to use blockchain technology are in fact using distributed ledger technologies. Even the government of Estonia, claiming to be "blockchain powered" since 2012 is actually using a type of DLT called DAG (Direct Acyclic Graph). Unlike blockchains, DAGs do not use miners or blocks.

Why ADMS and not AI?

In its most basic form, artificial intelligence **is a system that makes autonomous decisions**. AI is an extremely large, broad field. In keeping with the broader theme of public sector innovation, this report focuses on ADMS because they are AI-powered technologies that are increasingly used by governments to take decisions within a public service context, as detailed in reports by the AI Now Institute[13] and Algorithm Watch.[14]

[12] See Appendix A: Global public investment in blockchain and AI

[13] Whittaker et al. 2018

[14] Algorithm Watch 2018

Structure

The following report presents the key findings of the Digital Future Society Think Tank on the topic of emerging technologies in public sector innovation. The report begins with an introduction into the use of ADMS and DLT in the public sector, specifically examining current use cases and contexts, as well as the opportunities, risks, and challenges found in their implementation and deployment within the context of public service delivery. The report concludes with a look at the future and provides a set of 14 action-oriented recommendations for government officials.

1

Emerging tech in the public sector

How to do more with less

Governments around the world are under tremendous pressure to innovate, reduce costs, and find increasingly elusive ways to "do more with less". Consequently, distributed ledger technologies such as blockchains and AI-powered automated decision-making systems are being held up as the answer to improve the delivery of public services.

Both DLT and ADMS have the potential to improve the way data is stored and shared across departments and government bodies, and in some cases are already changing how public services are provided. But because these technologies are still in an experimental phase, governments face major challenges in separating hype from reality and making sense of competing narratives around each technology and its impacts on society.

On one hand, policymakers must become savvier about these emerging technologies in order to **leverage the many opportunities** each offers to improve public services. On the other, they must also know enough to **regulate emerging tech effectively**, understanding the societal implications of each in order to prepare citizens for potentially negative impacts. Meanwhile, **each industry is proposing its own rules** and governance structures, with more concern for profit generation and innovation than distributive consequences or externalities affecting the most vulnerable.

In addition to the hype surrounding emerging technologies like these, their application in public sector innovation raises an important set of questions. To what extent are such systems being used by governments in the sphere of public sector innovation? What are the real challenges of implementation? How can and should governments regulate emerging technologies to ensure that their deployment, use and governance is ethical and transparent? And what are the possible unintended consequences that could adversely affect citizens, to whom governments are ultimately accountable?

In this section we review a selection of key use cases that provide insights into such questions.

Meet Salvador

The year is 2030, and Salvador is enjoying a glass of wine to celebrate his retirement. A lifelong taxi driver, he chats with fellow regulars at the bar below his one-bedroom flat. After a painstaking climb up the stairs, Salvador boots up the 10-year-old laptop donated by a neighbour to check his email – something he does when he remembers. He is surprised to find a six-week-old message prompting him to claim his retiree healthcare benefits before the month is out, or risk losing them. Salvador suddenly remembers a letter he received before moving to a social housing flat: his country's public welfare system has gone completely digital and requires a new type of digital ID, powered by something mysterious called blockchain...

After hours of trying to figure out how to interact with the virtual assistant, Salvador is informed that his benefits have been cut off completely, but he can appeal the decision if he wishes. He manages to initiate the appeal process, but after months of waiting is dismayed to find his application has been rejected. He understands that his profile has been flagged "at risk" but the virtual assistant cannot give more information. Salvador has now been without benefits for months, his savings dwindling to near zero. He can no longer afford his heart medication, lost access to free transportation and cannot get to his next medical appointments. Now completely excluded from the system, Salvador's health worsens. He is denied entry as he tries to walk into a public clinic, whose facial recognition system doesn't recognise him – after all, he didn't register for his new digital ID during the 1-year transition period.

Before long, a year goes by. After suffering a massive heart failure due to stress, lack of medication and malnutrition, Salvador eventually loses his apartment and ends up on the street. He has no way of finding out that he has won the appeal for wrongful termination and his benefits have been restored.

How governments currently use emerging technologies

Automated decision-making systems

Public administrations are already using automated decision-making systems for purposes with significant societal impact, such as border control, crime prevention and welfare management.

The use of ADM systems in the United States, especially in the state of New York, has been well-documented by research and advocacy groups such as the AI Now Institute, which has found evidence of ADMS at every level of government. Examples range from ADMS in individual departments such as the Fire Department of New York, to the Department of Education whose school assignment algorithm is used to match eighth-graders to high schools based on preference, test scores and other criteria.[15] At the regional level, the state of Utah allocates housing and prioritises public services using an ADMS, while the Department of Corrections in Pennsylvania uses the technology to optimise security classification for inmate housing. ADMS are used at the federal level by the Immigration Customs Enforcement department to identify and process new targets for deportation and aid in removal proceedings.[16]

In Europe, a small sampling of findings from research and advocacy group Algorithm Watch shows a similar pattern of ADMS starting to be deployed at all levels of government. In France, automated traffic offence processing generates around 1 billion euros annually for the French government, but ANTAI, the National Agency for the Automated Processing of Offences, ignores legal requirements to disclose the algorithms.[17] Local authorities in England have started using ADMS to help determine how much money should be spent on each person, depending on their individual needs (known as a personal budget). Around forty town halls across England currently use the system, which has allocated personal budgets worth a total of over 4 billion euros.[18] At the local level, the German city of Mannheim's intelligent video surveillance project uses cameras programmed with motion pattern recognition to call first responders to a potential incident.[19]

[15] Automated Decision Systems: Examples of Government Use Cases 2018

[16] Woodman 2017

[17] Automating Society 2018

[18] Series and Clements 2013

[19] Reuter 2018

Case Study Singapore

Historically, the city state of Singapore has always capitalised on advances in ICT to drive its public administration and service delivery. Since 1966 when the newly founded Singapore Ministry of Defence introduced a computerised decision-making system to support allocation of national servicemen, ADMS has taken a central role in the government's drive for productivity, efficiency, and citizen-centred governance.[20]

To improve customer experience and provide speedy, consistent 24-hour assistance to the public, Singapore is combining ADMS-driven chatbots with conversational computing on several citizen-facing social services platforms. The aim is for citizens to have a more tailored personal relationship with the public service built out of personal conversations.[21]

The Ministry of Education's MySkillsFuture uses automated systems to identify fraudulent claims. Partnering with govtech firms and other private sector consultants, the initiative has developed machine learning algorithms to detect anomalies in claim submissions and identify those requiring further investigations. Results are dynamically fed back into the algorithms to strengthen future decisions.[22]

Patients not turning up for their out-patient appointments lengthens waiting lists, wastes budgets and health professionals' time as well as putting more strain on A&E departments. Various public hospitals have successfully trialed a no-show predictive model that uses data analytics to identify those most at risk of missing their appointments. With this information, patient interactions are personalised and a reminder text is sent to those patients with a high rate of no-shows resulting in better patient care and optimised hospital resources.[23]

In January 2019, Singapore became the first Asian nation to publish a Model AI Governance Framework providing detailed guidelines on ethical principles and practices in AI implementation, including in customer relationship management and risk management in autonomous decision-making.

The Minister for Communications and Information explained, "We hope to co-create with companies in the development of new AI solutions... We're looking to democratise access to data and AI tools, so everyone can learn and experiment with AI solutions. We want to support small and medium enterprises (SMEs) to adopt AI and work with the government on relevant use cases."[24]

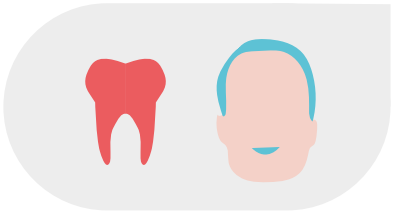
[20] Tan and Yimin 2018

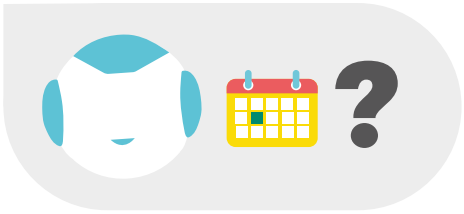
[21] Indra 2017

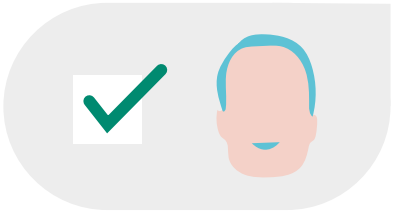
[22] SkillsFuture Singapore 2018

[23] Bhattacharya 2018

[24] Yu 2019







In New Zealand, immigration officers process more than 800,000 visa applications a year from around the world. Since 2015, ADMS have helped officers triage visa applications more efficiently and so invest more time on higher-risk cases and spotting changing trends in risks that can then be fed back into the algorithms.[25]

In the eastern province of Jiangsu, China, a fleet of three-foot robots have been used to review legal cases. In seven city governments and over 30 lower level authorities across the province, the robots have detected issues and corrected mistakes in almost 15,000 legal cases, including commuting 541 convictions. The pilot was deemed a success and there are plans to roll the technology out further as well increase the scope of the types of cases from mainly traffic infringements to more serious crimes.[26]

[25] Stats NZ 2018

[26] Connor 2017

Case Study Uruguay

The last ten years have seen Uruguay establish itself as a regional leader in the application of ICT solutions to public service delivery and governance. In 2017, the Uruguay 2020 Digital Agenda was published with the objective that "all ministries with large volumes of data should develop models for the descriptive and predictive analysis of phenomena that affect the community."[27]

As part of this vision, the Ministry of the Interior procured the predictive policing software Predpol with the goal of anticipating where crimes would occur and so supporting decisions around deploying police officers more effectively.

However, the system's high degree of opacity and its potential to reinforce discrimination and exclusion made it a problematic case. The Ministry of Interior data used was classified information on reported crimes and the algorithms employed were secret black box technology which made any form of accountability impossible.

Furthermore, developers of the software recommend using it as a tool for supporting deployment decisions while in Montevideo quadrants identified by Predpol were saturated with a police presence, which was not only seen as antagonistic to local residents but also displaces the crimes or creates a self-perpetuating cycle as more crimes are likely to be reported.[28]

From 2015 to 2017, half the district policing in Uruguay's capital, Montevideo, used Predpol and other predictive policing tools, while the other half was informed by annual retrospective statistics. Evaluation shows that the Predpol districts performed no better than the other districts and needed more police officers. This put a strain on the insufficient human resources of the force, which was precisely one of the challenges that the original software implementation was aiming to address.

The ministry scrapped the system in under three years, replacing it with the retrospective statistical tools developed by their own teams which had proved more effective.[29]

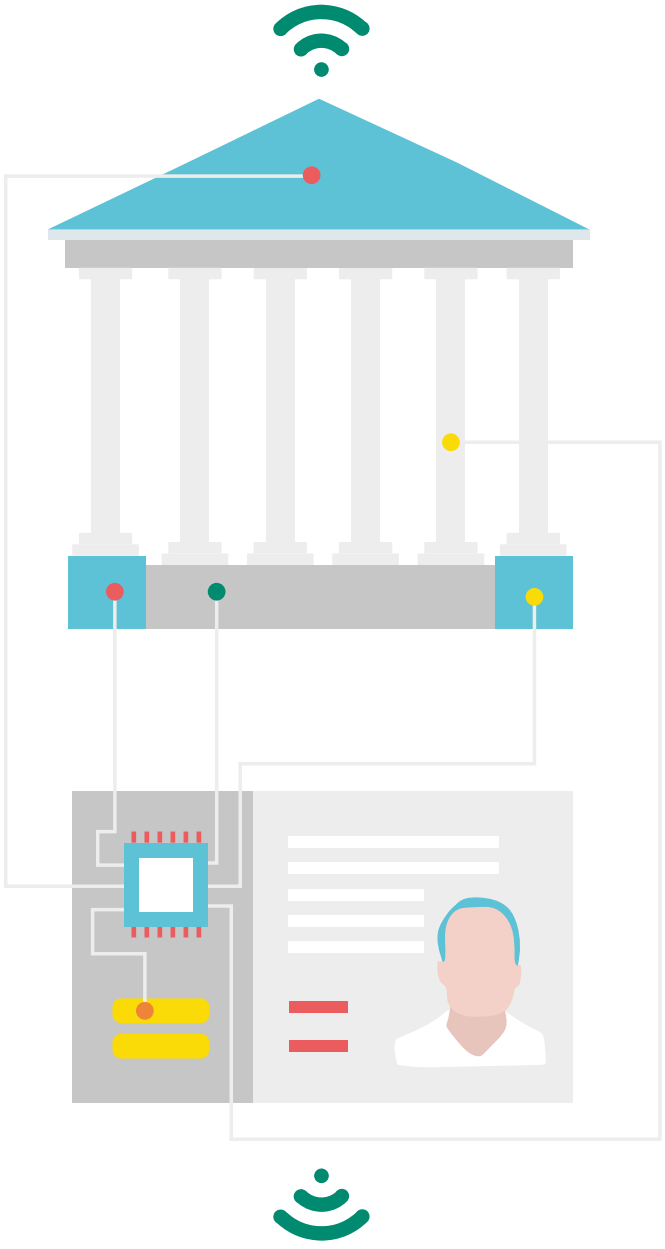
[27] Ortiz Freuler and Iglesias 2018

[28] ¿Cómo evitar el delito urbano? El programa de alta dedicación operativa en la nueva policía uruguaya 2017

[29] Ortiz Freuler and Iglesias 2018

Distributed ledger technologies

A number of public administrations are already using DLTs and piloting blockchain projects across a range of public services, at varying speeds and levels of government. Among the most widely cited applications of DLT in public services is that of identity management and digital citizenship. We explore one of the few initiatives that has moved beyond the proof-of-concept and pilot stages and into production in the following case study.



Case Study Estonia

Estonia was the first country to move most of its government services fully online fifteen years ago. Named the most advanced digital society in the world, [30] Estonia has been exploring distributed ledger technologies since 2008 and claims that its national health, judicial, legislative and security registries have been running on blockchain technology since 2012.[31]

Estonia now has the most regularly used national public key infrastructure in the world. Citizens use their digital ID card to order prescriptions, vote, bank online, review their children's school records, apply for state benefits, file tax returns, submit planning applications, upload their will, apply to serve in the armed forces, and approximately 3000 other functions. For SMEs and entrepreneurs, the system is used to file annual reports, issue shareholder documents and apply for business licences. Government officials use the ID card to encrypt documents for secure communication, review and approve permits, contracts and applications, and submit information requests to law enforcement agencies, while ministers use their digital IDs to prepare for cabinet meetings, draft legislation, submit positions and objections, and review minutes.[32]

Since digital authentication has become critical to government operations and public service delivery in Estonia, it is essential for the government to validate records and ensure they have not been altered. To do this, as well as reduce the administrative burden on the state and citizens, the government uses a form of distributed ledger technology known as Keyless Signature Infrastructure (KSI), developed by an Estonian company called Guardtime.[33] This DLT pairs cryptographic hash functions with a distributed ledger, allowing the Estonian government to guarantee a record of the state of any component within the network and data stores. It also enables citizens to verify the integrity of their records on government databases. By providing proof of time, identity and authenticity, KSI signatures offer data integrity, backdating protection and verifiable guarantees that data has not been tampered with. While the Estonian ID Card may never be immune to a breach, the government claims that alterations to public data will be 100% detectable.[34]

In an effort to attract more entrepreneurs and tech talent, Estonia began piloting a beta digital citizenship program (along with financial benefits such as tax breaks), becoming the first country to offer e-residency, allowing individuals to become a resident of the country without actually living there.

According to research analyst Csilla Zsigri, the use of DLT and digitising public services more generally saves the government of Estonia approximately 2% of GDP annually.[35]

[30] Hammersley 2017

[31] Frequently asked questions: Estonian blockchain technology

[32] Distributed ledger technology: beyond block chain 2016

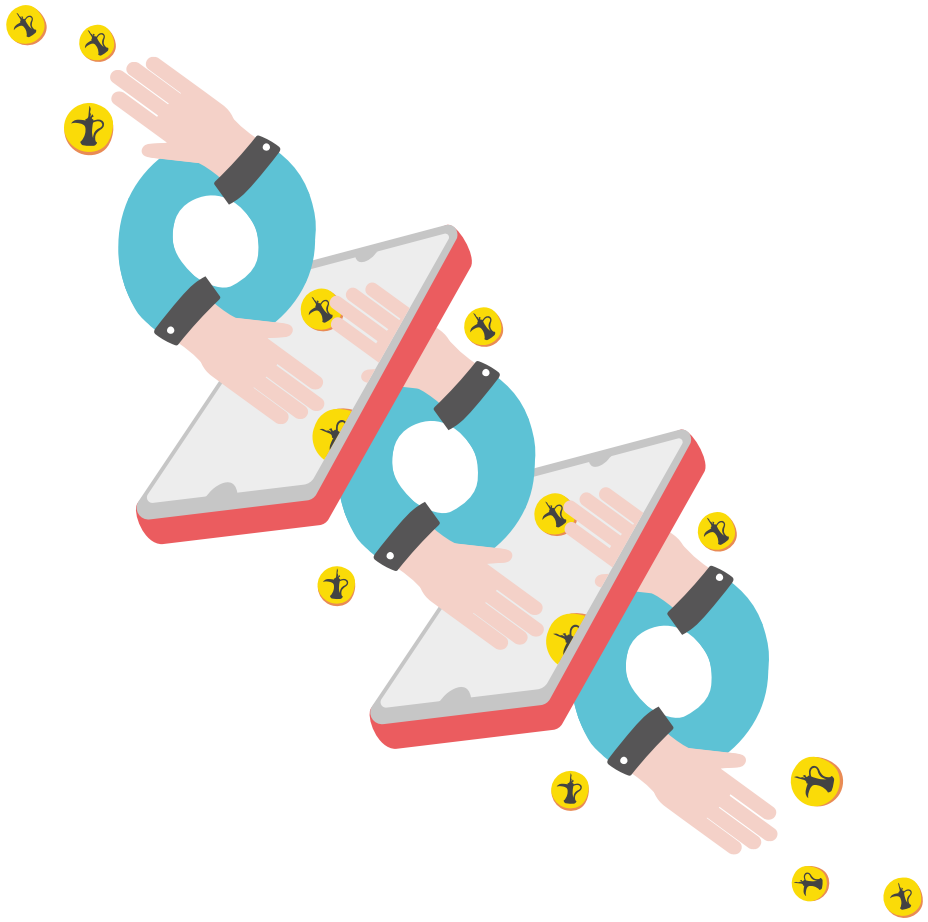
[33] Indra 2017

[34] Distributed ledger technology: beyond block chain 2016

[35] Merian 2018

Across Latin America, governments are introducing DLT technology with the aim of reducing corruption and restoring trust in public institutions as well as increasing transparency and citizen participation. Both Mexico and Colombia have announced public procurement procedures using blockchain technology.[36] Chile's largest stock exchange, the Santiago Exchange, registers agreements and transactions using DLT to promote transparency and reduce risk.[37] In Brazil, the BNDES token is a stablecoin pilot for tax-deductible contributions to cultural institutions aiming to strengthen accountability for public funding, while a blockchain-based platform designed by the state-run tech company Serpo regulates land titles to reduce fraud and corruption in property transactions.

The city government of Bogota also launched a pilot program in a few schools in collaboration with innovation center ViveLab, using distributed ledger technology to record votes in student elections. The small-scale exercise is just a small step in the country's ambitious goal to digitise its electoral processes. Tovar has stated that using blockchain technology in the ballots could result in savings of up to 1.3 billion Colombian pesos and expects the technology to be perfected within three years.[38]



[36] Mejia 2019

[37] Alarcon and Araya Falcone 2018

[38] Gomez 2019

Case Study Dubai

The largest and most populous city in the United Arab Emirates, Dubai aims to become a global benchmark for blockchain-powered government, as well as "the first government in the world to forego paper transactions altogether and execute the entirety of its transactions through blockchain technology by 2021."[39] The emirate is planning to use DLT to power all visa applications, bill payments and license renewals, accounting for over 100 million documents each year.[40] According to the Smart Dubai website, the adoption of DLT could save the emirate 1.17 billion USD annually in document processing costs alone.[41]

To meet this goal, the government has partnered with IBM to launch "the first government-backed blockchain platform in the Middle East."[42] After having launched several proof-of-concept and pilot initiatives across different government agencies (roads and transport, energy, health, and education), the new platform aims to digitise the provision of public services for residents and businesses. The first agencies to trial the new system were the Electricity and Water Authority (DEWA) and the Knowledge and Human Development Authority.[43]

Two projects are worth noting:

1. Launched last year through a public-private partnership with IBM, the Dubai Pay Blockchain Settlement and Reconciliation System enables government entities to conduct transactions with other official bodies, banks, or financial institutions in real time instead of the 45 days it usually takes to process payments.[44] Previously, public administrators had to manually reconcile and settle payments collected through various portals.

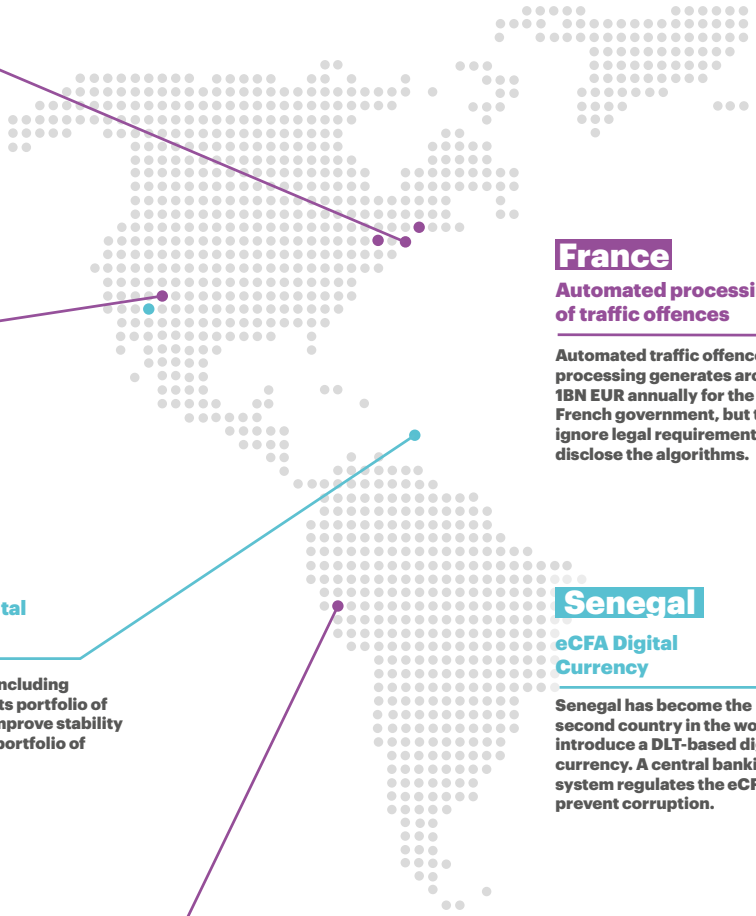
2. In collaboration with Smart Dubai and IBM, Dubai's Department of Economic Development has launched a unified corporate registry. The aim is to digitise the process of issuing business licences and exchanging commerce information for business owners, investors, entrepreneurs and startups, enabling them to conduct real-time transactions in a trusted and secure environment. The Dubai Silicon Oasis Authority, which is the regulatory body for Dubai Silicon Oasis (DSO), the integrated free zone technology park, will be the first free zone to implement the pilot project.[45] The system is expected to enable businesses to establish operations in the UAE more quickly.

Dubai's government-led approach to blockchain adoption through public innovation could serve as an example for developing countries by establishing standards of integrity in trade systems, especially where exports require verification of origin (coffee, timber, etc.)[46]

[39] Dubai Pulse 2018
[40] Dutt D'Cunha 2017
[41] Smart Dubai 2019
[42] Spong 2018
[43] Smart Dubai 2019
[44] Smart Dubai 2019
[45] GDN Online 2018
[46] Gupta and Knight 2017

ADMS and DLT projects around the world

The following map shows where and how governments worldwide are already implementing automated decision-making systems and distributed ledger technologies.



USA (New York)

School assignment algorithm

NYC uses school assignment algorithms to match eighth-graders to high schools based on preference, test scores and other requirements.

USA (Utah)

Housing First

Housing First fights homelessness by analysing information from across government agencies to assess and prioritise allocation of housing based on public services used.

France

Automated processing of traffic offences

Automated traffic offence processing generates around 1BN EUR annually for the French government, but they ignore legal requirements to disclose the algorithms.

Barbados

Central Bank Digital Currency

Barbados evaluates including cryptocurrencies in its portfolio of foreign reserves to improve stability and the return on its portfolio of assets.

Senegal

eCFA Digital Currency

Senegal has become the second country in the world to introduce a DLT-based digital currency. A central banking system regulates the eCFA to prevent corruption.

Peru

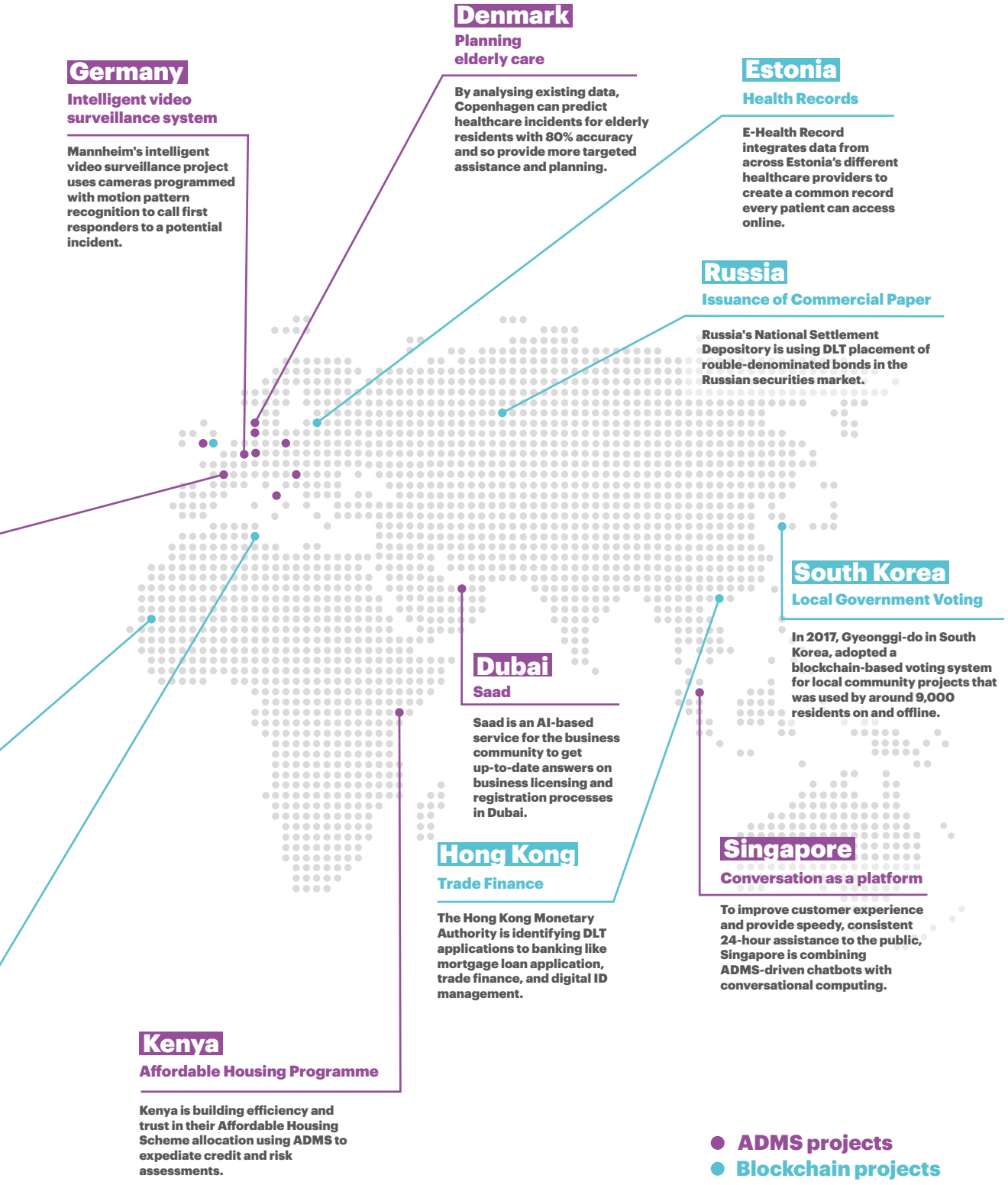
Proactive disease prevention

Peru's Ministry of Health uses AI to support risk analysis, automatic decision making and early warning for particular diseases, including dengue fever.

Tunisia

eDinar Digital Currency

The Tunisian eDinar is a blockchain-based national digital currency enabling banking services such as mobile money transfers, bill paying and managing ID.



Germany

Intelligent video surveillance system

Mannheim's intelligent video surveillance project uses cameras programmed with motion pattern recognition to call first responders to a potential incident.

Denmark

Planning elderly care

By analysing existing data, Copenhagen can predict healthcare incidents for elderly residents with 80% accuracy and so provide more targeted assistance and planning.

Estonia

Health Records

E-Health Record integrates data from across Estonia's different healthcare providers to create a common record every patient can access online.

Russia

Issuance of Commercial Paper

Russia's National Settlement Depository is using DLT placement of rouble-denominated bonds in the Russian securities market.

South Korea

Local Government Voting

In 2017, Gyeonggi-do in South Korea, adopted a blockchain-based voting system for local community projects that was used by around 9,000 residents on and offline.

Dubai

Saad

Saad is an AI-based service for the business community to get up-to-date answers on business licensing and registration processes in Dubai.

Hong Kong

Trade Finance

The Hong Kong Monetary Authority is identifying DLT applications to banking like mortgage loan application, trade finance, and digital ID management.

Singapore

Conversation as a platform

To improve customer experience and provide speedy, consistent 24-hour assistance to the public, Singapore is combining ADMS-driven chatbots with conversational computing.

Kenya

Affordable Housing Programme

Kenya is building efficiency and trust in their Affordable Housing Scheme allocation using ADMS to expediate credit and risk assessments.

- ADMS projects
- Blockchain projects

2

Challenges and opportunities

Leveraging benefits while mitigating harm

Distributed ledgers and automated decision-making systems have the potential to be radically disruptive. Their processing capability is real time, near tamper-proof and increasingly low-cost. They can be applied to a wide range of government services, such as welfare, healthcare and identity management. But like any radical innovation, as well as providing opportunities emerging technologies creates challenges for those who are unable to respond. The following section highlights the opportunities and challenges in the use of these emerging technologies across public sector application areas.

Opportunities opened by DLT

Data integrity assurance

Since changes by any participant with the necessary permission to modify the ledger are immediately reflected in all copies, DLT has the potential to benefit policymakers and citizens by giving them more visibility into, and in some cases control over, information used in government service delivery. Achieving such data integrity assurance to date is typically a highly complex, opaque and bureaucratic process for governments and citizens alike.

In Estonia, for example, an e-health registry powered by DLT is used for paperless prescriptions. The system assures and provides independent proof of the integrity of both personal health records and their processing. Citizens can log in to the system at any time and see who has handled their data (for instance to see if the police have run a background check or a doctor has handled their medical data).[47]

[47] Lyons et al. 2018

Streamlined service delivery and lower transaction costs

Because of its decentralised nature, DLT like blockchains can be used to streamline service delivery and reduce transaction costs for specific categories of citizens such as expatriates, minorities, the disabled, and pensioners, offering reductions in administrative costs. They remove the need for a trusted authority, and signed data can be verified across geographies.

With an expatriate population of nearly 90%, the United Arab Emirates must deal with the issue of remittances - expat workers sending money back home.[48] Using blockchain technology, the Dubai International Finance Centre seeks to co-develop micropayments products in developing countries that makes the expat experience more attractive and could attract additional expatriates to the city. Blockchain technology offers the potential for reduced transaction costs as recipients receive money instantly. The government of Dubai can use lessons learned from remittances pilots to apply to services typically needed by expats, such as housing, identification, taxes and more.

DLT also has the potential to streamline, automate and secure the way the public sector registers assets.

In Spain, property titles are kept in a private registry. Several town halls in Catalonia are exploring the possibility of using blockchain technology to create a decentralised registration system. The benefits for citizens include unlimited access to those documents free of charge and a choice in who they share it with. Public sector entities see benefits in the form of reduced service times, streamlined processes, and simplified interactions with citizens, which can in turn improve citizen engagement with the administration and increase overall trust in the system.

The immutability of DLT and especially blockchain has the potential to translate into direct benefits for citizens if applied in a public services context, especially in land registries.

In Latin America, drug trafficking is an issue that plagues citizens and public authorities alike, especially when powerful cartels take over their homes and properties by force. Several years ago, the US Department of Justice granted 300 million USD in aid so that Guatemala, Honduras and El Salvador could use DLT for land restitution purposes. The grant was also intended to fund efforts to standardise a land registration system that had previously been based on paper documentation and handshakes.

[48] World Population Review 2019

"Trustless" innovation through public-private partnerships

Because blockchain and DLT allow large groups or organisations to reach agreement on and permanently record information without a central authority, it presents an opportunity for governments to break through silos and innovate collaboratively, internally by cross- pollinating departments and externally through public-private partnerships. For instance, the private firm ConsenSys partnered with the Monetary Authority of Singapore to develop and open source software prototypes for decentralised interbank payment and settlements with liquidity savings mechanisms.

In another example, the Swedish land registration authority wanted to see if DLT could improve the real estate transfer process, but it could not design and execute the proof of concept on its own. The government eventually collaborated with banks, tax authorities, blockchain developers and other stakeholders to map and successfully execute the process, developing a private blockchain especially for the project. The process can be redesigned to involve other actors such as notaries, insurance companies and local public authorities.[49] Although no plans currently exist to implement the system in a live setting, this public innovation project was an important source of learning for all stakeholders and served as a landmark test case for DLT in government.[50] According to the testbed final report, for countries without a trustworthy real estate ownership record and land registry, a similar project could "[...] become an institution for trust in one of the most fundamental parts of an economy: land and real estate."[51]

Improving transparency and inclusion

Commercial ventures often support public administrations by increasing transparency and citizen participation through public-private partnerships. Project i2i in the Philippines, for example, aims to increase financial inclusion and break the poverty cycle in a society where 70% of the population are unbanked.[52] In a second phase the DLT-based inter-rural bank payment platform will also be expanded to include international transfers to cater for international remittances, which make up 10% of the Philippines' GDP.

[49] Kempe 2017

[50] Lyons et al. 2018

[51] Kempe 2017

[52] Consensys 2018

Potential benefits of ADMS

Increased efficiency and cost savings

AI-powered technologies offer governments the potential to improve decision-making by removing human error, increasing efficiency by automating repetitive tasks as well as free up human time to focus on the jobs where they add real value. In the US, the Postal Service is able to process 18,000 pieces of mail an hour using handwriting recognition software to sort by ZIP code. In the UK, the Customs and Revenue Agency has reduced call centre handling times by 40% and processing costs by 80% by automating the first step of interaction when cases are opened. Some experts estimate that automating tasks routinely done by computers could free up 96.7 million federal government working hours annually, potentially saving 3.3 billion USD.[53]

Faster information flow in crisis situations

During times of crisis, information can be as critical as food and shelter. By bringing together technology, crowdsourcing and civic action, Philippines -based Project Agos7 ensures the flow of critical and actionable information to those who need it before, during, and after disasters. Powered by an ADMS, this lifesaving real-time information helps disaster responders to mobilise faster and more efficiently.

Project Agos7 is an example of a collaborative ADMS platform that combines top-down government action and bottom up civic engagement to help communities mitigate risks and deal with climate change adaptation and disaster risk reduction. The Philippines government has adopted the platform, demonstrating the value of this type of civic-government engagement.[54]

[53] Eggers et al. 2017

[54] Data Revolution for Policymakers 2017

[55] Khan 2018

[56] Data Revolution for Policymakers 2017

Proactive disease prediction and life-saving ADMS

In Denmark, the National Institute of Health, Copenhagen Emergency Services and the University of Copenhagen have trialled software that supports dispatchers at health-emergency hotlines to identify when someone has had a cardiac arrest and so guide appropriate responses more quickly. The software successfully detected 93% of cases where humans had a success rate of 73%. Moreover, the dispatch decision is made half a minute faster when the ADMS is used – a time that could mean the difference between life and death in some cases. Research by Corti, the company behind the ADMS, claims that the best outcomes occur when the system works together with human dispatchers.[55]

Another example from the Centro De Desarrollo Sostenible in Peru highlights how efforts to help the Ministry of Health analyse data on dengue prevalence has tremendous value in creating predictive models to undertake risk analysis, automatic decision making and early warning for particular diseases. This represents a significant shift from a reactive to proactive approach to disease prediction and control.[56]

Leadership in international standard setting, transparency and regulation

Canada's decision to extend its use of ADMS in its immigration and refugee system has led to complaints about trialing technology on such a vulnerable group where nuanced decision making can become a matter of life or death. Given that administrations are often inspired to replicate the technology other countries introduce, others demand that Canada should seize this as an opportunity to lead the way in developing international standards for automated decision systems in immigration scenarios.[57]

New Zealand offers another compelling example of public sector leadership in ADMS governance, having completed a cross-departmental analysis of the development and use of algorithms in 14 agencies. When it comes to ADMS specifically, the analysis reinforces the importance of human oversight in significant decisions and states that the use of automated decision-making is clearly established under New Zealand law.[58]

[57] Molnar and Gill, 2018

[58] Stats NZ 2018

Challenges of emerging technologies in public services

While creators or vendors of systems powered by DLT or automated decision-making algorithms promise short-term cost savings and more efficient public services, it is governments, not third parties, who will ultimately be responsible for their failings. For this reason, governments must be aware of the challenges and pitfalls of each technology, especially in terms of impacts on and potentially harmful consequences for society.

Anecdotal evidence

Many pilots are taking place across government agencies. But as happens in other areas of innovation, transforming pilots into production and scale is a considerable challenge. Experts warn that what might be perceived as a revolution is in fact only anecdotal evidence of many pilots taking place around the world, with only a very small percentage of pilots becoming live, consolidated and sustainable projects.

Exacerbating bias

Human bias, error and corruption have always existed in public service delivery, creating deep inequalities for decades before the arrival of artificial intelligence systems. Nobody is free from bias, and individual public service agents can also take decisions based on bias or poor judgment. According to ADMS expert Virginia Eubanks, automated decision-making systems don't actually remove bias – they simply move and in some cases, magnify its impact. Many of these systems are untested and poorly designed for their tasks, resulting in illegal violations of individual rights.

Last year, the British Home Office cancelled thousands of visas and deported people in error based on the information provided by an automated voice recognition system used in English language examinations.[59] In 2016, bias was found in algorithm-based risk scoring systems used by criminal justice departments in the United States.[60] In 2014, the Polish Ministry of Labour and Social Policy introduced an ADMS to local labour offices, as part of its efforts to counteract unemployment more effectively, increase efficiency and guarantee public services of a higher quality.[61] The system categorised women, older people and less educated people as "farther" from the labour market and thus less likely to benefit from job assistance services which led to their lower prioritisation and exclusion from the system.[62]

Without adequate transparency, accountability and oversight, these systems risk introducing and reinforcing unfair biases and arbitrary practices in critical government determination and policies.[63] These decisions are likely to increase public distrust in the government, running counter to the European Commission's view that public sector innovation boosts public trust and legitimacy.

[59] Wright 2018

[60] Angiwn and Larson 2016

[61] Niklas et al. 2015

[62] Tisne et al. 2017

[63] Whittaker et al. 2018

Remembering Salvador

In Salvador's case, the algorithm deciding whether he should receive his benefits was using proxies instead of actual evidence of misconduct. The fact that he drove a car every day (as a taxi driver) after regularly visiting a bar (where he always goes for lunch) told the system that he is more likely to have a propensity for drunk driving: an understandable but fundamentally incorrect inference. What's more, the caseworker was not able to explain to Salvador how or why the system arrived at its decision; she only knows that she cannot disburse benefits.

Lack of internal knowledge and expertise

Emerging technologies are sophisticated, their applications are very new, and their real impacts and consequences remain to be seen, especially in a public services delivery context. The experts working with government bodies and who have contributed to this report all agree that those projects which get off the ground rely entirely on having internal champions, with enough knowledge and leverage to move it forward. At the same time, the lack of interested and well-informed policymakers in decision-making positions can be a considerable obstacle. When one has little real knowledge, it can be tempting to blindly get carried away by external promises to solve problems. Related to this is the lack of technical expertise within governments leading to the reliance on third party actors which can lead to conflicts of interest.

Narratives, storytelling and framing

As we have seen, investment in both DLT and especially in AI applications generally has grown in recent years with governments and corporations competing for leading positions in what is frequently called the new arms race. The following extract from the UK AI Sector Deal illustrates this example:

> **" A revolution in AI technology is already emerging. If we act now, we can lead it from the front. But if we 'wait and see' other countries will seize the advantage. Together, we can make the UK a global leader in this technology that will change all our lives." [64]**

Framing the situation as a competition or race can undermine the need for a comprehensive and inclusive debate with civil society on desirable futures. Secondly, it runs counter to the need for a slower approach that allows for the thorough examination of the social implications and governance challenges that are emerging from the use of these technologies in the realm of public innovation and the unintended consequences on individuals and communities across society.

It also raises the question - beyond the scope of this report to answer - of what happens to non-digital hubs that are left out of this so-called race? Will their contribution be reduced to the offering of labour force in the data farms, much like the clothing industry sweatshops of the twentieth century?

[64] AI Sector Deal 2018

Legacy systems

Another challenge facing policymakers using or thinking of using these new technologies is that any innovation or introduction of a new system begs the question of what to do with the existing systems. While Nigeria does not have a land registration system in place, it makes sense for public institutions to experiment with blockchain technology for land registry purposes. In this case, blockchain might be the solution they are looking for, and they do not have the factor of integrating existing systems. However, for countries with existing legacy systems that are costly to replace, there is no easy answer.

Cost savings can become cost sinks

As enthusiasm for emerging technology deployment in the public sector grows, so does the risk of governments purchasing or building inadequately tested or harm-causing systems using public funds. Manon den Dunnen, Digital Strategic Specialist of the Dutch National Police explains:

> **"We think that we save money and staff with new technology, but it is not always the case. Once our police department had funding to do a pilot project using virtual reality (VR) software. We only had money to do the pilot. We found that it costs a lot of money, time and people to build 3D models of crime scenes [...] The modelling was so labour intensive and specialised, that there was no business case for a large scale implementation. VR is still only used in a very small percentage of complex cases where the added value of understanding the context outweights the extra costs of specialists (time). The same thing happens with ADMS. More data does not save personnel. You actually need more people with higher analytical skills and abilities to interpret what the complex models say. For that you not only need to understand the working & quality of the algorithm, but also of the original data-sources ."**

Recalling the case of Uruguay, the Ministry of the Interior acquired predictive policing software Predpol with the goal of anticipating where crimes would occur and deploying police officers more effectively. However, the system's high degree of opacity and its potential to reinforce discrimination and exclusion made it a problematic case. Moreover, the ADMS failed to reduce crime in absolute terms; only small reductions of crime were experienced in areas where the system was implemented. After spending a total of nearly 400,000 USD on the software, the Ministry of the Interior eventually scrapped the system in under three years, replacing it with retrospective statistical tools developed by the Ministry's own teams which proved more effective.[65]

[65] Ortiz Freuler and Iglesias, 2018

The challenge of scale

Scaling up is one of the key challenges of implementing blockchain technologies in the public sector. Decentralised systems are inherently less efficient than centralised ones, and there are trade-offs between security and scale.[66] In some countries, DLT experts have found it easier to implement public interest projects at the city level rather than nationally. For example, a decentralised energy exchange project based on a model of user consumption from the city will not be easily scalable to the rest of the region where people have different consumption habits and neighbourhoods are structured differently (as single unit homes as opposed to large communities in blocks of flats).

When it comes to using blockchain technology for voting, experts warn that we are still a long way off from seeing implementation by governments of more populous countries. Restricted budgets and budget cycles hinder the ability of public innovators to move projects from pilots to scale. Related to this is the nature of public procurement processes which tend to favour large organisations and make it difficult for smaller innovative companies to compete. For these reasons, experts predict it will probably take longer for DLT to reach large-scale adoption in government than in other sectors such as supply chain management or financial services.

Widening the digital divide

For any government that holds inclusion as a guiding principle of its public innovation efforts, the challenge of innovating with emerging technologies without leaving anyone behind is critical. Governments implementing ADMS can fail the very people who most need them: the vulnerable and marginalised, especially those in economically precarious situations. One false positive can tip the balance of a person's entire life.

For example, in Brazil almost 70,000 children were left out of school as a result of the government switching to an online-only registration system.[67] This is in a country where only 56% of citizens have access to the internet. If this was the consequence of trying to digitise a registration service, what would be the consequences of switching to a blockchain powered service? Recalling the UK example of using ADMS to determine personal care budgets, research in the Journal of Social Welfare & Family Law found that automated personal budget decisions did not always correspond to people's needs; that they could be used as a mechanism for implementing spending cuts; and that the algorithmic nature of the system led to a lack of transparency.[68]

[66] Webb et al. 2018

[67] MPRJ 2019

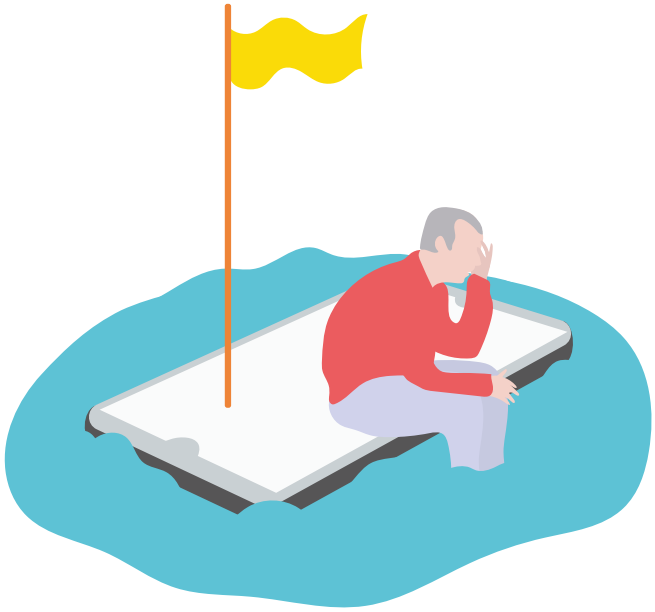
[68] Automating Society 2018

Automating empathy

Situations like Salvador's are not far from today's reality. In Indiana, state officials feared that a system allowing caseworkers and users to develop personal relationships would lead to more fraud after one case of corruption cost the state 8,000 USD. After 1,500 local case workers were replaced with online forms and call centres, benefits denials increased by 54%.

The charity Golden Opportunity Skills and Development (GOSAD) reports that 80% of users of the Universal Credit welfare system in the UK are digitally excluded. "The claimant journey is not only unrealistic but impossible for the digitally excluded, the ones who need it most," explains Programme Lead Sharmarke Diriye [69]. "Nobody has been consulted – these systems have been introduced without having people in mind. When public authorities co-design, they do it with their own staff, not with actual users of these services."

It's not that ADMS are inherently less effective in the public sector compared to the familiar ones we know in the private sector, such as Cabify or Deliveroo. According to Virginia Eubanks, author of Automating Inequality, the risk comes from using these systems to "override empathy" and "avoid some of the most pressing moral challenges of our time" – such as poverty, in Salvador's case.



[69] Diriye 2019

3

Looking ahead to act now

Envisioning multiple futures

When thinking ahead, it is useful to consider the power of visioning.[70] While visions can influence the future, promote research agendas and investments of time and money, they can also be dangerous "insofar as they draw attention away from other possibilities and other possible agendas for research and development".[71]

Who gets to decide what each vision looks like holds tremendous power. Public policies and public innovation are not value neutral, nor is the choice over what technology is used and how it is applied. In the spirit of multiple possible futures and multiple visions, we use the methodology described in this section to provide a vision of different possible futures and the consequences of each on citizens who tend to be left out of such conversations.

Futures in plural

(a singular "future" does not exist)

Futures as tools

(not as destination)

Futures to be created and shaped

(predictions are too boring)

Futures as tools

The methodology used in Digital Future Society working groups employs the concept of future(s) as tools for the discussion, collective analysis and strategic anticipation of key challenges and identifying opportunities that could emerge over the next decade.

This concept should not be confused, misused or misunderstood with the mindset of "predicting the future". In using this approach, our purpose is not to try to predict what will happen in 2030, but rather to apply collective long-term thinking and avoid common hindsight bias when it comes to exploring the impact of emerging technologies on society. By combining the perspectives of experts from the public, private, academic and third sectors, we create a richer and more holistic vision and narratives to build a deeper, more informed and strategically valuable understanding of the themes that Digital Future Society is exploring.

The future(s) as tools methodology creates a space to cultivate a greater and future-proofed value of the actionable recommendations expected to emerge from the collective intelligence gathered, informed by the drivers, trends and key uncertainties shaping the near futures of emerging technologies and society from multiple perspectives. The following section presents three scenarios that fit three different emotive framings: optimistic, pragmatic and catastrophic. Each imagines a world in 2030.

[70] Note the difference between predictions, speculations and visions. Prediction and speculation can overlap in the sense that both forecast the future, but speculation is more tentative than prediction. In principle, predictions are amenable to truth testing.

[71] Johnson 2014

Why 2030?

By using the 2030 time horizon for the scenarios in this report, Digital Future Society aims to deliver recommendations in a shared framework and connecting to existing transnational narratives, particularly the United Nations Sustainable Development Goals. 2030 is temporal reference used by many other governments, international organisations, and transnational initiatives within entities such as the World Economic Forum, the World Bank and the European Commission.

4
Quality education

5
Gender equality

8
Decent work and economic growth

9
Industry, innovation and infrastructure

10
Reduce inequalities

16
Peace, justice and strong institutions

Our aim is to encourage policymakers use the sustainable development goals as a guiding framework to build a common shared vision of desirable future(s) when faced with the decision of deploying emerging technologies in public services, especially in light of the goals that are designed to promote stronger institutions, quality education, gender equality, decent work and innovation in industry and infrastructure. By looking ahead and explaining what possible futures of the deployment of DLT and ADMS within public services might look like, and how it could affect key social, economic and environmental factors, we can catalyse action-oriented policy responses now.

A note on scenario building

To construct these possible futures, experts from the public, private, academic and third sectors discussed key trends, drivers and uncertainties. Some examples from the working group are as follows:

Key drivers and trends

- The exponential growth of data as an asset
- Increasing pressure on policymakers to act
- Climate change
- The drive to increase trust in public institutions
- Polarisation of perspectives: each region will have a particular approach (EU/North America/Asia) especially towards AI
- The use of automation for policy decisions will grow
- Capital investment influx into emerging tech, growth of the tech sector

Critical uncertainties

- **Who will benefit from emerging technologies in public services? Many or few?**
- **Control and concentration of data: high or low?**
- Public attitudes: will the techlash continue?
- Regulatory landscape
- Environmental impacts of emerging tech
- Who will pay for critical infrastructure?
- The evolution of the nation-state and geopolitics in general

This collective mapping is followed by a facilitated discussion, creating consensus around the likelihood and magnitude of the identified uncertainties.

The scenarios presented in this report are based on key uncertainties identified by workshop participants:

- High or low concentration of data used by emerging technologies (AMDS and DLT)
- High or low distribution of the benefits brought by emerging technologies

Catastrophic scenario

The year is 2030, and only a few large corporations and government bodies control data for their own benefit. Due to minimal regulations, monopolies form that widen the digital divide, centralise information and increase inequality across societies globally. The collection and use of data is highly opaque by both the public and private sectors, and there is no limit on what data is collected, by whom and for what purposes. Governments restrict information under the premise that the public is unable to act in the interest of the greater good. Information becomes increasingly confidential and while public blockchains become outlawed from data ownership perspectives, private DLT and ADMS proliferate with extremely limited oversight. Automation across all sectors is leading to increased unemployment and the cost is borne by governments.

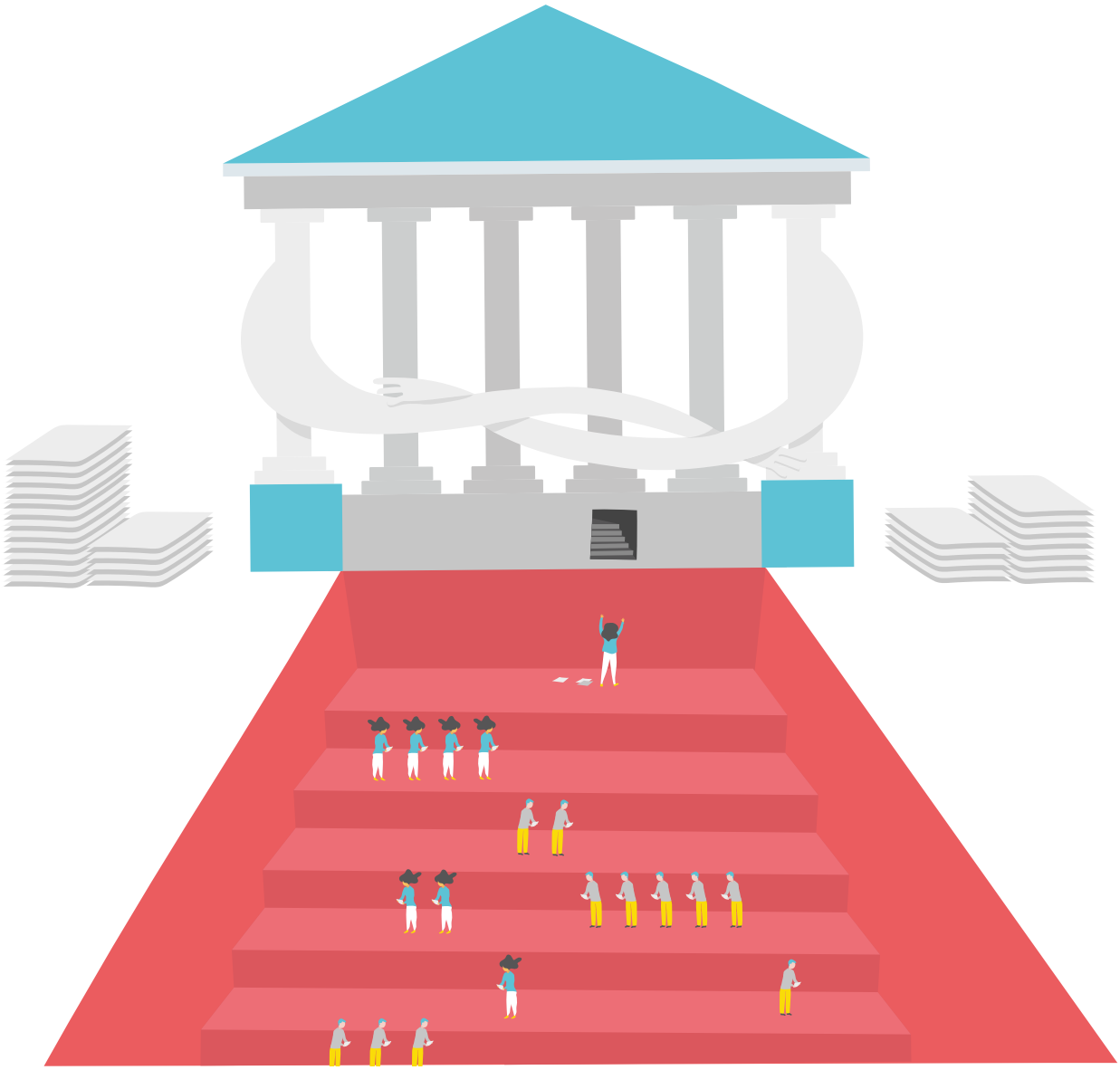
Even in a seemingly dire scenario, opportunities exist. Because governments have unfettered access to data, there is an upswing in personalised public services and satisfaction of citizens who understand how to use and benefit from these services. Lower levels of transparency and an almost blind faith in smart contracts and algorithmic decisions leads to the emergence of radical alternatives and ideologies, such as "data-free zones".

When it comes to challenges, governments struggle to close the digital gap and deal with growing unemployment, populism and radical activism as well as the prevalence of peer-to- peer services and economies. Blockchain turned out to be a technology that made it easier for governments to track citizens and abuse power. While earlier digital identity initiatives were voluntary, most have become compulsory. The immutability aspect of blockchain technology has made it nearly impossible to ensure that citizens maintain their GDPR-era digital rights such as the right to be forgotten.[72]

[72] General Data Protection Regulation: a regulation in EU law on data protection and privacy for all individual citizens of the European Union and European Economic Area.

Pragmatic scenario

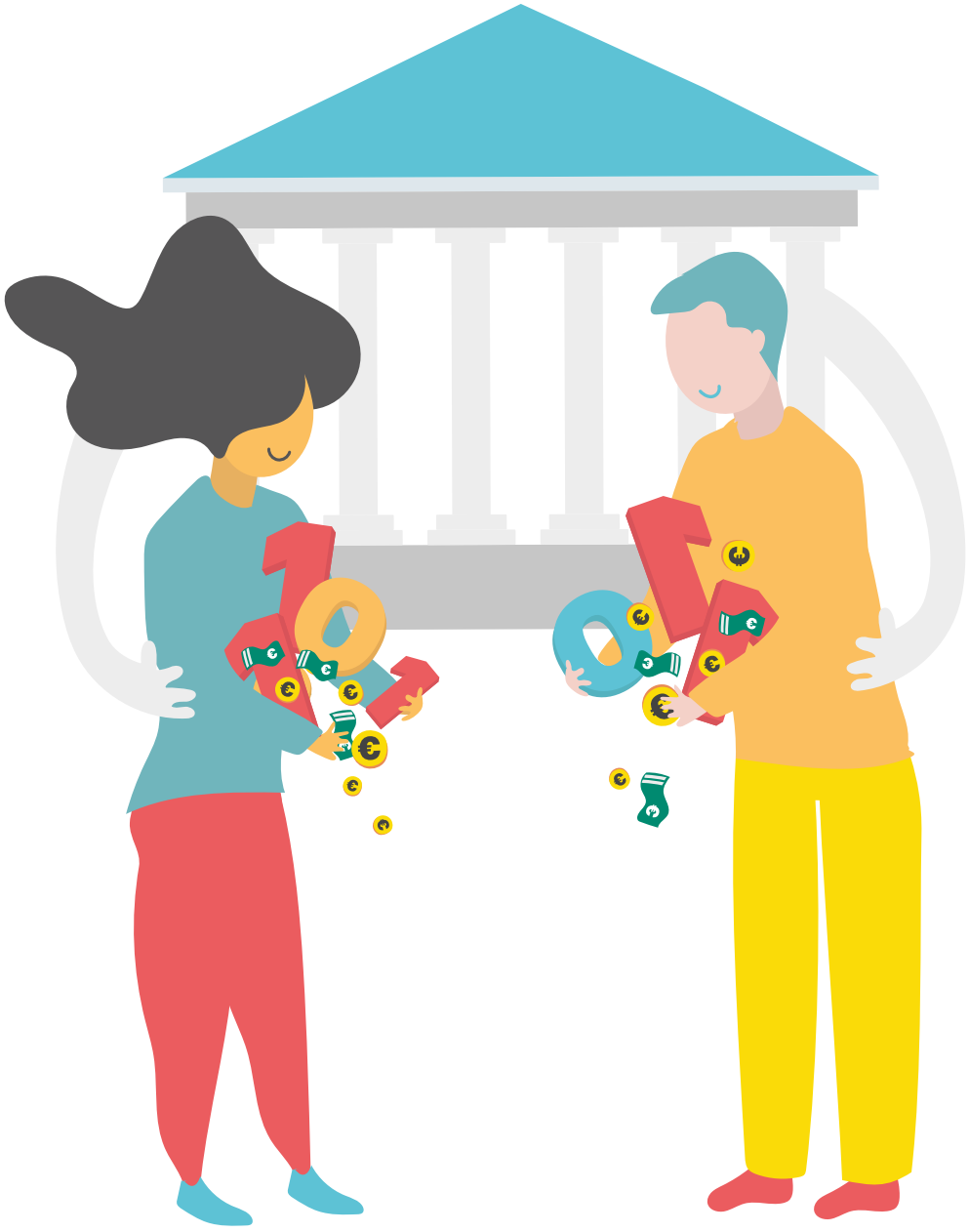
Only a few specific actors and types of information have become valuable enough to merit the additional resources and effort required to be put into a blockchain. Some governments champion DLT and ADMS, but it largely fails to create a change in how citizens think about information and access. The promised disruption ends up being negligible and does not scale. Rather than creating a revolution, public debate turns to the politics of immutable records. Blockchain technology is used only in asset investment and few people are interested. ADMS are mostly used in consumer-related applications, such as content filtering and online ads. Public and private investment has dried up as has the political incentive to integrate these technologies into public services. As there is a very low application of ADMS and DLT, the public is generally unaware and uninterested. Government bodies continue to function much in the same way they do now, with the same degree of bureaucracy and (in)efficiency as they find little use in these technologies for the purposes of public innovation.



Optimistic scenario

Data is owned by many and benefit also benefit from DLT and ADMS. Open data concepts have prevailed and citizens regularly contribute data to public health studies tracking disease outbreaks, for which they are compensated. Public services are more personalised, secure and reliable, and analogue alternatives are rare but still available. Governments incentivise citizens through tokenisation to adopt better social behaviours (traffic, noise, pollution), as well as encourage volunteering. Given that data is not held in private centralised monopolies, citizens have more trust in public institutions and governments have the opportunity to gather more accurate and diverse data on people and in turn build better social policies. New types of public services have become available, such as a blockchain-powered digital identity programme. In democratic countries with protections for individual freedoms and rights, digital citizenship has ushered in a new age of innovation and improved public services, tailored to each individual and less expensive than legacy siloed systems. Thanks to publicly funded research experiments with P2P digital interactions over the past decade, a standardised system of digital IDs and open-source networks have broken monopolies held by digital platforms and increased entry opportunities. However, a few authoritarian and totalitarian regimes have adopted these technologies as well, using them to maintain control and consolidate power.

In this scenario, citizens fully own, control and can even make revenue out of their voluntarily provided personal data. They understand which services use ADMS and how to appeal decisions that do not work out in their favour, thanks to free online and offline training sessions organised by the government. Challenges for governments in this scenario include ensuring that no citizen “falls through the cracks” of new public services powered by emerging technologies, and preventing abusive use of data in the name of public innovation.



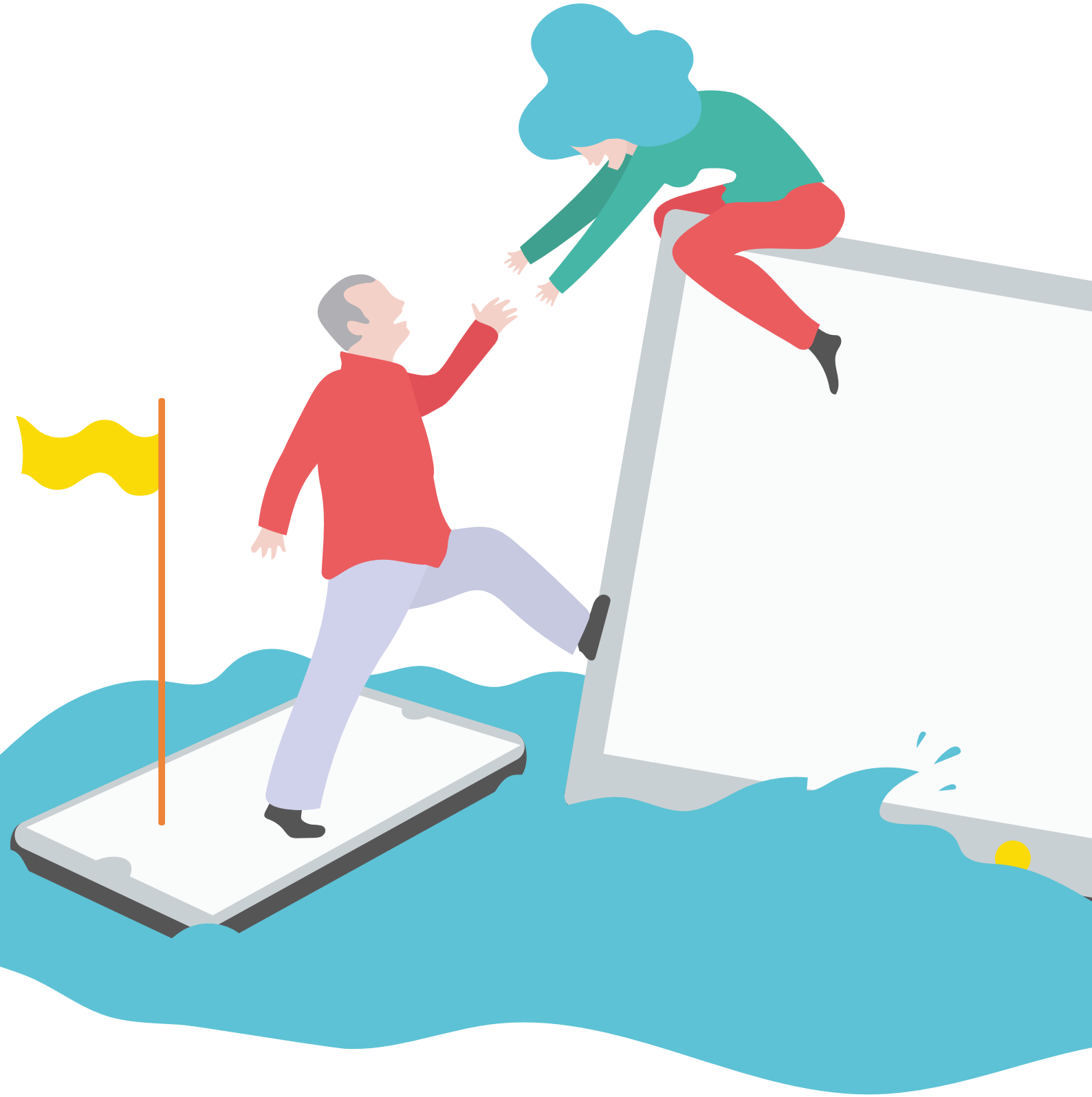
Toward inclusion

Salvador's example shows the dire consequences of digitising services with no analogue alternative for those who are at risk of digital exclusion. Unless efforts are made to bring inclusion into every part of the process, from the design to the delivery of any new innovative public service, a catastrophic scenario becomes increasingly likely.

So what does a more inclusive digital future look like for Salvador? Knowing he is about to reach retirement age, living alone and near the poverty line, the government sends Salvador a digital sherpa instead of an email to make sure his digital ID is up to date. Instead of forcing Salvador to come to a website or deal with email or private keys, core activities or changes in the public benefits system adapt to his context and experience, simplifying the process and bringing in technological support and input only when required, recognising when the digital option is not viable and offering an analogue alternative.

Where is this working in real life? In Taiwan, where Digital Minister Audrey Tang visits digitally excluded citizens herself (often the elderly, or those living in rural areas of the country) instead of expecting them to come to a website or download an app. [73]

[73] Basu 2017



4

Closing the responsibility gap

Key recommendations

Dominant narratives in popular discourse often present the impact of technological developments and some of the features as inevitable, when they are in fact the result of human choices. As researcher Deborah Johnson points out, "more autonomous technologies may well be developed in the future and a responsibility gap may occur, but this will be the result of human choices and not the inevitable outcome of the kinds of technologies currently in development".[74]

Once governments have determined that an ADMS or DLT is necessary to achieve a desired outcome, they must understand and acknowledge the moral consequences of their technological choice. It is they who must oversee the use of emerging technologies, especially those used in public administrations, and act accordingly. If ADMS and DLT are to be regulated at all, it should be by courts of law and legislators, not corporate policy teams. The creators and vendors of algorithmic decision-making systems and DLT should not be expected to do this for policymakers, nor should citizens like Salvador be held responsible or suffer the negative consequences of these systems without any form of redress or recourse.

Building on the outcomes of the working group, expert interviews, and desk research, the following recommendations are for policymakers who are ready to close the responsibility gap and take ownership of their use and governance of emerging technologies like ADMS and DLT.

[74] Johnson 2014

Focus on oversight and key regulatory actions

1 Invest in adequate oversight bodies, or create new ones where they do not exist

While oversight over automated decision-making systems should be organised by sector, few oversight bodies currently in place have the expertise to analyse and probe modern ADMS and DLT and their underlying risks. Here, policymakers and public administrations are called upon to invest in applied research to enable existing institutions to catch up, or to create new ones where needed. This oversight body should be able to conduct comprehensive and periodic audits of ADMS or DLT to determine whether targeted objectives are actually being met, flag any potential negative impacts (including the violation of existing legislation), and advise how the system should be adapted. For example, the UK charity Doteveryone suggests creating the Office for Responsible Technology: a digital protection agency not just for consumers but for citizens, that takes the position of citizens to ensure they are being treated fairly. Such an oversight body should have the technical competence to investigate and remediate cases of unfair bias.[75]

2 Use a flexible, sector-specific regulatory approach to oversee, audit and monitor emerging technologies at all levels of government

While necessary to serve as a central source of oversight and expertise, a general national oversight body is not enough on its own to meet the sectoral expertise requirements needed for nuanced regulation of emerging technologies like ADMS and DLT. Drawing inspiration from other industries which have supranational oversight, regulatory and/or auditing bodies (WTO for trade, WHO for health), policymakers should support the creation of independent third party organisations to oversee and create standards for the use of DLT, ADMS and other AI-powered applications globally.

At the national level, domains or ministries like health, education, criminal justice, environment and welfare typically have their own regulatory frameworks and bodies. A sectoral approach can also address the need for a balanced and flexible regulatory environment that provides the right protections and promotes industry accountability while allowing businesses to determine the best way to adhere to key principles.

[75] Miller et al. 2018

3 Consider how national and international regulatory goals and standards could be achieved using technical code as well as legal code

Consider how to put a regulatory framework in place that evolves in parallel with the development and of new implementations and applications of ADMS and DLT in public service delivery. Technical code could be used to assure compliance for legal code, thereby reducing costs of legal compliance. The very same technologies could be used to enhance regulation, as in the Estonia case in which ministers use DLT to draft legislation, submit positions and objections, and review minutes of parliamentary sessions. This will require a mix of skills and competencies with lawyers, mathematicians, ethicists, policymakers and computer scientists working together to ensure key issues are resolved. In Germany, the Algo.Rules project is starting to work with software developers in order to put their set of rules[76] into practice by way of code, to make it more actionable. A second example is that of the Fairness Measures Project, an international group of data scientists working to develop "fairness aware" algorithms that detect bias. [77]

4 Government as the expert customer in procurement: build ethical, transparent, inclusive design criteria into the public procurement process

Governments should hold vendors of emerging technologies like ADMS and DLT to higher accountability standards for what they can promise, especially when the evidence to back such promises is scant and longer-term consequences are known, and such systems are funded by taxpayers. While the terms of past contracts may be difficult or impossible to reopen, policymakers should commit to demanding openness in all future contracts with vendors of emerging technologies. Moreover, the teams developing and selling emerging technologies to governments often fail to represent society as a whole. The gap between the developers, and those who profit from emerging technologies and those most likely to suffer the consequences of their negative effects is growing.[78]

[76] See Appendix C

[77] Automating Society 2018

[78] Whittaker et al. 2018

When governments contract emerging technologies, accountability, diversity and ethics should also factor into the public procurement process:

- **Ethical:** Have vendors complete ethical impact assessments as part of the process.
- **Transparent**: Demand that vendors waive trade secrecy, proprietary interests and other legal claims that stand in the way of accountability, auditability and interpretability.
- **Inclusive:** Use selection criteria that rewards vendors with demonstrably diverse design and development teams comprised of people of different ages, backgrounds, ethnicities and walks of life.

Support the creation of local government demonstrators or regulatory sandboxes that can test ethical, legal, regulatory and technical standards for each technology and its application

The applicability of many existing or updated legal and regulatory frameworks is often untested. Some countries such as the UK are using regulatory sandboxes to give startups the opportunity to test products and technologies with users. The same approach could be used to test regulatory standards in addition to the technologies themselves. A city-level demonstrator could provide important opportunities for trialling and implementing safe, inclusive instances of DLT and ADMS. At the local level, trials and pilots of ADMS and DLT should be coordinated in a similar fashion to the way that clinical trials are implemented, documented and assessed in the pharmaceutical industry, in order to ensure uniformity and maximise the rigour of the process.

Invest in internal capacity building

6 Measure and invest in internal expertise

Working with emerging technologies is an entirely new pursuit for many public organisations. Public administrations should ensure a high level of expertise within their own institutions and departments in order to either develop systems themselves, or at least be in a position to meaningfully oversee outsourced development. This can be achieved stepwise, first by conducting an organisation-wide survey to determine internal expertise levels, and creating dedicated research bodies or task forces, i.e. in cooperation with universities or research centres, that can teach, train and advise public servants on how to deal with emerging technologies effectively and ethically. For example, the UK has conducted several surveys among their policymakers to document and build knowledge on the use of emerging tech in government.[79] There is also an opportunity for public-private partnerships for internal knowledge building and expertise. Together with Consensys, the government of Dubai will launch a similar survey among its staff this year.

7 Prioritise knowledge exchange and coordinate policy responses across departments

Promoting interdisciplinary exchange across departments or ministries are essential to appropriate skills development. Building on the sectoral approach described in Recommendation 2, trained experts should be proficient in algorithmic testing and impact assessments, cyber security and inclusive design, and would work alongside regulators to help craft fitting policy responses for each sector. Continuing with the UK as an example, an internal government expert on DLT would work with the Financial Conduct Authority (FCA) and Ofgem to explore different impacts of blockchain technology on the finance and energy sectors. Coordinated responses across regulators can be carried out by task forces such as the one planned by the FCA, Bank of England and Treasury on cryptocurrencies.[80]

[79] GOV.UK 2018

[80] Sahloul 2018

8 Bring rights-focused organisations on board

Involve a wide range of stakeholders in the development of criteria for good design processes and the enforcement of audits, including civil society organisations. Many governments claim to involve civil society stakeholders in discussions about emerging technologies, using the broadest sense of the term to refer to academics, think tanks and the like. Yet if organisations or representatives focused specifically on ethics, civil rights and liberties are not part of such oversight bodies, crucial viewpoints are likely to be overlooked. To avoid ethical window-dressing, organisations focused on rights must be included in the creation and enforcement of oversight criteria. A concrete action to implement immediately would be to appoint an ethicist-in-chief with the technical expertise to effectively advise policymakers on the societal implications of emerging technologies like ADMS and DLT.

9 Start developing technology-specific governance tools or use existing frameworks, such as algorithmic impact assessments for ADMS

As more governments adopt automated decision-making systems, public servants will require specifically adapted governance tools to address the challenges outlined in this report. Algorithmic Impact Assessments are one example of a framework that can help policymakers understand the automated decision systems they procure, and give the public more insight into these systems in order to keep them accountable.[81] For instance, an "Algorithmic Accountability Act" that would force large companies to check algorithms for bias has recently been introduced into the United States Senate.[82]

10 Invest in third party, non-profit academic research on the use of ADMS and DLT in public services

Related to Recommendations 1 and 2, investing in applied research can help existing institutions to catch up when it comes to the capacity for oversight or inform the creation of new oversight bodies. Developing funding calls, facilitating network opportunities and making public funds available for research are all concrete actions policymakers can take to boost their internal expertise while simultaneously building civil society engagement around the topic of emerging technologies.

[81] Reisman et al. 2018

[82] Kaminski and Selbst 2019

Create mechanisms for citizen redress and support

11 Invest in transparency efforts that inform and educate citizens

Governments have a crucial role in making sure citizens are well-informed and prepared for how ADMS and DLT are used in public service delivery, how it might affect them, along with the risks are and options for recourse in cases of wrongdoing or harm. This can be achieved starting with simple transparency efforts, such as the algorithm assessment report published by the statistics department of the government of New Zealand. The oversight body from Recommendation 1 should publish and keep updated a list of where algorithms with significant impacts are being used in government, along with specific projects aimed at introducing public service algorithms. Policymakers should also strive to respond to public concerns about bias and discrimination by specifying which services and decisions are already based on an algorithm, and what that means for citizens in practice. In connection with the implementation of Recommendation 9, governments should strive to ensure the results of Algorithmic Impact Assessments are publicly available.

12 Ensure newly automated public services are designed with and for the public they are meant to serve

Equitable digitalisation and implementation of emerging technologies means inclusive, not going digital for the sake of it. Rather than focusing the discussion on the technicalities of how emerging technologies work (does Salvador really care if the system providing his benefits is powered by blockchain technology or artificial intelligence?) governments could invest in making sure new automated systems and DLT are designed with and for and the public they are meant to serve. Any cost savings generated by efficiency gains from implementing emerging technologies in public services can and should be reinvested in such inclusivity efforts.

13 Create easily accessible recourse and redress mechanisms

The people most at risk of harm from emerging technologies are often those least able to contest the outcomes.[83] Public authorities and policymakers should define and implement best practices for handling public complaints about impacts of ADMS and DLT in their services, such as making the process easy and accessible. They should also provide backstop mediation by supporting public entities that represent those cut off from social services due to automated decisions, CSOs and organisers that are at risk of job loss and exploitation etc. Complaints and actions taken should be documented and shared across departments to flag emerging issues and inform regulatory and oversight bodies that should be in place after implementing Recommendations 1 and 2.

14 Provide a way for citizens to opt out or around digital public services through an analogue alternative

In addition to being informed if an algorithm-based decision system is in use and offered recourse if something goes wrong, citizens should be able to opt out of DLT or ADMS powered services if they choose to. Not all citizens should be forced to comply with a digital-only option when it comes to using public services. It is the government's responsibility to make sure alternative, non-digital options exist, especially for digitally excluded citizens like Salvador. User experiences should be adapted to different groups.

For instance, Taiwan, widely considered one of the most advanced governments in terms of digital transformation, still offers analogue alternative pathways so that digitally excluded citizens (e.g. the elderly and those living in non-digital hubs) can access the same government services.

[83] Whittaker et al. 2018

A call to action

With a wide range of stakeholders, services and roles, governments must carry out a multitude of different operations. Some distribute value rather than create it, and others create and maintain effective regulatory regimes. Many of these activities will be enhanced by the opportunities afforded by emerging technologies through public innovation, and others will be challenged.

The focus of this report has been to elucidate how public sector organisations can embrace the opportunities that emerging technologies have to offer while ensuring that their potential challenges and risks are adequately addressed.

Having explored what kind of ideas, techniques, and approaches might best keep such systems accountable, we have reached the limit of what can meaningfully be discussed in the abstract.

We conclude this report by inviting policymakers who wish to lead in this area to join Digital Future Society in proactively developing, testing and improving prototypes of these questions, methods, and more inclusive approaches to involving people in actual initiatives to see what works.

Moving from action-based reflection to experimentation will be the strongest indicator of whether we can really change behaviour and enable public sector organisations to follow a path of responsible public innovation when it comes to emerging technologies.

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Appendix A
Global public investment in blockchain and AI

Artificial intelligence and blockchain technology are two emerging technologies prioritised by governments around the world in terms of research and development spending.

According to IDC research , the public sector accounted for 7% of total spending on blockchain technology worldwide in 2017. [84] As machine learning capabilities improve, world governments will likely invest even more in AI research. Below is a non-exhaustive list of specific examples illustrating the scale and scope of such investments.

Blockchain and DLT

In the European Union, over 80 million EUR have been allocated to blockchain related projects through financing Horizon 2020 Research and Innovation projects. Up to 340 million EUR is expected to be allocated by 2020.[85]

The South Korean Ministry of Science and ICT announced that it will be investing 9 million USD to kick start pilot blockchain projects in the public sector. The projects involve using the technology for online voting, customs clearance, supply chain management, logistics, real estate, and cross-border e-document distribution. The government plans on further stimulating blockchain growth. [86]

The United States federal government is likely to increase its spending in the blockchain industry over the next three years. IDC states that the United States is expected to raise its blockchain spending to 123.5 million USD by 2022, equivalent to a 1,000 percent increase in spending compared to 2017. [87]

[84] Shirer and Goepfert 2018

[85] Lyons et al. 2018

[86] Vilner 2018

[87] Shirer and Goepfert 2018

Artificial intelligence

Research firm IDC estimates the US government's investment in cognitive and artificial intelligence technologies will grow at a rate of 54.3% from 2018 to 2021.

In Canada, the 2017 federal budget included 125 million CAD for a pan-Canadian Artificial Intelligence Strategy administered by the Canadian Institute for Advanced Research. A Quebec-based proposal for research on AI and supply chains won a share of the 950 million CAD "superclusters fund" in 2018. [88]

In Europe, France is pledging 1.5 billion EUR to hasten the development of its fledgling AI ecosystem[89], while the German government has set aside around 3 billion EUR for research and development of AI to close a gap in software-led innovation between it, America and Asia.[90]

The United Kingdom has announced 1 billion GBP in funding for AI research, adding more than 300 million GBP of newly allocated government funding for AI research to the 400 million GBP that the government had previously announced. [91]

[88] McKelvey and Gupta 2018

[89] Han 2018

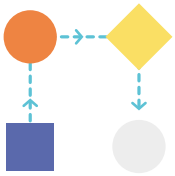
[90] Hansen 2018

[91] Macaulay 2018

Appendix B
10 questions to ask before using emerging technologies in the public sector

1 - Objective

Why is this technology needed and what outcomes is it intended to enable?



2 -Use

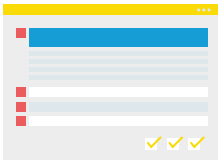
In what processes and circumstances is the ADMS/DLT appropriate to be used?

3- Impacts

What impacts - good and bad- could the use of this technology have on people?

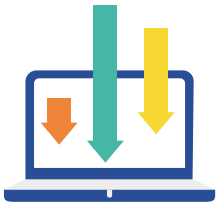
4- Assumptions

What assumptions is the system based on? What are their limitations and potential biases?



5- Data

What data sets is/was the system trained or built on? What are their limitations and potential biases?



6- Inputs

In the case of an AMDS, what new data does the system use when making decisions?

7- Mitigation

What actions have been taken to mitigate the negative impacts that could result from the system's limitations and potential biases?

8- Ethics

What assessment has been made of the ethics of using this system?

9- Oversight

What human judgment or intervention is needed before acting on the system output? Who is responsible for ensuring its proper use?

10 -Evaluation

How and by what criteria will the effectiveness of the system be assessed, and by whom? How often? Will the results be publicly available?

Appendix C
A framework for action: emerging technology in government

Many governments prefer to take a "wait and see" approach after seeing new research or hearing about emerging technologies. Although it can be difficult to take risks in times of political, technological and economic uncertainty, governments must take some action, however small, to build momentum to eventually be able to confront the possible future(s) described in Section 3 of this report.

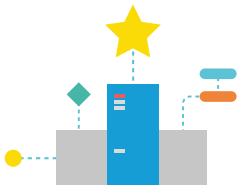
The below framework adapted from the Future Today Institute is intended to help governments continually monitor emerging technology developments as they move from the fringe to the mainstream.[92] The idea is to focus on taking incremental action now while thinking exponentially and strategically. This approach can help public administrations make more informed decisions ahead of time rather than trying to manage technology-related crises under duress.

[92] Adapted from Webb et al. 2019


High
Low
"Should we do it?"
Uncertainty about technology
Learning stage
As we research and test this new technology, what can we learn and apply to our organisation? What must we do now to keep ahead of the trend?
Sample Action
Devote an all-hands action day to investigating this trend. Invite people from all departments within your organisation to participate. Bring in outsiders for added expertise.
Listening for signals at the horizon
Emerging but bona-fide technology and trends; uncertain trajectory and timeline; ecosystem forming; market forming.
Sample Action
Assign one member of your team to be the resident expert on the tech trend. Have them send notes to the rest of the team on a regular basis.
Capacity Building Stage
How can we work to better understand the emerging tech and develop the internal expertise to act? How do our key stakeholders and constituents see this trend? What are their expectations of us?
Sample Action
Develop and ship a survey to assess how well-positioned your current team is to address this trend. Determine whether additional training is necessary.
Developing ideas stage
How can we develop a new product or service that leverages the technology, even as the market is still evolving? How can we assess possible risk and implications in a meaningful way?
Sample Action
Facilitate a scenarios workshop, with a goal of identifying probable and plausible outcomes.
Low
High
Uncertainty about a trend
Do citizens want it?

Appendix D
Algo.Rules

Policymakers can use this set of rules for the design of algorithmic systems to guide their decision to deploy emerging technologies, especially automated decision making systems.[93]



1 - Strengthen competency

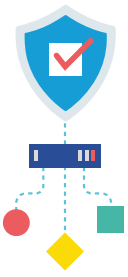
The function and potential effects of an algorithmic system must be understood

2 -Define responsibilities

Natural or legal person must always be held responsible for the effects involved with the use of an algorithmic system

3- Document goals and anticipated impact

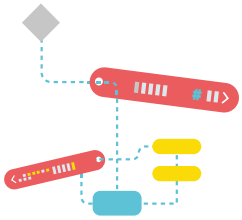
The objectives and expected impact of the use of an algorithmic system must be documented and assessed prior to implementation



4- Guarantee security

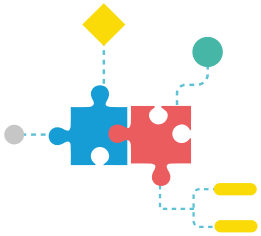
The security of an algorithmic system must be tested before and during its implementation

[93] See Algorules.org



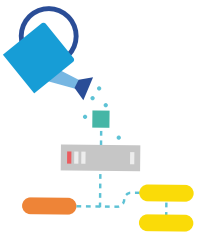
5- Provide labeling

The use of an algorithmic system must be identified as such



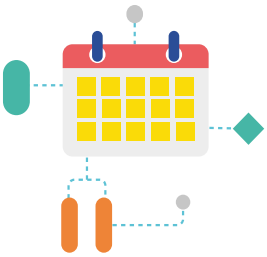
6- Ensure intelligibility

The decision-making process within an algorithmic system must always be comprehensible



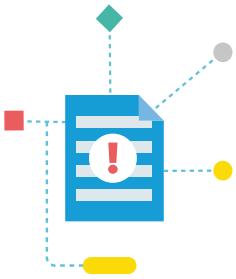
7- Safeguard manageability

An algorithmic system must be manageable throughout the life time of its use



8- Monitor impact

The effects of an algorithmic system must be reviewed on a regular basis



9- Establish complaint mechanisms

If an algorithmic system results in a questionable decision or a decision that affects an individual's rights, it must be possible to request an explanation and file a complaint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