



Connecting the dots

Data sharing in the public sector

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Executive Summary

Governments today are expected to address a wide range of complex, interconnected challenges. This requires a program of action that is joined-up, data-driven, and evidence-based. However, not all of the data that can best support those actions is available to governments, or the right agency of government. This makes data sharing and working collaboratively between and beyond public sector organizations strategically vital.

Data ecosystems provide a systematic approach to data sharing. They arise when organizations agree to share data and insights under applicable regulations to create new value for all participants. Public sector leaders recognize their potential. In our survey of 1,000 public sector organizations globally, respondents believe that data ecosystems can enable a 9.5% improvement on average in the use of government funds and resources. Those organizations that have deployed data ecosystems

or are currently rolling them out are already benefitting in significant ways. Public sector leaders tell us that data ecosystems are contributing to improved efficiency, effectiveness, and outcomes. Tax authorities are using them to improve compliance; welfare agencies to reach targeted groups of citizens more effectively; police departments to improve public safety; and local, state, and central administrations to engage citizens and drive sustainable development.

9.5%

estimated improvement in utilization of government funds and resources that organizations believe data ecosystems can potentially deliver

Executive Summary

However, although public sector organizations in our research see data ecosystems as beneficial, most have not yet deployed them. In fact, only 10% have fully deployed data ecosystems, while another 17% are in the midst of a deployment phase. The great majority – the remaining 73% – are still planning or piloting initiatives. Besides the challenges of technology, people-based challenges are the main concern – specifically, culture and trust.

The public sector's path to mature data ecosystems

Building mature data ecosystems is a long-term journey. Today the data is available, and the technologies are already mature. But establishing trust, fostering new skills, and changing organizational culture are also integral to that journey.

Our research has highlighted four priorities:

1. Identify the use cases, data sources, and participants necessary for an ecosystem
2. Develop infrastructure for interoperability and data collaboration
3. Establish trust across the full spectrum of data sharing practices, from governance and organizational setups to technology
4. Develop skills and capabilities for a data-driven culture.

We live in an era of escalating, interrelated crises that demand a systemic response: pandemics, global supply chain issues and resource scarcity, evolving security threats, climate, and biodiversity. Our time to address these is limited. Having the right data – and connecting the dots – is the start.

Only **27%**

of public sector organizations are rolling out, or have fully deployed data ecosystem initiatives

Introduction

Data ecosystems have a crucial role to play in helping governments craft a systemic response to social, environmental, and economic challenges. Given the interconnected nature of these challenges, access to a range of data sources is critical to developing a holistic understanding of them and designing effective policy interventions. Recognizing the need for such a joined-up, data-driven approach to decision-making, the UK government is running a program called the Shared Outcomes Fund. The program provides funding for pilot projects that tackle complex challenges that require collaboration between multiple public sector organizations.¹ These include:

- Shared Digital Carbon Architecture (SDCA) – a project to enable a more joined-up approach to decarbonizing infrastructure, as part of the UK government's goal of achieving net zero emissions, by improving visibility of carbon impacts across infrastructure sectors. The project is a collaborative effort between the Department of Transport (DoT) and organizations including Network Rail, National Highways, and the Infrastructure Projects Authority (IPA). It aims to develop technology and data systems that provide policymakers with access to high-quality carbon data across infrastructure sectors, to facilitate the design of more effective decarbonization strategies.²

Introduction

- Counter-Disinformation Data Platform – a project led by the UK's Department of Digital, Culture, Media and Sport (DCMS), bringing together government departments such as the Home Office, Ministry of Defence, and the National Cyber Security Centre (NCSC), to develop a comprehensive understanding of disinformation and design more effective, data-driven policies to tackle disinformation. The project involves developing a data platform to ingest, store, and analyze anonymized social media data, track the evolution of harmful narrative trends in public discourse, and identify key areas of risk. The platform is intended to enable collaboration and sharing of data and insights across departmental boundaries and silos.³

With advancements in technology, today's data ecosystems provide a foundation of trust, transparency, and interoperability to support a range of data sharing use cases. The Centre National d'Etudes Spatiales (CNES, the French government space agency) is supporting the development of Space Data Marketplace – a data ecosystem designed to foster innovation using space data. The ecosystem uses the Dawex data exchange technology platform to facilitate the sharing of space data within a secure environment in compliance with applicable regulations. This enables a range of innovative use cases in areas such as housing, mobility, energy, and the environment. For instance, Airbus and Dassault Systèmes are using space data to develop a digital twin of the earth. The project aims to simulate human activity in order to understand its impacts and to find ways to address future environmental challenges (e.g., simulating

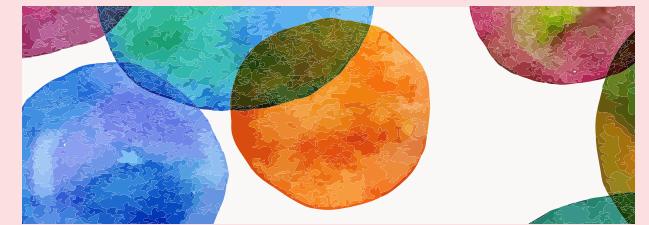
Introduction

rising water levels can help inform future infrastructure decisions or plan emergency response). Other use cases include an environmental monitoring dashboard for local, regional, and national authorities that is being developed by Murmuration, a green tech startup.⁴

Our past research has shown the benefits of data ecosystems for the private sector. These included a 15% improvement in customer satisfaction, 14% improvement in productivity/efficiency, and an 11% reduction in costs annually over 2–3 years.⁵ In our current study, we wanted to understand how public sector organizations can benefit from data ecosystems, the extent to which they are adopting them, and the obstacles holding back progress.

To examine these areas, in June 2022 we surveyed 1,000 senior officials from public sector organizations that are

working on or planning to work on data ecosystems. The survey covered organizations in North America, Europe, and Asia from various levels of government, representing a range of functional areas including welfare, tax and customs, security and defense, as well as local, state, and central administrations. We excluded healthcare from the scope of the study. We also interviewed more than 20 experts (more details on the research methodology are available at the end of the report).



Introduction

This report focuses on the following questions:

01

In what ways can public sector organizations benefit from data ecosystems?

02

To what extent are public sector organizations engaging in data ecosystem initiatives?

03

How can public sector organizations progress towards mature data ecosystems?

DEFINING PUBLIC SECTOR DATA ECOSYSTEMS

For the purposes of this research, we define a public sector data ecosystem as: “A system of data collaboration involving a public sector entity along with other private and/or public organizations and/or citizens. These data collaboration initiatives should benefit the public organizations participating in the ecosystem and/or other target beneficiaries, such as citizens, and help them attain their overall strategic goals and mission.”

01

HOW DATA ECOSYSTEMS DRIVE VALUE FOR PUBLIC SECTOR ORGANIZATIONS

Below, we explore the value and benefits that data ecosystems can deliver for public sector organizations.

Data ecosystems can significantly improve utilization of funds and resources

Based on estimates from our survey respondents, we found that on average, a fully functional data ecosystem could be expected to improve government utilization of funds and resources by 9.5%. The UK's Government Counter Fraud Function (GCFF), for instance, works with public sector departments to tackle fraud using data and analytics, and supports several data sharing pilots (fraud is estimated to cost the UK government £33–£55 billion

annually). A recent pilot facilitated data sharing between HMRC (the UK's tax, payments, and customs authority) and the Education and Skills Funding Agency (ESFA) to tackle fraud in apprenticeship schemes, resulting in savings of over £12 million.⁶

Teresa Girbal, Vice President and CIO at eSPap, a Portuguese public sector shared services organization, comments:

"A key priority for us is to minimize duplication in the collection of information and to reuse the data that we have in the public administration, so that data collection is more efficient and to the purpose. To this end, we have adopted an interoperability platform that allows data to be shared securely between public sector entities. This is a very powerful tool: it helps public sector entities direct their efforts, utilize budgets more efficiently, and avoid wastage of resources."



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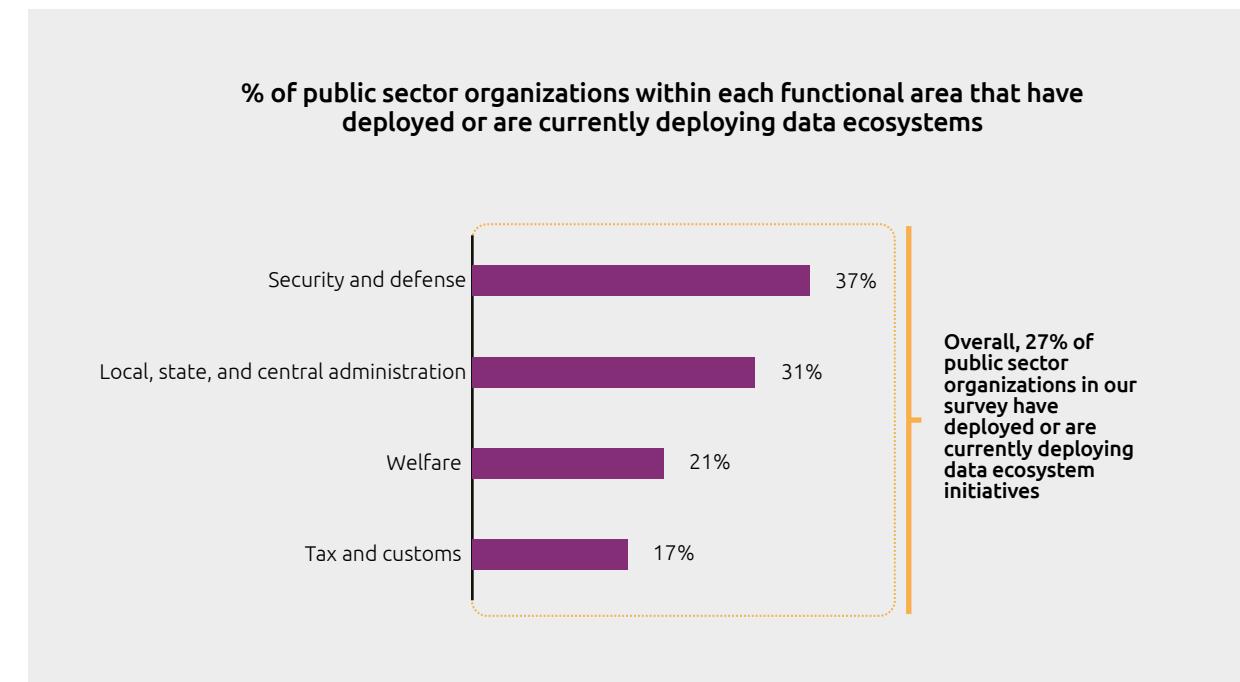
Fig.1

Close to three in ten (27%) public sector organizations have deployed or are currently deploying data ecosystems

Improved citizen experience and operational efficiency are among the key benefits

In addition to estimating the potential benefits that data ecosystems can deliver, we also examined the benefits already realized by the 27% of public sector organizations in our survey that have already deployed or are currently deploying data ecosystem initiatives (broken down into functional areas in Figure 1).

We found that the majority of organizations that have deployed or are currently deploying data ecosystems have experienced a range of benefits, including improved citizen experience, increased operational efficiency, and reduced operational cost (see Figure 2).



Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=1,000 public sector organizations that are working on or planning to work on data ecosystems comprising N=200 security and defense organizations, N=400 local, state, and central administrative organizations, N=200 welfare organizations, and N=200 tax and customs organizations.

Fig.2

Improved citizen experience and increased operational efficiency are among the top benefits delivered by public sector data ecosystems

What benefits has your organization derived from operating or participating in data collaboration and allied ecosystems?

% of organizations that have realized the following benefits



76%

of public sector organizations that have deployed or are deploying data ecosystems say that data ecosystems have helped improve decision-making

Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=274 public sector organizations that have deployed or are deploying data ecosystem initiatives.

Benefits realized by local, state, and central administrative organizations

Local, state, and central administrative organizations that have deployed or are deploying data ecosystems report benefits including an increase in open government (93%),⁷ improved citizen engagement (81%), and an increase in data-driven policymaking (71%) due to data ecosystems. Crucially, data ecosystems are also helping public sector organizations progress towards sustainability. Close to seven in ten (69%) local, state, and central administrative organizations report that data ecosystems have helped improve their sustainability roadmaps (see Figure 3).

The German city of Hamburg has established a data ecosystem to support its goal of improving its citizens' quality of life and driving sustainable development. The data ecosystem is enabled by a data platform called

Urban Data Platform Hamburg (UDP_HH) that links the city's numerous systems and databases using application programming interfaces (APIs). This simplifies access to data, allowing it to feed into decision-making. The platform enables the development of a wide range of services that promote openness and transparency in governance and encourage citizen participation in planning processes, as highlighted in the examples below:

- The Digital Participation System (DIPAS) is an integrated digital system enabled by the data platform to drive citizen participation in urban planning. DIPAS provides citizens with access to digital maps, aerial photos, 3D models, and geodata and enables them to provide feedback on areas including green infrastructure and traffic planning.
- The Cockpit for Social Infrastructure (CoSI) is a GIS-based planning support system that provides urban

planners with data visualization and analytics tools to enable sustainable neighborhood and infrastructure development.

- Connected Urban Twins (CUT) is a joint project between the cities of Hamburg, Munich and Leipzig to develop digital twins that will be accessible to citizens and urban planners and will enable data visualization, forecasting, and simulations to support urban planning and sustainable development.⁸

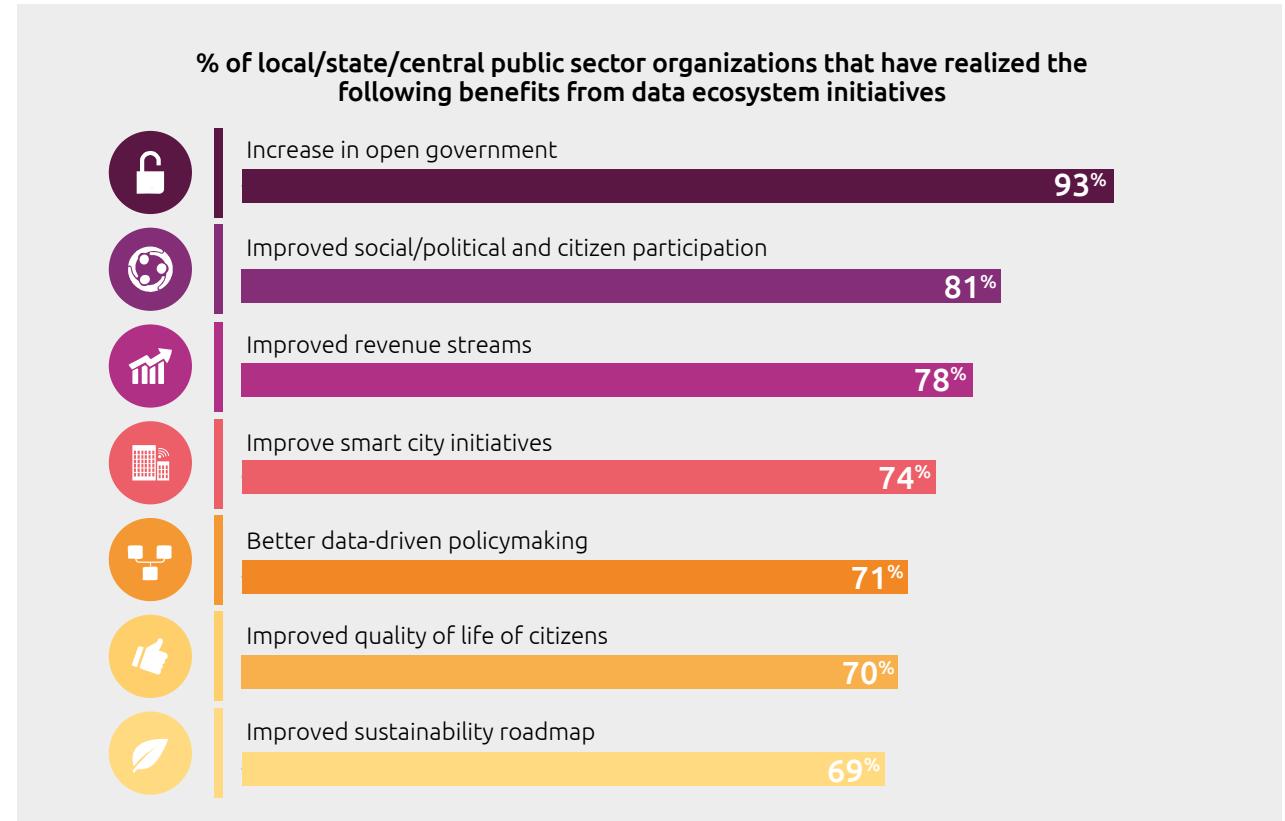


Fig.3

Data ecosystems are driving a range of positive outcomes for local, state, and central administrative organizations

81%

of local, state and central administrations that have deployed or are deploying data ecosystems say that data ecosystems have helped improve citizen engagement



Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=125 local, state, and central administrative functions that have deployed or are deploying data ecosystem initiatives.

Fig.4

Improved compliance and ease of doing business are among the top benefits of data ecosystems for tax and customs departments

Benefits realized by tax and customs departments

Tax and customs departments that have deployed or are deploying data ecosystems report improved compliance levels from citizens and businesses (97%), greater ease of doing business (91%), and an increase in tax contributions (79%), among the benefits realized due to data ecosystems (see Figure 4).

97%

of tax and customs departments that have deployed or are deploying data ecosystems say that data ecosystems have helped improve compliance



Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=33 tax and customs public sector organizations that have deployed or are deploying data ecosystem initiatives.

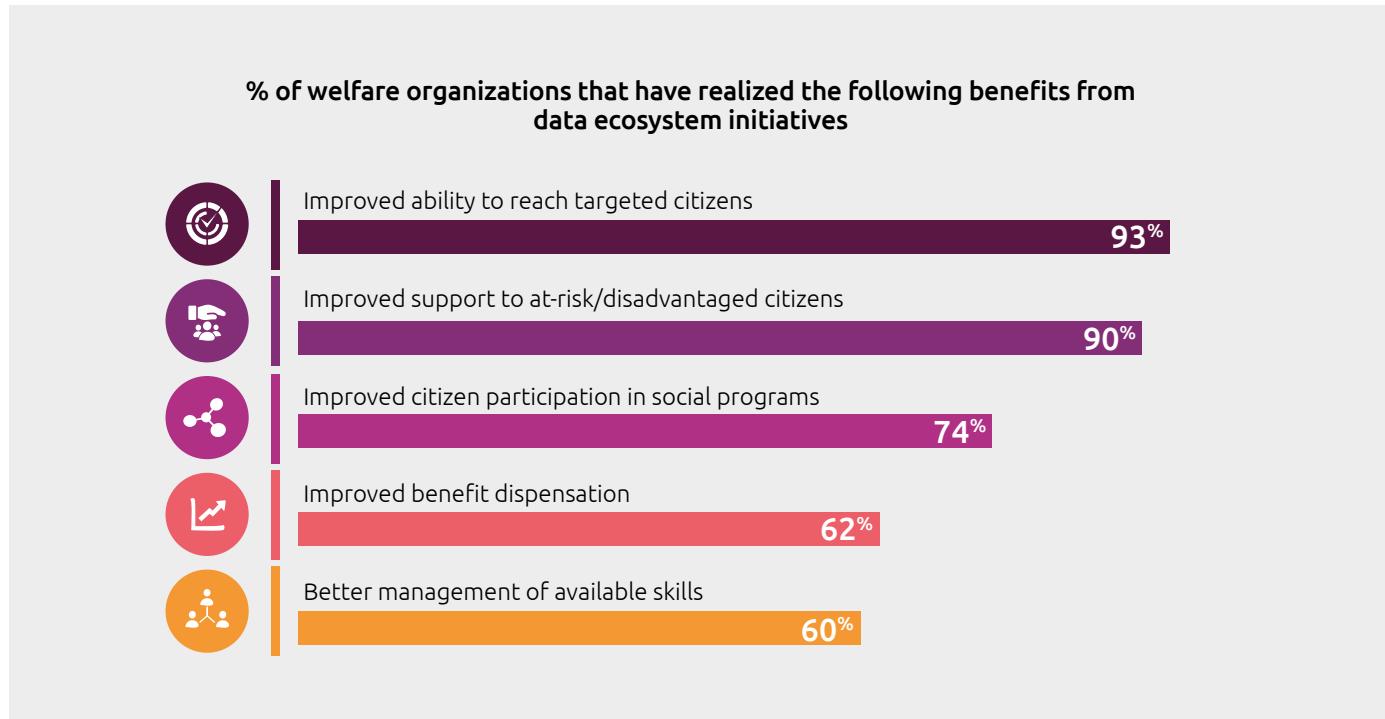
The Estonian Tax and Customs Board and the Finnish Tax Administration are engaging in real-time cross-border data sharing to investigate tax violations and improve service efficiency. Data sharing is enabled by X-Road, a secure, interoperable data exchange platform that facilitates the development of data ecosystems. X-Road was originally developed by the government of Estonia to enable data sharing in the public sector and has now been adopted by several countries, including Finland. X-Road also supports cross-border data exchange by enabling the creation of federated ecosystems, as in the case of the Estonian and Finnish tax administrations.⁹



Fig.5

Data ecosystems are helping welfare departments target beneficiaries of welfare programs more effectively

How does PSO share data?



Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=42 welfare organizations in the public sector that have deployed or are deploying data ecosystem initiatives.

Benefits realized by welfare departments

As Figure 5 shows, data ecosystems are helping welfare departments target beneficiaries of welfare programs more effectively (93%), provide support to at-risk and disadvantaged citizens (90%), and improve citizen participation in social programs (74%).

Cross-department data sharing played a key role in enabling the UK's Department of Work and Pensions (DWP) to provide high-risk patients with welfare support during the COVID-19 pandemic. The DWP also views cross-department data sharing as a key enabler of post-pandemic labor market recovery. The DWP is running a pilot project called Labour Market Data Trust to improve data sharing between four government departments that have access to granular data on labor market developments. These include the DWP, the Department

for Education (DfE), the Department for Business, Energy and Industrial Strategy (BEIS), and His Majesty's Revenue and Customs (HMRC). The pilot aims to connect labor market data that resides in silos across government departments in order to improve citizen outcomes and drive informed policymaking.¹⁰

Benefits for security and defense departments

The vast majority of security and defense organizations that have deployed or are deploying data ecosystems cite improved resilience to cyberthreats (78%), increased citizen satisfaction (74%), and improved decision-making (73%) as benefits realized from data ecosystems. Figure 6 highlights the benefits that police departments (a subset of the security and defense organizations in our survey) have realized from data ecosystems – 97% say they have helped improve public safety, 84% cite better juridical implementation, and 79% say they have improved response times. The examples below illustrate how data ecosystems are helping police departments and other security and defense departments meet their goals:

- Fulton County, Georgia in the US has adopted a data sharing platform that connects criminal justice agencies, courts, and behavioral health systems. The platform helps judges and police departments gain a deeper understanding of detained individuals and lower incarceration rates. For instance, insights enabled by the platform showed that many individuals with a history of repeated arrests were homeless and had mental illnesses and/or substance abuse issues. This information helps police officers direct detainees to appropriate healthcare facilities. Mike Rowicki, Director of Strategic Planning and Performance Management, Fulton County, Georgia, comments, *"The data insights we have help us find alternatives for people so they're getting the treatment they need instead of cycling through the criminal justice system."*¹¹
- Seoul, the South Korean capital, has implemented a data ecosystem that is enabling innovative public services in areas including traffic management, public safety, environmental protection, and welfare services. One of these is a public safety service called Ansimi – operated via an app that links 40,000 CCTV cameras

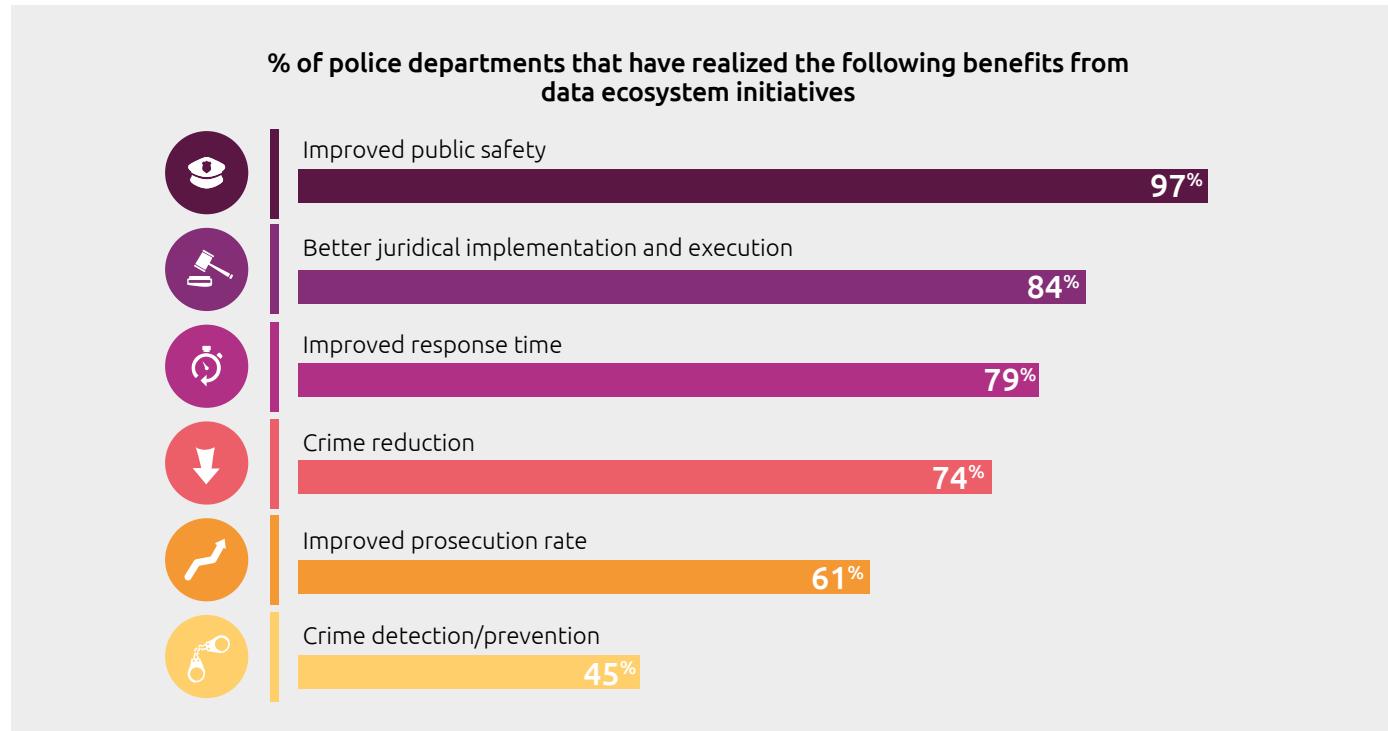
across the city for real-time monitoring and rescue support. The app lets citizens share location data as well as real-time smartphone footage with police officers if they feel unsafe. Police officers can use this data along with surveillance camera feeds, to respond swiftly in cases of emergency.¹²

93%

of welfare departments that have deployed or are deploying data ecosystems say that data ecosystems have helped them target beneficiaries of welfare programs more effectively

Fig.6

Police departments report improvements in public safety and response times among benefits realized from data ecosystems



Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=38 police departments that have deployed or are deploying data ecosystem initiatives.

Data ecosystems have the potential to deliver significant value for public sector organizations by enabling them to make data-driven decisions, improve operational efficiency, and provide better services to citizens. Public sector organizations that have deployed or are deploying data ecosystems are already reaping benefits. However, current deployment levels are low as indicated by our survey. We explore the reasons for this in the next section.

97%

of police departments that have deployed or are deploying data ecosystems say that data ecosystems have helped improve public safety

02

**THREE-QUARTERS OF
PUBLIC SECTOR
ORGANIZATIONS ARE
MISSING OUT ON THE
DATA COLLABORATION
OPPORTUNITY**

41%

of public sector organizations who have or are deploying data ecosystems say that the benefits of data ecosystems have exceeded expectations

As seen in the previous section, data ecosystems are delivering clear benefits for public sector organizations. Further, for 41% of organizations who have or are deploying such ecosystems, benefits have exceeded expectations. However, most public sector organizations are still missing out on the opportunities that data ecosystems help unlock, as they are yet to progress beyond the planning and pilot stages of deployment. As Figure 7 shows, while 27% of organizations are rolling out data ecosystems initiatives or have fully deployed them, close to three-quarters (73%) are still at the planning or pilot stages.

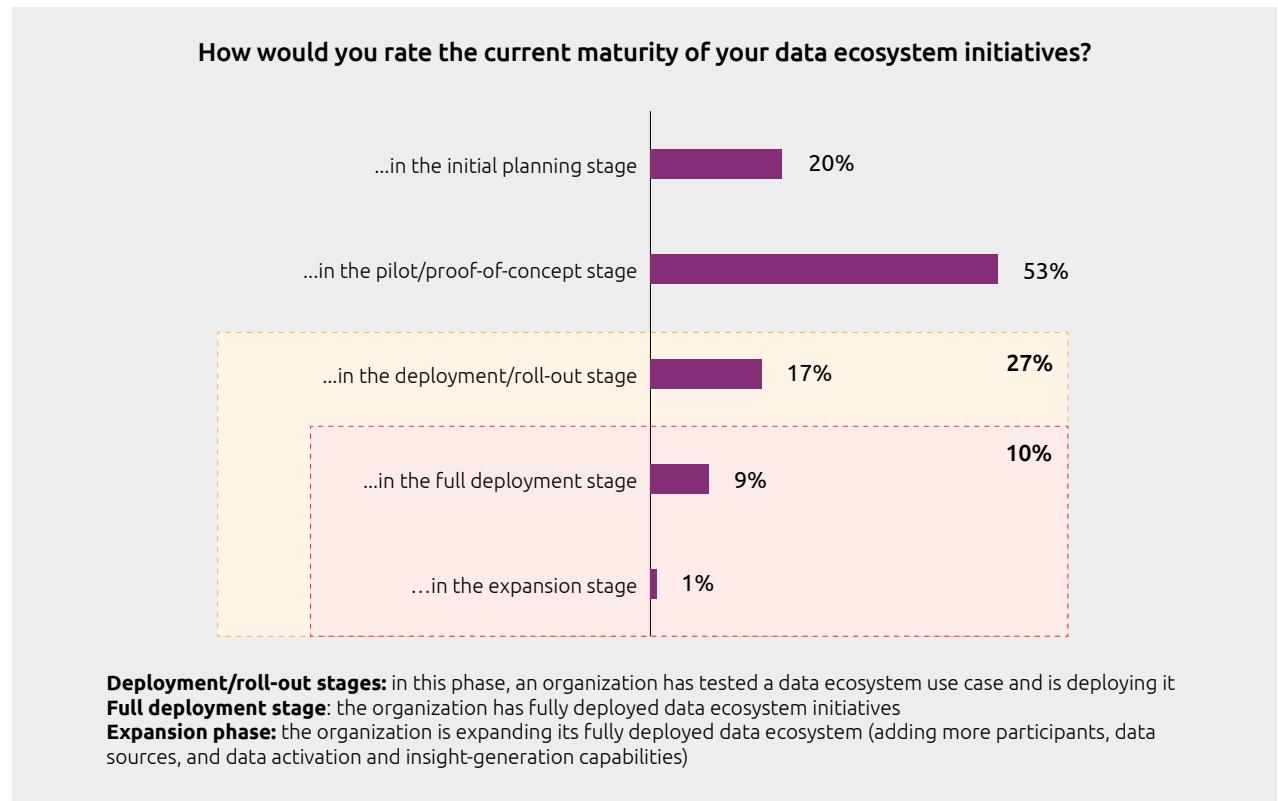


Fig.7

Most public sector organizations are yet to fully deploy data ecosystem initiatives

80%

of public sector organizations have started implementing data ecosystem initiatives

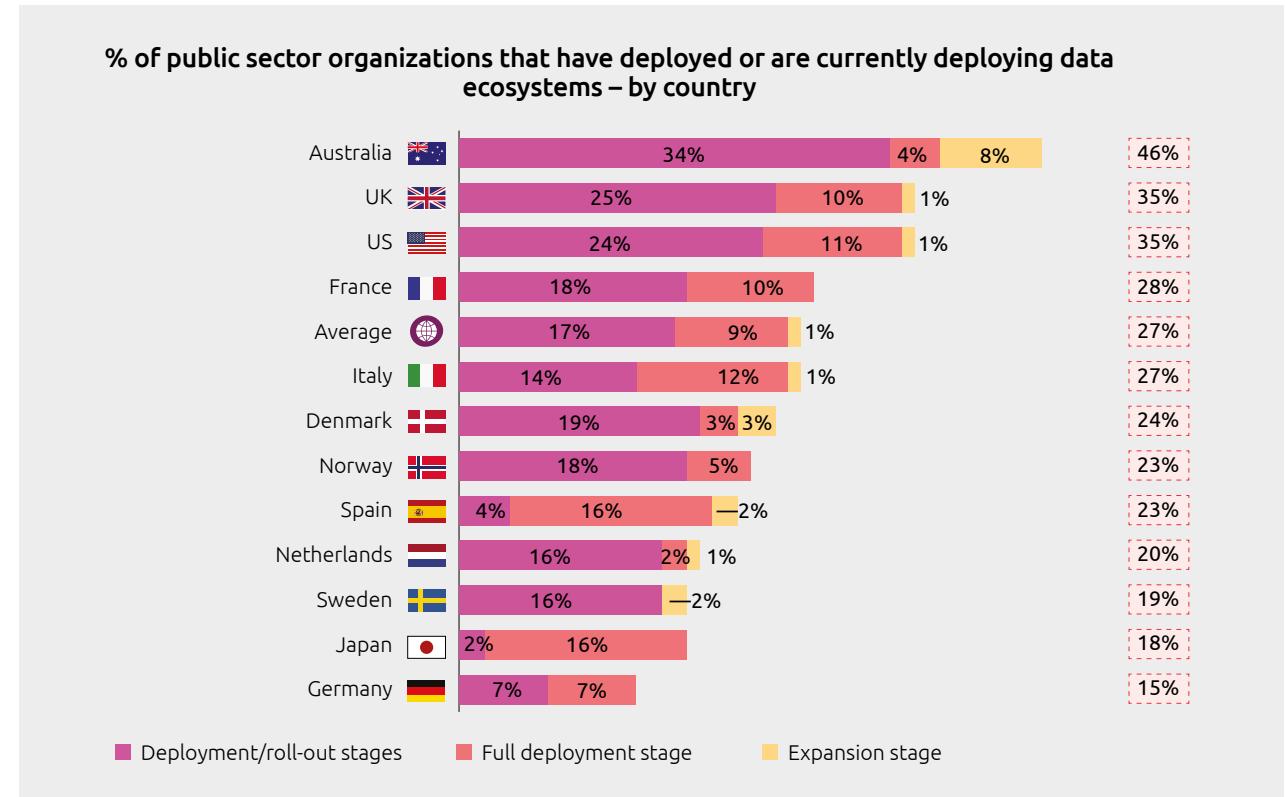


Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=1,000 public sector organizations that are working on or planning to work on data ecosystems.

Fig.8

Public sector organizations in Australia lead in the deployment of data ecosystem initiatives

Survey responses by country show that Australia leads in the deployment of data ecosystems in the public sector, with 46% of organizations reporting that they have either deployed or are currently deploying them. The US, UK, and France follow, with Japan and Germany lagging. Only 18% of public sector respondents in Japan and 14% in Germany say their organizations have deployed data ecosystems or are currently rolling them out (see Figure 8).



Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=1,000 public sector organizations that are working on or planning to work on data ecosystems.

Fig.9

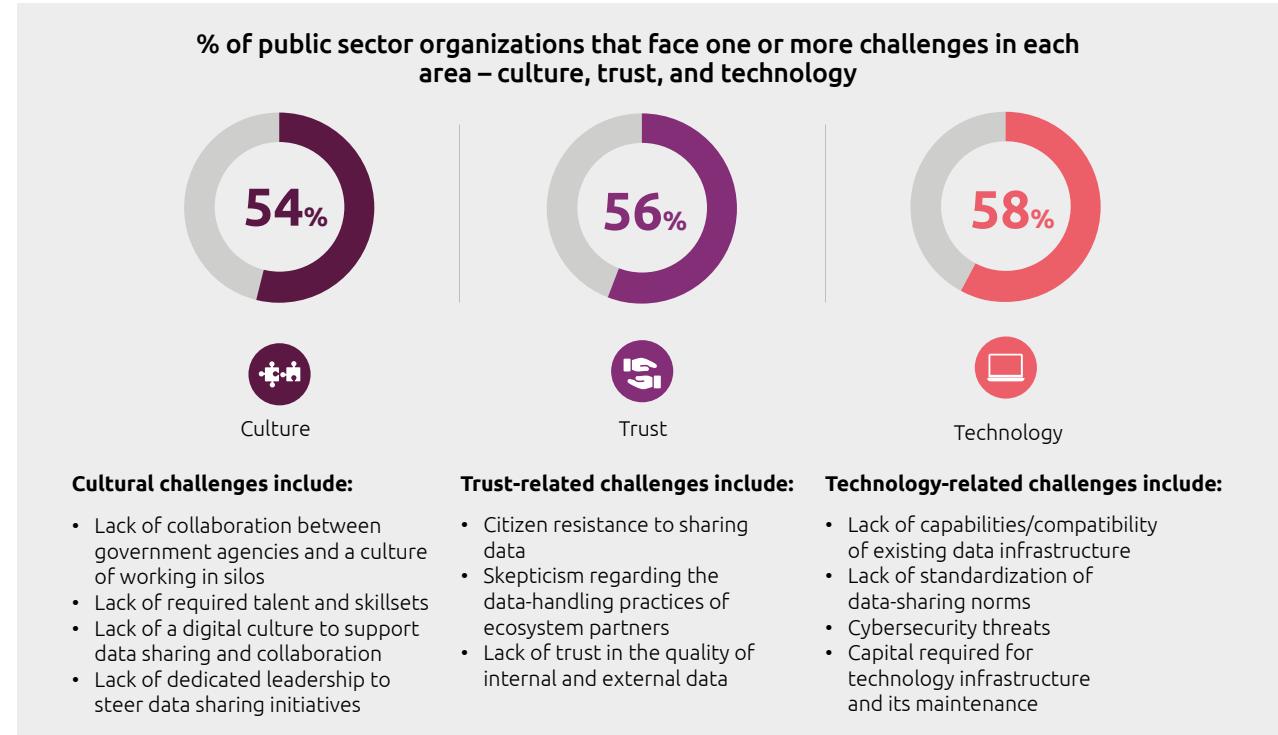
Challenges that are holding back large-scale deployment of data ecosystems

Barriers related to culture, trust, and technology are holding back wider deployments of public sector data ecosystems

Public sector organizations face challenges related to culture, trust, and technology when deploying data ecosystems. More than half (54%) of respondents in our survey cite one or more challenges related to culture as barriers to scaling data ecosystem initiatives; 56% cite one or more challenges related to trust, and 58% to technology (see Figure 9).

Cultural barriers are holding back wider adoption of data ecosystems

The adoption of data ecosystems requires a shift towards a collaborative mindset and an organizational culture



Capgemini Research Institute, Survey: Data ecosystems in the public Sector, June 2022, N=1,000 public sector organizations that are working on or planning to work on data ecosystems.

(incorporating skills, processes, tools, and governance structures) that supports data sharing and data-driven decision making. Our research indicates that many public sector organizations lack these attributes. As Figure 9 shows, more than half (54%) of public sector organizations report facing one or more challenges related to culture, such as a lack of collaboration between government agencies, lack of talent and skillsets, lack of a digital culture to support data sharing and collaboration, and a lack of dedicated leadership to steer data sharing initiatives. Further, our discussions with experts revealed that unclear stakeholder governance within data ecosystems results in conflicts and acts as a disincentive to adoption.

Moreover, data needs to be “activated” – i.e., infused into core processes – to allow fact-based and data-driven policy-development and operations. However, just over half (53%) of organizations say they have adequate competencies in data activation.

Meghan Mariman, Data Division Chief, Office of the Chief Information Officer, US Army, comments:

“Public sector organizations will need to learn and grow to be as flexible and adaptable as possible. This requires being open to new technology and new ways of thinking, and new work cultures.”

Barriers related to trust are impeding progress on data ecosystems

Trust is vital in data sharing and lack of trust is undermining the adoption of data ecosystems. As Figure 9 shows, 56% of public sector organizations report facing one or more challenges related to trust. These include citizen resistance to sharing data, skepticism regarding the data-handling practices of ecosystem partners, and lack of trust in the quality of internal and external data.

Accelerating the deployment of data ecosystems will require addressing trust barriers at multiple levels. Public sector organizations will need to operationalize trust within data ecosystems through governance (defining clear guidelines governing data sharing) as well as technology interventions (using privacy preserving technologies). However, our research suggests that many

public sector organizations lack the data management capabilities to do this. For instance, only 44% say they have adequate competencies in defining data principles – i.e., standards and policies that promote public trust in data sharing. Data principles include aspects such as access policies for all participants in a data ecosystem, data security and privacy by design, and federated data governance (to avoid the need for pooling data in a centralized location).

Eileen O’Dea, Ecosystems Architect at the European Food Safety Authority (EFSA), confirms the significance of trust: *“Building a collaborative environment with our partners and stakeholders, in which they are comfortable and trustful to share information, enables that body of data to be more readily and quickly available.”*

Christina Schmidt-Holtmann, head of the unit for data availability, digital sovereignty and SPRIND – the Federal Agency for Disruptive Innovation in Germany – comments: *“You need to work on trust and transparency from the very beginning of a data ecosystem. This becomes more important especially in the case of personal data.”*

“Building a collaborative environment with our partners and stakeholders, in which they are comfortable and trustful to share information, enables that body of data to be more readily and quickly available.”



Eileen O'Dea

Ecosystems Architect
at the European Food
Safety Authority (EFSA)

Progress on data ecosystems is also held back by technology challenges

In addition to barriers related to trust and culture, public sector organizations also face technological challenges in the deployment of data ecosystems. Close to six in ten (58%) say they face one or more technology challenges in the deployment of data ecosystems (see Figure 9).

These include lack of capabilities/compatibility of existing data infrastructure, lack of standardization of data-sharing norms, cybersecurity threats, and lack of the capital required for technology infrastructure and its maintenance. Ecosystems Architect at the European Food Safety Authority (EFSA)

Figure 10 highlights key gaps in technology competencies that public sector organizations will need to address to deploy data ecosystems at scale. For instance, only

39% of public sector organizations have the ability to identify and collect multiple types of data, automate data collection, establish full visibility of their data inventory, and maintain up-to-date data catalogs. Further, only 50% have the ability to modernize their data and AI platforms to support cloud-based, scalable data management architectures.

Paulo Saraiva, Managing Director of Data Collection and Management at INE – Statistics Portugal, comments:

"Using data to make decisions has now become a matter of survival and cannot be dealt with using spreadsheets. Public sector organizations need to go further in terms of infrastructure, towards integrating and participating in data ecosystems."

Gyu Myoung Lee from Liverpool John Moores University, UK, as an expert for International Telecommunication Union (ITU) standardization, comments:

"When building a data ecosystem, public sector organizations should fully consider the entire lifecycle of data from identification and collection to the extraction of insights to enable actions."

As we found in our research, a large share of public sector organizations is missing out on the opportunity to leverage data ecosystems to drive value. In order to effectively collaborate on data and unlock its full potential, public sector organizations must first address the challenges that hinder data sharing. We propose ways to do this in the following section.

"When building a data ecosystem, public sector organizations should fully consider the entire lifecycle of data from identification and collection to the extraction of insights to enable actions."



Gyu Myoung Lee

Liverpool John Moores University, UK, as an expert for International Telecommunication Union (ITU) standardization

Fig.10

Many public sector organizations lack the technology infrastructure required to support data ecosystems at scale

% of public sector organizations that have mature competencies in the following areas

Identify and collect data

The ability to capture structured, semi-structured, and unstructured data; develop a 360-degree view of all data inventory; maintain updated data catalogs; and implement automated data collection

Store and process data

The ability to analyze data dynamically; combine multiple types of data for analysis; store, retrieve, and analyze data at all levels; and cleanse data quickly and efficiently

Modernize data and AI platform

The ability to offer a cloud-based environment, scalable systems, services-based data-management architecture, continuous integration/continuous development, API-led architecture, and self-service analytics

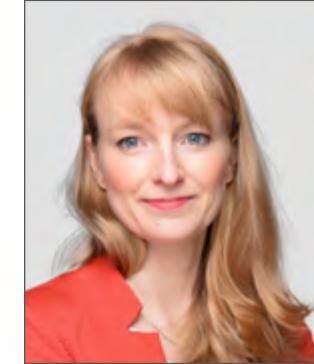
39%

52%

50%

Source: Capgemini Research Institute, Survey: Data ecosystems in the public sector, June 2022, N=1,000 public sector organizations that are working on or planning to work on data ecosystems.

"You need to work on trust and transparency from the very beginning of a data ecosystem. This becomes more important especially in the case of personal data."



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Schmidt-Holtmann**

Head of the unit for data availability, digital sovereignty and SPRIND – the Federal Agency for Disruptive Innovation in Germany

03

THE PUBLIC SECTOR'S PATH TO MATURE DATA ECOSYSTEMS

Fig.11

Four key actions in the journey to mature data ecosystems

Building mature data sharing ecosystems is a long-term journey. We recommend four key actions that public sector organizations need to take in order to develop mature data ecosystems (see Figure 11).



Source: Capgemini Research Institute analysis.

Identify the use cases, data sources, and participants necessary for an ecosystem

To begin with, public sector organizations must clarify the purpose of developing a data ecosystem in order to identify use cases that are aligned with their mission. For instance, the European Commission, as part its Digital

Europe Programme, plans to create common European data spaces in a range of areas, with the core objective of accelerating the EU's digital transformation. In line with this objective, the commission has launched DS4Skills – a project focused on developing a data space for education and skills. Access to skills data is crucial to identifying the EU's emerging skilling needs, framing policies to address skill gaps, and matching job seekers with employers. All of this is currently made difficult by the fragmentation of skills data – a challenge that DS4Skills aims to address.¹³



"For the public sector, starting with an outside-in perspective is necessary to fully understand what is important for our citizens. This perspective, really common in other businesses, is needed in the public sector in order to design our services in the best way possible, and that becomes the first step in defining the purpose of the data ecosystem."



Patrik Sundström

Chief Digital Officer of Sweden's Municipalities and Regions

Patrik Sundström, Chief Digital Officer of Sweden's Municipalities and Regions, says, *"For the public sector, starting with an outside-in perspective is necessary to fully understand what is important for our citizens. This perspective, really common in other businesses, is needed in the public sector in order to design our services in the best way possible, and that becomes the first step in defining the purpose of the data ecosystem."*

Having identified the right use cases, public sector organizations will need to identify the internal and external data sources that will be needed to bring the use cases to life. In the case of the DS4Skills initiative, this includes data on skills, educational profiles, and job and training offers residing in siloes across educational institutions, private training providers, employers, EdTech companies, job boards, and social networks. The DS4Skills initiative aims to bring together these diverse

data sources to drive innovation through a common data sharing network.¹⁴

When identifying data sources, public sector organizations should also bear in mind the role of citizen-generated data. In the healthcare sector, for instance, citizen-generated data – such as data from smartphone sensors or wearable devices – can be a valuable source of insight on disease monitoring and treatment.

It is also crucial to prioritize the quality of data sources. Singapore, for instance, is investing in frameworks and platforms to facilitate data sharing across industries in order to drive innovation using AI. In this context, Josephine Teo, Minister for Communications and Information, Singapore, comments on the importance of high-quality data sets: *"It is equally, if not more important to gather good quality data from diverse sources. A smaller,*

but richer data set can often produce better AI models than a larger, narrower one."¹⁵

Public sector organizations will also need to determine who the participants in the data ecosystem should be, how the ecosystem can offer value to all participants, and how to incentivize ecosystem partners to share data. Other key decisions include:

- What are the service level agreements (SLAs)? What happens if SLAs are not fulfilled?
- What scope of use and related liability is borne by each party for use of the data ecosystem?

Develop infrastructure for interoperability and data collaboration

The use cases identified in the preceding step will require infrastructural and governance support to scale and deliver the expected results. A robust digital infrastructure for data sharing comprises three key building blocks:

1. Data exchange platforms
2. Decentralized data management architectures (such as data mesh)
3. A cloud-based foundation



Data exchange platforms

Data exchange platforms such as Snowflake, Dawex, Harbr, Azure Data Share, and AWS Data Exchange provide a range of capabilities that are key to enabling secure and trusted data sharing among multiple participants within a data ecosystem. These include simplified access to multiple data sets using APIs, data protection and compliance management, user access management, management of data licensing requirements, and data quality management, among others. Data exchange platforms allow ecosystem participants to extract value from disparate data sources within a secure, privacy-controlled environment that allows data owners to retain full control of their data sets. They are, therefore, key to building trusted data partnerships.

Josh Sattler, former General Manager for Innovation, Growth & Development Services for the City of Darwin, Australia, comments on the benefits of data exchange

platforms, based on the City of Darwin's experience of using such a platform: *"An ability to include external organizations into the platform in a controlled ecosystem where every organization has full control of its data enables outcomes across the board."*¹⁶ He adds, *"An "ecosystem approach" means we can all work together bringing our unique data sets as well as our diverse skills and capabilities and perspectives to provide solutions."*¹⁷

Decentralized data management architectures

Decentralized data management architectures such as data mesh have a critical role to play in the development of data ecosystems. Unlike centralized data architectures, such as data lakes, where data is owned by a central team, a data mesh architecture decentralizes the ownership of data by allocating data ownership to data "domains" – groups of data owners organized around a common

purpose. As a result, data mesh architectures enable data ecosystem participants to engage in data partnerships around specific, shared objectives. At the same time, the federated nature of data mesh architectures allows for data governance policies to be defined and managed centrally. In the context of data ecosystems, this ensures that security and compliance in the ecosystem is managed according to a common set of standards and policies.

Alberto Palomo, Chief Data Officer, Government of Spain, highlights the importance of "liquid" data models (models that facilitate data exchange) – and the need for federated architectures to enable them: *"The goal is to create federated data ecosystems. There is no way to consolidate all data; so developing nodes that require as little central governance as possible is our main approach. We think of this new model as a liquid data ecosystem with federated nodes."*

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Alberto Palomo

Chief Data Officer,
Government of Spain

Cloud-based foundation

The transition from traditional on-premise data warehouses to a cloud-based environment is key to ensuring that data ecosystems can scale – facilitating easier integration with external data sources and enabling compute resources to be increased on demand.

Our previous research, based on a survey conducted in May–June 2021, showed that sovereignty – i.e., the need for data to be subject to the laws of the country/region in which it is collected or processed – is gaining priority in the formulation of cloud strategies. Nearly half (48%) of public sector organizations in the survey were either already considering cloud sovereignty as a part of their cloud strategy or planning to include it in the next 12 months. The research also showed that organizations expect cloud sovereignty to contribute to building trust,

foster collaboration, and accelerate the shift to a data-sharing ecosystem by providing a trusted and secure cloud environment for data, and better opportunities for collaboration across sectors.¹⁸

The Gaia-X initiative in Europe, for instance, aims to develop a European cloud infrastructure based on the principles of cloud sovereignty.¹⁹ The initiative is piloting seven lighthouse projects to develop data exchange platforms that are built on the principles of transparency, trust, and openness. One of these is the Agdatahub project to build a data ecosystem for the agricultural sector. The project uses the Dawex data exchange platform to facilitate the sharing of agricultural data among multiple stakeholders in the agri-food chain in order to drive sustainability and stimulate innovation.²⁰



Establish trust across the full spectrum of data sharing practices, from governance and organizational setups to technology

As discussed previously, trust-related challenges are holding back large-scale implementation of data ecosystem initiatives. Establishing trust should, therefore, be a core focus of data ecosystem implementation.

To ensure that data ecosystems are built on a strong foundation of trust, public sector organizations should focus on two key areas of action:

1. Building governance mechanisms that drive transparency and accountability
2. Harnessing advancements in privacy preserving technologies

We explore each of these areas below.

Building governance mechanisms that drive transparency and accountability

Strong governance mechanisms that drive transparency and accountability are key to establishing trust in data ecosystems. Measures to build such mechanisms should be developed by a predefined governing body and include:

Defining a charter for responsible data sharing within the ecosystem. As a first step, public sector organizations must develop a well-defined charter for responsible data sharing within the ecosystem. The charter should build a shared understanding of data protection challenges, the measures necessary to protect data privacy and security, and the roles and

responsibilities of all ecosystem participants.

Crucially, the charter should be developed collaboratively with ecosystem participants, with all having the opportunity to voice concerns and suggest areas for development. As the ecosystem matures, the charter should be reviewed and adapted to reflect evolving conditions. Emphasizing the need for a collaborative approach, Sérgio Guerreiro, Senior Director, Turismo de Portugal, Portugal's national tourism authority, says: *"Ecosystems are based on trust. You have to find ways of taking your stakeholders with you and explaining where you want to go in terms of developing the ecosystem."*

"Ecosystems are based on trust. You have to find ways of taking your stakeholders with you and explaining where you want to go in terms of developing the ecosystem."



Sérgio Guerreiro

Senior Director,
Turismo de Portugal,
Portugal's national
tourism authority

Key elements that the charter should cover include:

- The scope and objectives of data sharing
- Regulatory requirements governing data sharing
- Guidelines for responsible collection, storage, use, and disposal of sensitive data
- Roles and responsibilities of ecosystem participants
- Audit processes to ensure that guidelines are followed

- **Proactively addressing citizens' concerns on data privacy.** Research on public attitudes towards data sharing in the UK indicates that, in general, people are comfortable with their personal data being used when the societal benefit of doing so is clear. For instance, 81% of respondents in a survey reported being comfortable with providing personal data about themselves to the National Health Service (NHS) to assist in the development of new healthcare treatments. However, respondents also reported

concerns related to data security and privacy.²¹

To gain the trust of citizens, public sector organizations must do more to communicate the benefits of sharing data. About one-third (34%) of public sector organizations in our survey say they are unable to effectively communicate the benefits of sharing data to citizens. In addition, public sector organizations should implement strong data governance mechanisms to protect data privacy and communicate these measures widely.

In more detail, such trust-building should include:

- Developing a code of conduct around ethical use of citizen data that clearly sets out the ethical standards to be followed; less than half (47%) of public sector organizations say they have set up a code of conduct for the ethical use of citizen data.

- Educating citizens about how their data is used and protected – in 2018, for instance, the NHS launched a public campaign to raise awareness around its use of patient information, the measures taken to store data safely, and the choices that citizens had regarding the use of their data.²² Such measures are crucial to reassuring citizens regarding the use of personal data.
- Creating grievance-redressal mechanisms applicable to all participant organizations, public and private, with clear timelines for addressing concerns from citizens; also, establishing the post of data ombudsman.
- Raising employee awareness regarding non-ethical uses of citizen data and training employees working with citizen data to handle data responsibly.

Harnessing advancements in privacy preserving technologies

Technology is a key enabler of trust in data ecosystems. Privacy enhancing technologies (PETs) such as differential privacy, federated learning, and homomorphic encryption offer new and improved pathways towards safeguarding data privacy:

- **Differential privacy** is a technique that introduces statistical noise when performing a data analysis on a dataset to mask identifiable characteristics of individuals within that dataset. Noise is introduced in a calibrated manner, so that it does not materially impact the accuracy of insights. As such, it allows for data to be analyzed meaningfully without compromising the privacy of personal information. The United States Census Bureau is using differential privacy techniques to protect personal information in census data.²³ Differential privacy also facilitates data sharing between the US Internal Revenue Service (IRS) and the US Department of Education (DoE) to develop College Scorecard, an online platform intended to allow citizens to compare the cost and value of higher education institutions in the US.²⁴

Marco Gaboardi, co-founder and Chief Scientist of DPella, a startup working in the area of data privacy, comments: *"Today, there are a lot of factors that can identify individuals, such as the ID of a wearable device, an IP address, or other personal attributes. Differential privacy plays a vital role in protecting privacy while maintaining statistical accuracy."*

- **Federated learning** is a decentralized approach to developing machine learning models that allows AI algorithms to be trained using data that is stored locally in multiple, distributed sources. As a result, data does not need to be pooled in a centralized location, which helps protect the privacy of sensitive data. Singapore's national AI research and development program, AI Singapore, is developing an open-source platform for federated learning called Synergos, to enable secure sharing of data among multiple stakeholders while ensuring data privacy.²⁵

Federated learning was also implemented by three Spanish hospitals in a collaborative initiative aimed at increasing the speed and accuracy of COVID-19 screening. Dr. Javier Blázquez, Head of the Radiology

Department at Hospital Ramón y Cajal, one of the participating hospitals, says: *"Federated learning allows us to improve our diagnostic reliability without disrupting data privacy; since the experience of a hospital is shared among several others, the results improve a lot with respect to those obtained separately."²⁶*

- **Homomorphic encryption** is a technique that allows mathematical computations to be performed on encrypted data without first decrypting it. The results of the computations remain encrypted and can only be decrypted with the correct decryption key. As such, homomorphic encryption can enable organizations to share sensitive data for processing and analytics, without revealing the original data. The EU-funded project My Health – My Data (MHMD), demonstrates the impact of PETs such as homomorphic encryption in facilitating the sharing of sensitive health data, while maintaining data privacy and security – in turn, paving the way for the development of an innovative healthcare data ecosystem in Europe.²⁷

“Today, there are a lot of factors that can identify individuals, such as the ID of a wearable device, an IP address, or other personal attributes. Differential privacy plays a vital role in protecting privacy while maintaining statistical accuracy.”



Marco Gaboardi

Co-founder and CTO
of DPella – a data
privacy startup

PETs allow organizations to balance the benefits of data sharing with the need to safeguard data privacy. Public sector organizations are increasingly exploring applications of PETs, as illustrated by the examples below:

- The UN has launched the UN PET Lab to facilitate secure, cross-border data sharing. The lab's first use case is a pilot program involving four National Statistical Offices (NSOs) – the US Census Bureau, Statistics Netherlands, the Italian National Institute of Statistics, and the UK's Office for National Statistics. It intends to demonstrate how PETs can enable fully compliant data sharing. Bert Kroese, Deputy Director-General and CIO of Statistics Netherlands, comments: *"The pandemic has shown how important it is that governments have access to reliable data to make informed policy decisions. National Statistical Offices have the obligation and a long history in protecting privacy while enabling access to useful insight. PETs are promising ways to provide additional privacy protection while still allowing useful and important analyses on new data sources."*²⁸
- The government of Estonia plans to use PETs to facilitate the sharing of sensitive datasets among public sector agencies. Ott Velsberg, Estonia's Chief Digital Officer, says: *"We need to respect different spheres of privacy, but at the same time we want to make maximum use of data."*²⁹
- Singapore has set up the Digital Trust Centre to drive R&D in PETs. In addition, Singapore's media and communications regulator, the Infocomm Media Development Authority (IMDA), and its data regulator, the Personal Data Protection Commission (PDPC), have launched a PET sandbox – an experimental environment to help businesses innovate with PETs while protecting consumer data. PDPC Deputy Commissioner Yeong Zee Kin, says, *"PETs can support the essential elements of a digital economy – namely, the seamless transfer of data and the use of data to support innovation."*³⁰
- The UK and US governments have jointly launched a £1.3 million prize to encourage innovation around the use of PETs to combat global societal challenges.³¹

Develop skills and capabilities for a data-driven culture

The success of data ecosystem initiatives hinges on the availability of the right skillsets and the presence of a data-driven culture within an organization. Public sector organizations will need to design a holistic skilling program to equip employees with core data and AI skills, as well as skills related to managing data privacy. Only 55% of organizations in our survey say they have trained employees on the ethical use of citizen data, suggesting that a significant proportion are yet to act on such a critical area.

To develop a data-driven culture, public sector organizations need to ensure that data is viewed as an asset by all employees, rather than the sole remit of the IT or data team. Organizations must also communicate the critical role of data sharing in addressing current environmental and societal challenges. In addition, organizations should incentivize employees to collaborate using data, while clarifying the rules around responsible data sharing. Dr. Kion Ahadi, Director of

Strategy, Futures and Insight at the Law Society, UK, stresses the need for a culture shift in public sector organizations to drive data sharing: *"There's a culture shift that needs to happen – moving away from being risk averse, having clear examples of the benefits of collaboration and the advantages for the efficiency of public services."*

Other actions that can foster a data-driven culture and data capabilities include:

- **Using sandboxes.** To promote experimentation with data and AI, public sector organizations should consider setting up sandboxes. The US Patent and Trademark Office, for instance, is using a cloud-based sandbox environment developed by Google – called RAD Lab – to enable its technical specialists and business experts to test and develop solutions using technologies such as AI and machine learning. The sandbox provides a secure and privacy compliant environment (the solution complies with regulations such as HIPAA and GDPR), as well as simplified processes and tools to help employees experiment with new technologies.³²

To enable effective use of sandboxes, they must have access to datasets that they can safely experiment with. Using real data can pose challenges such as cost and privacy constraints. Synthetic data – i.e., artificial data generated by anonymizing real-world data using algorithms – can be an effective alternative to real data, facilitating experimentation while protecting data privacy.

- **Setting up innovation labs.** Innovation labs can help build data capabilities and a collaborative mindset within public sector organizations by bringing in external expertise from startups, universities, and other external entities. In the UK, the Department of Work and Pensions (DWP) has set up an innovation lab to tap into the expertise of a diverse ecosystem of partners, startups, and other government organizations. An area of focus for the lab is its work on “synthetic data”.³³

However, while innovation labs can help organizations bring in external expertise to co-create solutions, they run the risk of operating in a silo, disconnected from

the rest of the organization, leading to inefficient dissemination of learnings. For innovation labs to facilitate a true culture and mindset shift, public sector organizations will need to consciously work towards scaling the lab’s way of working. For instance, LabX, a government innovation lab in Portugal set up to drive the modernization of public administrative services, is providing training and mentorship to replicate its approach towards innovation across all levels of government. LabX is mentoring teams from the municipalities of Lisbon, Coimbra, Loulé, and Valongo, as well as the tourism and police departments within the central government. It is also extending its reach internationally by training a team from Brazil. Jorge Lagarto, Director at LabX, highlights the effectiveness of this approach: *“We understand that we need to spread this way of working[ing].”* He adds, *“Five years ago, when we were created, no one knew what co-creation meant. Now, it’s widely used by everyone in the public sector.”*³⁴

- **Organizing hackathons.** Hackathons can help public sector organizations access external expertise to solve

problems, as illustrated by the following examples:

- Eurostat, the statistical office of the EU, hosts a biannual European Big Data Hackathon. In 2021, the hackathon brought together 22 teams from across Europe to build algorithms and suggest solutions to a defined problem, using datasets provided by Eurostat.³⁵
- Germany’s Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection brought together teams from across Europe to take part in Code4Green 2.0 – an environmental data hackathon with the aim of finding solutions to ecological challenges such as mitigating climate change and protecting biodiversity, using digital tools and data. The teams worked with environmental datasets to build prototypes of solutions applicable across Europe.³⁶

Hackathons can also be used as opportunities to familiarize internal teams with data and analytics. The Data Arcade Tournament, for example, is an annual visual analytics competition organized by the Data Science and

Artificial Intelligence Division (DSAID) of the Government Technology Agency of Singapore (GovTech). The tournament aims to familiarize public sector officials with data analytics and visualization using tools such as Qlik Sense and Tableau, and to encourage them to apply data science to their daily work.³⁷

- **Setting up data academies.** Public sector organizations should also set up data academies – specifically, training programs geared towards upskilling employees on data and AI. The Government Technology Agency of Singapore has launched the Digital Academy upskilling program to equip public sector officials with the skills needed to accelerate the public sector's digital transformation. The academy offers a suite of training programs, including a program on applying data science techniques to improve policymaking and operations, and building AI products and platforms for the public sector. The program covers a range of topics, including data engineering, data storytelling, data visualization, machine learning, and data privacy and ethics. The academy developed the curriculum in partnership with organizations

such as Amazon Web Services, Coursera, Google, and Microsoft.³⁸

- **Collaborating with universities.** Close collaboration with universities can allow organizations to gain proximity to emerging cutting-edge techniques in data science, learn about new working methods and approaches, and, potentially, tap into a stream of academic data science talent. Scott Heald, Director, Data and Digital Innovation at Public Health Scotland, says, *"We have strong relationships with the main universities in Scotland. It is really important that we look into how we might do things differently. New graduates tend to come in with the most up-to-date skills and techniques."*
- **Appointing a chief data officer.** The setting up of a central data office and the appointment of a chief data officer (CDO) are crucial steps in developing a data-driven culture and strengthening data governance within public sector organizations. This is especially important in relation to working with external data sets, as well as making more internal data available

externally, via data ecosystems.

Acknowledging the importance of the role of CDOs in the public sector, the US government has established the position of CDO within all government agencies and set up a Federal CDO Council, as part of the Foundations for Evidence-Based Policymaking Act of 2018, in order to establish government-wide best practices for the management, use, protection, dissemination, and generation of data.³⁹

Patrik Sundström, Chief Digital Officer of Sweden's Municipalities and Regions, comments, *"Data ecosystems help eliminate gaps across organizations, borders, and sectors. This offers limitless opportunity to offer innovative solutions. However, they also come with the need for stricter due diligence. You have to reevaluate how you lead, how you govern, and how you collaborate with others."*

Conclusion

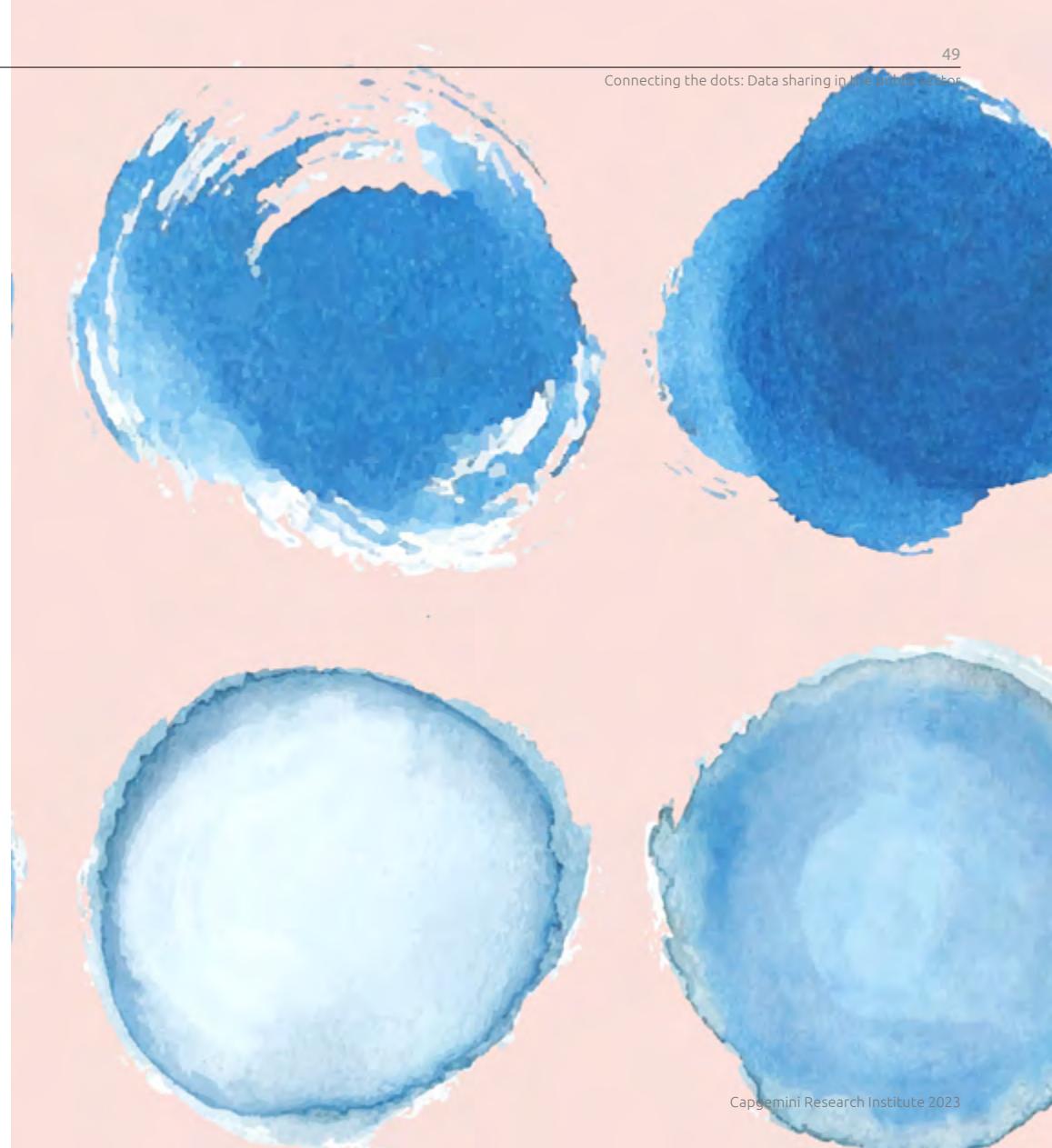
Data ecosystems can bring about a paradigm shift in how the public sector functions. Their impact is already being felt globally. Data ecosystems are helping public sector organizations in numerous ways, such as improving citizen experience and operational efficiency, and driving sustainability transformation. However, only one in ten public sector organizations has scaled their data ecosystem initiatives. To achieve the true potential of data ecosystems, the focus should be on addressing barriers related to trust, culture, and technology that are currently impeding wider adoption. Embedding security and privacy by design will be critical to the success of data ecosystems, requiring strong governance structures, as well as the use of privacy

preserving technologies. Public sector organizations will also need to foster the cultural attributes necessary to operate data ecosystems – specifically, a collaborative mindset that breaks down siloed approaches to decision-making and equips decision-makers with the skills and tools they need to activate data. All of this will require a technology foundation that is built to scale and offers interoperability and federated data governance. As public sector organizations face increasingly complex societal challenges, tapping into the immense potential of data ecosystems will be vital.

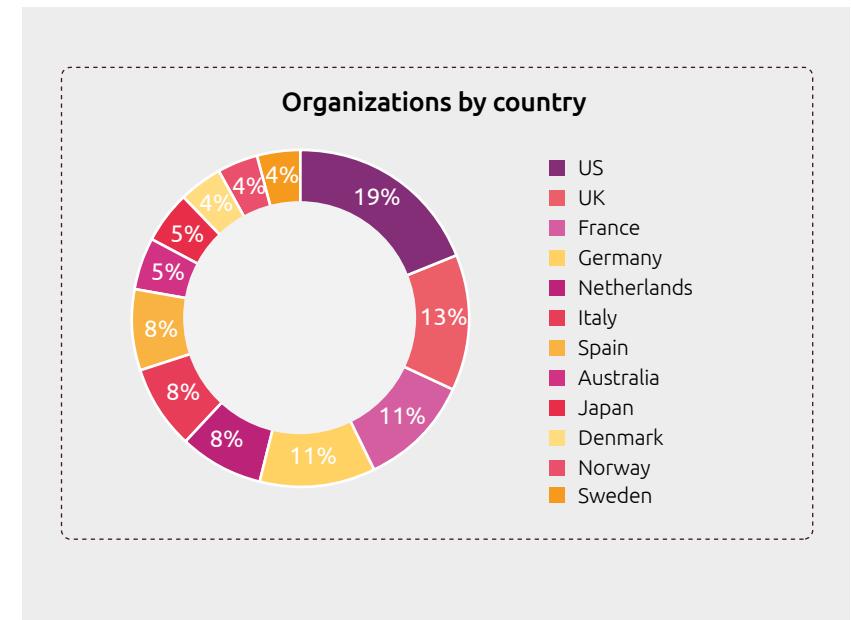
Research methodology

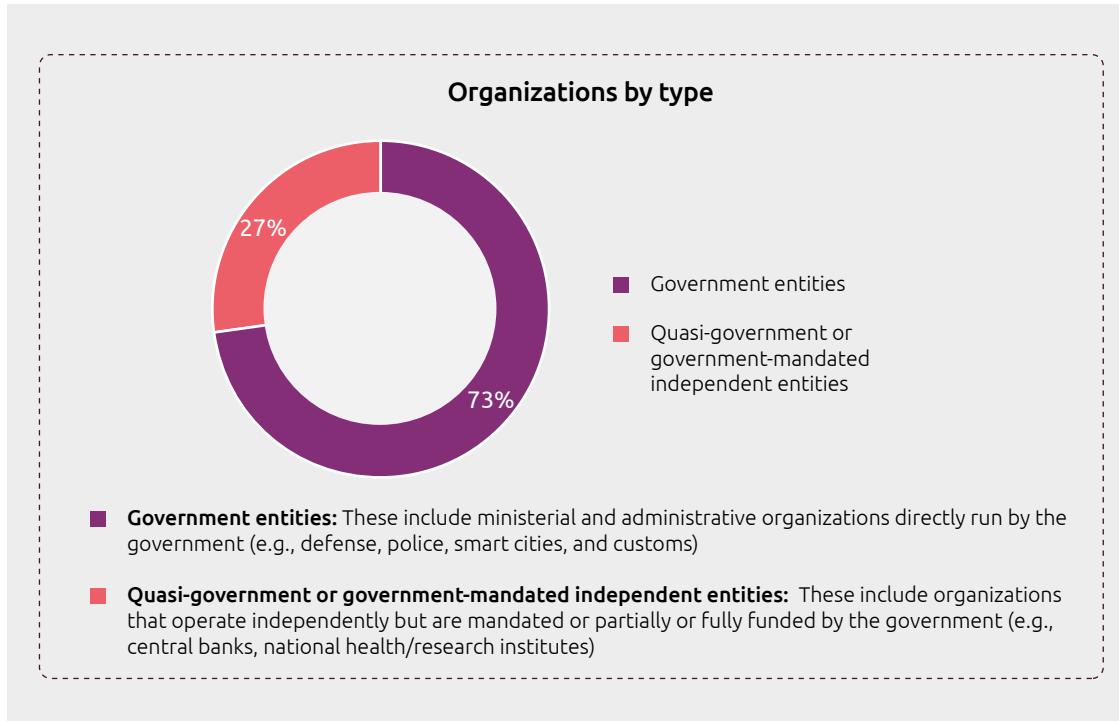
In June 2022, we surveyed 1,000 senior officials from public sector organizations that are working on or planning to work on data ecosystems. The survey covered organizations in North America, Europe, and Asia and key functional areas including welfare, tax and customs, security and defense, and local, state, and central administrations. Please note that while our survey was designed to filter out organizations who did not have or were not planning to work on data ecosystems, we did not find any organization that was filtered out due to this criteria.

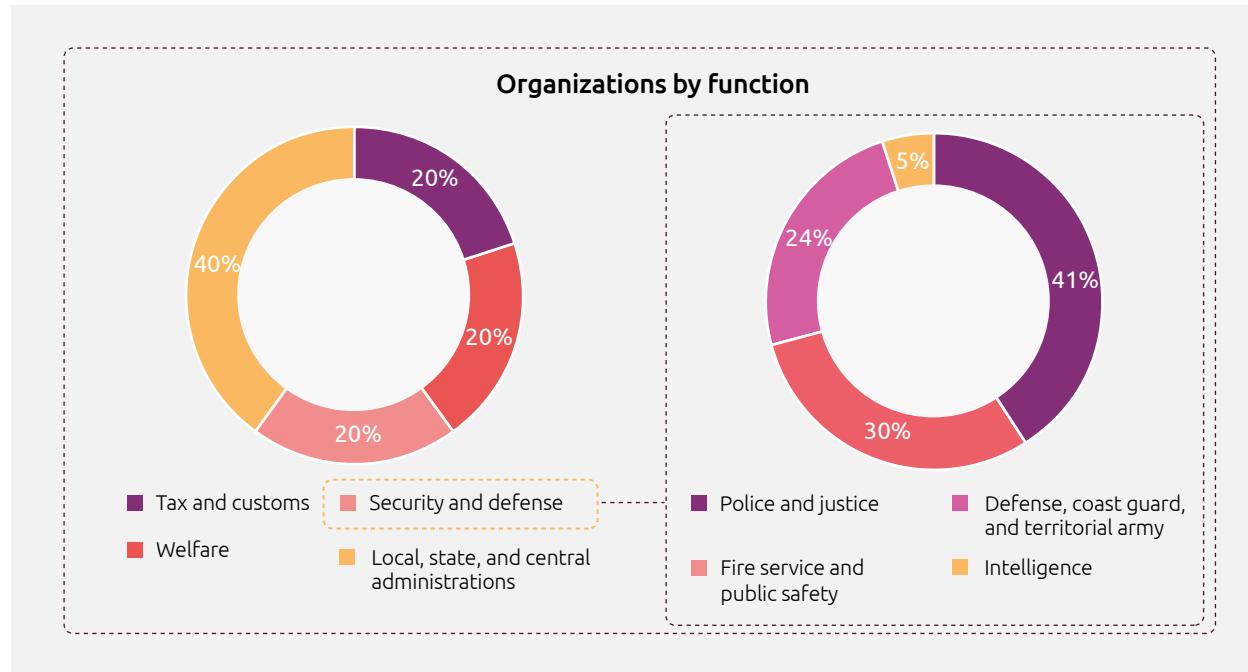
In addition to the survey, we also conducted in-depth interviews with more than 20 senior public sector leaders and academics for this research.

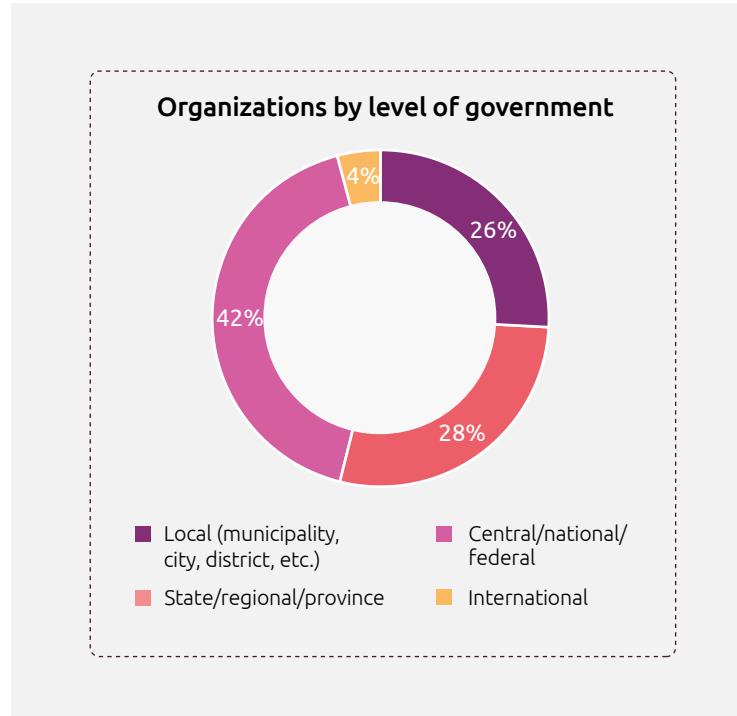


Functional areas covered in survey	Coverage (for the purpose of this study)
Local, state, and central administration	a) District, city, or metropolitan councils, regional administrations b) Central government, chancellor/PM/presidential offices, statistical offices c) Forestry agencies, rural affairs ministries and other departments not covered in other functional areas (excluding healthcare)
Tax and customs	Ministries of finance, ministries of economy, tax authorities, customs agencies
Welfare	Employment and pensions agencies, job centers, family or other benefit agencies
Security and defense	Police forces, fire and rescue services, ministries of justice, ministries of interior, ministries of defense, military police









The study findings reflect the views of the people who responded to our online questionnaire for this research and are aimed at providing directional guidance. Please refer to the methodology for details about the respondents or contact a Capgemini expert to understand specific implications.

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Creating complete data ecosystems hence unleashes unprecedented opportunities to reimagine the public sector. Multiplying insights enables organizations to design new citizen services, optimize costs of processes, reduce time to market or accelerate their sustainability goals.

An end-to-end service enabling data-driven advice

With CDE4PS, Capgemini advises public organizations with a set of capabilities ranging from the creation of the target operating model to the delivery of federated learning platforms, homomorphic encryption, or differential privacy. All of these aim to support the

planning, creation, and running of the ecosystem of data and stakeholders with the right governance and ownership setup, while activating the benefits linked to [data sharing](#): increased efficiency in operations, growth in data insights, enhanced collaboration between departments, and the activation of scaled privacy-preserving AI.

Connecting insights across organizations and geographies

Capgemini is already delivering data sharing projects, both on the advisory and implementation side. Scenarios for data sharing can be identified across all segments of the public sector, whether in public administration (statistical hubs), welfare (skills matching), tax & customs (international customs supply chain), defense (aircraft maintenance), healthcare (deconfinement strategies), smart territories (earth observation), or security (fraud detection).

Our approach to data sharing

Strategy and vision

VISION

- Key objectives and analysis of the challenges
- Industry benchmarks and use case prioritization
- Identification and management of stakeholders

DESIGN

- Creative design of new services and new products
- Industry-specific strategy and roadmap for data sharing

LIAISON

- Partnership selection and set-up
- Participation in advocacy coalitions
- Governance and operating model
- Standardized digital collaboration process creation
- Data governance set-up to secure data privacy and quality

TRUST

- Legal compliance and ecosystem protection
- Create and/or operate label and certification scheme

Implementation

DATA FOUNDATIONS

- Data Marketplaces and Industry Data Cloud platforms
- Data Mesh architectures and Federated learning capabilities
- Data ingestion – shape marketplaces
- New analytics services – federated learning

SECURITY & PRIVACY

- Homomorphic encryption & differential privacy
- Data Centric Security

Selected client projects and engagements

FUTURE4CARE, E-HEALTH STARTUPS ACCELERATOR

In January 2021 Capgemini, Generali, Orange and Sanofi joined forces to create a joint venture specialized in e-health with the ambition of creating the largest innovation ecosystem in Europe. The [Future4care](#) joint venture is live since May 2021 and commits to fully support more than 100 startups in their development.

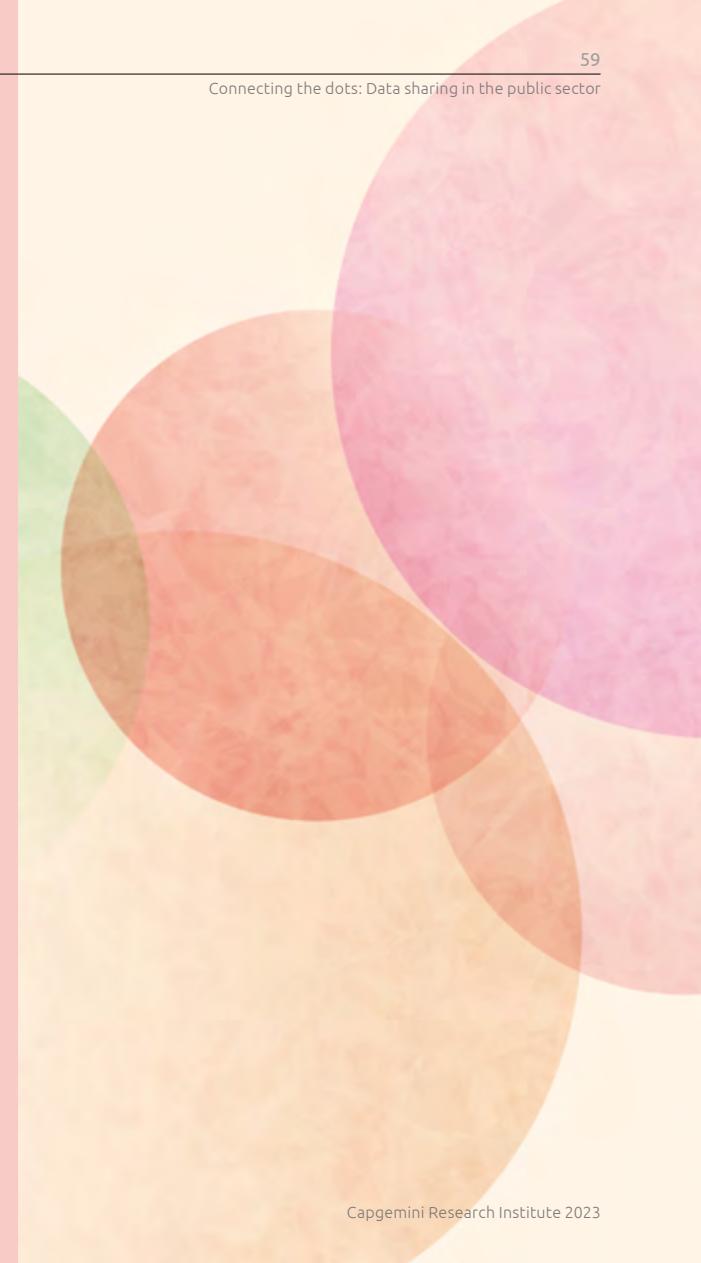
ONDIJON – THE FIRST FRENCH SMART CITY

Within a consortium of partners across the public sector, energy stakeholders and local start-ups, the city created a Central Command Center connecting its citizens, equipment, and response teams through a state-of-the-art digital platform. Amongst other things, the [OnDijon](#) platform delivers use cases in the field of smart parking, air quality and incident notification.

CONNECTING HOSPITALS WITH FEDERATED LEARNING

We supported three of [Spain's leading hospitals](#) - Hospital Ramón y Cajal, Hospital 12 de Octubre in Madrid, and Sant Pau Hospital in Barcelona in creating a private network based on federated learning principles to enable AI-based research on COVID19, allowing healthcare professionals to access advanced diagnostic techniques from any location and respecting data privacy.

To learn more about how we support public organizations to engage in data sharing, visit our dedicated [Collaborative Data Ecosystems for the Public Sector](#) webpage.



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The Capgemini Research Institute is Capgemini's in-house think tank on all things digital. The Institute publishes research on the impact of digital technologies on large traditional businesses. The team draws on the worldwide network of Capgemini experts and works closely with academic and technology partners. The Institute has dedicated research centers in India, Singapore, the UK, and the US. It was recently ranked number one in the world by independent analysts for the quality of its research.

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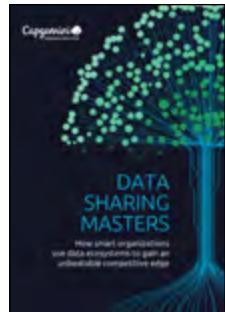
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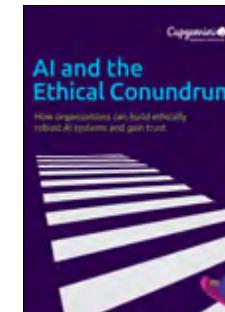
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Street smart: putting
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center of smart city
initiatives



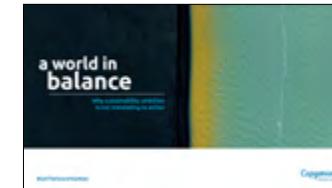
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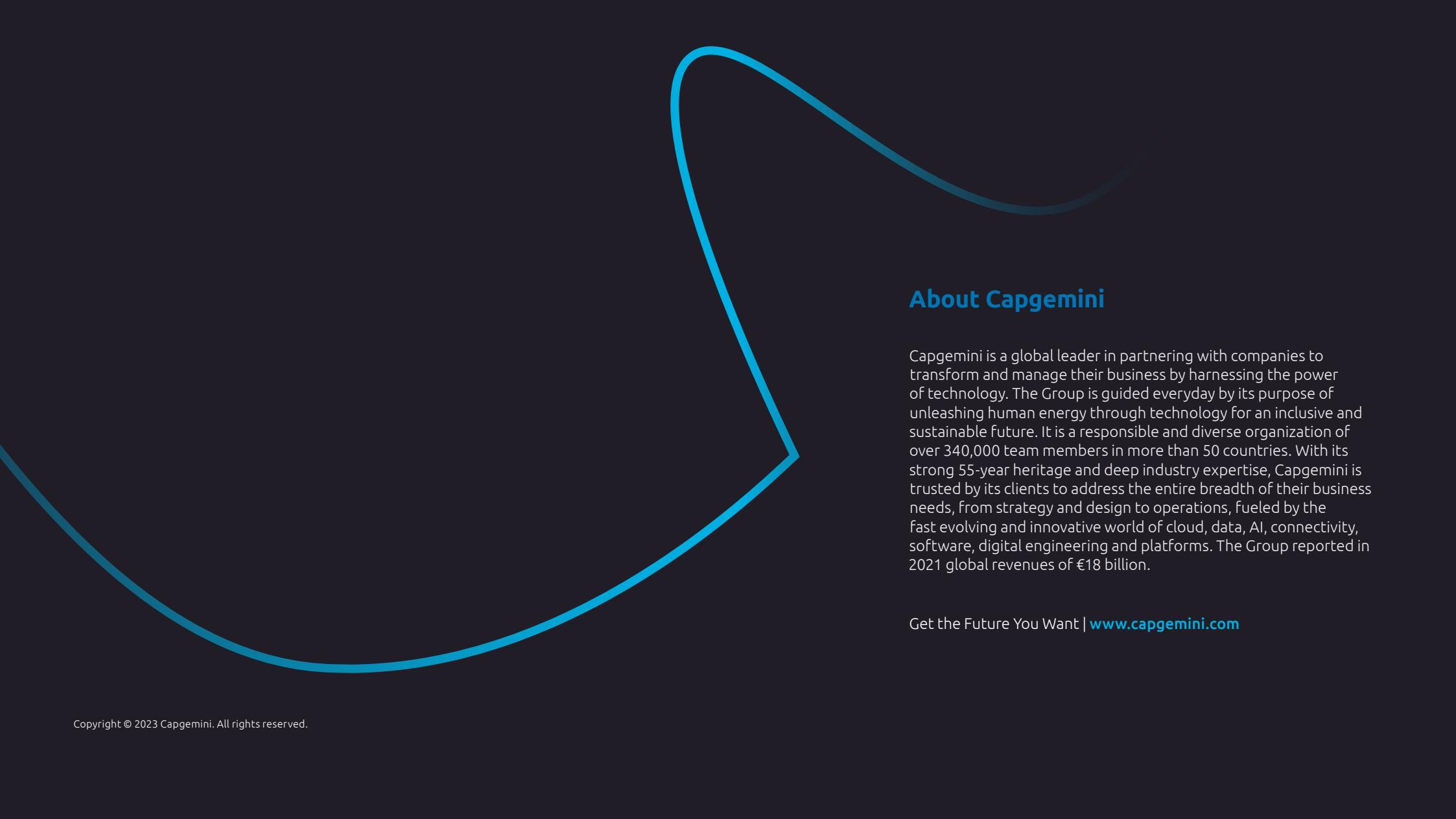
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