



Digital Transformation of National Statistical Offices



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Foreword

The Partnership in Statistics for Development in the 21st Century (PARIS21) promotes the better use and production of statistics throughout the developing world. Since its establishment in 1999, PARIS21 has successfully developed a worldwide network of statisticians, policy makers, analysts, and development practitioners committed to evidence-based decision making. With the main objective to achieve national and international development goals and reduce poverty in low and middle-income countries, PARIS21 facilitates statistical capacity development, advocates for the integration of reliable data in decision making, and co-ordinates donor support to statistics.

Governments, businesses, and societies are going through a rapid pace of digitalisation, fundamentally changing traditional roles. This situation presents new and multiple challenges, especially for national statistical offices (NSOs) in low and middle-income countries. Official statistics must adapt to the digitalised world, meet the growing expectations of data users, strengthen operational processes, develop digital capabilities in NSOs and support the emerging data ecosystem. The COVID-19 pandemic highlighted the acute relevance of digital transformation for NSOs and accelerated the need for adaptation. Demand for data increased even as lockdowns and containment measures made it more difficult for national statistical systems (NSSs) to supply data. Alternative data sources that could be used when traditional survey-based data production is interrupted — such as mobile networks, traffic tolls and satellite data — raise ethical issues regarding data sensitivity, privacy and anonymisation, for which proper regulatory frameworks may be lacking. The often limited statistical capacity and weak administrative data systems of low and middle-income countries made it even harder for NSOs to ensure an inclusive response to the pandemic.

NSOs have often been amongst the first national institutions to systematically harness digital approaches and data flows, as is exemplified by the integration of administrative data by the French National Institute of Statistics and Economic Studies (INSEE) or by the extensive usage of digital aerial imagery and photogrammetry software by the Swiss OFS, both since the early 2000s. Digitalisation has already delivered enormous benefits for NSOs in low and middle-income countries worldwide, with more benefits still on offer. A digital transformation of NSOs is a crucial component for the public sector to adapt to the digital age. However, this task is challenging for many countries, given the limited resources and insufficient exposure to this process.

The report sheds light on selected countries in this process. It brings the topic closer to the context of other countries and elucidates the drivers and barriers in this process. It is the right and crucial time to provide insights to governments and the statistical community on these factors and identify actions to help them integrate digital technology into their operations.

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Abbreviations and acronyms

AI	Artificial intelligence
CAPI	Computer-assisted personal interviewing
CSPA	Common Statistical Production Architecture
GAMSO	Generic Activity Model for Statistical Organizations
GIS	Geographic information system
GSBPM	Generic Statistical Business Process Model
GSIM	Generic Statistical Information Model
HLG-MOS	High-Level Group for the Modernisation of Official Statistics
ICT	Information and communication technology
IT	Information technology
KNBS	Kenya National Bureau of Statistics
NSO	National statistical office
NSS	National statistical system
UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management

Executive summary

Governments, businesses and societies are undergoing digital transformations that are fundamentally changing the traditional roles of various institutions, including national statistical offices (NSOs).

National statistical systems (NSS) and NSOs must adapt to the digitalised world to meet the growing expectations of data users. To support the emerging data ecosystem, NSOs need, in particular, to strengthen their operational processes and develop their digital capabilities. These tasks are particularly challenging for NSOs in low and middle-income countries, which, in many cases, have had limited exposure to digitalisation and yet must identify digital approaches and tools most relevant to their context amid the rapid pace of technological change, as requested by the second strategic area of the Cape Town Global Action Plan¹ (*“Innovation and modernisation of national statistical systems”*).

This report outlines some of the most common barriers and challenges to the digital transformation of NSOs in low and middle-income countries, as well as specific drivers that can facilitate such a transformation. Building on the extensive experience of PARIS21 of working with NSOs around the world, the paper highlights the examples of the NSOs of Cambodia, Colombia, Kenya, Mongolia, the Palestinian Authority and Senegal. The insights shared by representatives of these NSOs about the processes driving their digital transformations and their most prominent success stories and difficulties contributed to a set of evidence-based and actionable recommendations.²

This report argues that a digital transformation must be understood and achieved through the prism of its four core dimensions: individuals, technologies, organisation and processes, and the system and/or environment. The central message of this report is that a digital transformation is profoundly intertwined with the way an institution conducts its activities: governance, processes and people are at the core of the business and will, therefore, be at the core of the digital transformation as well. The technologies themselves play an obvious role in this transformation. But it would be a mistake for NSOs to address the technological aspects (e.g. procurement of hardware and software, development of data platforms) independently of their connections to the other three dimensions at play in digital transformations.

There are at least two reasons to avoid a focus solely on technology and instead take a holistic approach to the digital transformation of NSOs:

- the foreseeable difficulties of anchoring new technologies in inappropriate or outdated processes
- the missed opportunity to reinvent the NSO’s business model to better fit the data challenges of the 21st century.

In sum, a digital transformation should not be seen as simple digitisation of documents or digitalisation of isolated processes. Rather, it should be an overarching approach to support the core business of the NSO and help define and implement new roles and business models.

Notes

¹ Cape Town Global Action Plan, <https://paris21.org/Cape-Town-Global-Action-Plan-ctgap>.

² Country examples are presented in Annex 1. In the body of this paper, where findings or recommendations are based directly on a case study, this is indicated in brackets: [country examples, Country].

1. Why and how should national statistical offices implement digital transformations?

This chapter outlines the benefits of a successful digital transformation in national statistical offices as well as the difficulties for NSOs in low and middle-income countries in turning potential into reality. Based on findings from six country example NSOs, the chapter offers recommendations for a successful digital transformation.

1.1. Why harness a digital transformation?

The dramatic growth of digital technologies is having a wide array of impacts on public services, such as fostering innovation, revolutionising communications and increasing trade and investment.

However, unlike digitisation or digitalisation, which refers to the automation of processes and incorporation of technology, a digital transformation is a fundamental change across the processes and infrastructure of organisations in order to achieve previously unattainable outcomes (Figure 3.1). Such a fundamental digital transformation requires substantial initial investments, for instance, for procurement and capacity development and in new procedures and governance systems.

However, digital transformation is challenging for NSOs in low and middle-income countries, which have had limited exposure to digitalisation and yet must identify digital approaches and tools most relevant to their context amid the rapid pace of technological change.

NSOs often lack consistent and sufficient financial resources to sustain a digital transformation. This can pose a real threat to the very identity of NSOs at a time when new (and big) datasets and more complex indicators are needed to understand and monitor the main challenges of the 21st century, such as climate change and sustainable development.

The next chapter presents specific recommendations to assist national statistical offices (NSOs) in achieving successful digital transformations. Given the considerable diversity in situations, needs and contexts, the recommendations should not be regarded as compulsory or appropriate for all NSOs. Each NSO, following its own digital transformation journey, should instead identify those that are most relevant. However, the choice of recommendations to implement must be grounded in hard facts — an evaluation of the NSO's current digital landscape, for instance. NSOs and their partners should refrain from cherry-picking recommendations without first having a deep and fact-based understanding of the current situation and acute needs. The Data Flow Analysis Framework (PARIS21, 2021^[1]) can be used in this context to assess the maturity of an NSO's digital data flows: To identify current bottlenecks, the framework starts from the end of the statistical production chain (data dissemination) and looks across the chain to understand the root causes of the identified problems and challenges.

The recommendations outlined here are organised along the four dimensions of digital transformation, but most are, in essence, multi-dimensional. Thus, while the recommendations are classified by dimension (individuals, technologies, organisation and processes, system and/or environment), they should be understood as probably having significant implications for other dimensions as well.

Box 1.1. Statistical frameworks and models

The worldwide statistical community develops and promotes various frameworks and models aimed at improving, modernising and harmonising the production of official statistics. Most of them offer specific information and recommendations related to NSO's digital transformation:

GSBPM (Generic Statistical Business Process Model) describes and defines the set of business processes needed to produce official statistics. It provides a standard framework and harmonised terminology to help statistical organisations to modernise their statistical production processes, as well as to share methods and components. The GSBPM can also be used for integrating data and metadata standards as a template for process documentation, harmonising statistical computing infrastructures, and providing a framework for process quality assessment and improvement. It subdivides the statistical production into eight phases (specify needs, design, build, collect, process, analyse, disseminate, evaluate) and according sub-processes. Within a digital transformation, each phase will be associated with various digital tools, approaches and methodologies. The GSBPM can therefore be seen as a background template that can be used to facilitate and systematically plan, organise and implement an NSO's digital transformation.

GAMSO (Generic Activity Model for Statistical Organisations) describes and defines the activities that take place within a typical organisation that produces official statistics. It extends and complements the Generic Statistical Business Process Model (GSBPM) by adding additional activities needed to support statistical production, such as the management of IT resources and data and information flows. The GAMSO describes activities – that is, what statistical organisations do – while the GSBPM describes the process – that is, how statistical organisations undertake the activity of statistical production.

GSIM (Generic Statistical Information Model) is a reference framework of internationally agreed definitions, attributes and relationships that describe the pieces of information used in the production of official statistics (information objects). It enables generic descriptions of the definition, management and use of data and metadata throughout the statistical production process. Within a digital transformation, it can serve as a template to design and develop the data structures and concepts that will ultimately shape the digital data flows. GSIM objects can, for example, be the inputs and outputs of a GSBPM sub-process.

1.2. How to harness a digital transformation? Recommendations for NSOs and their partners to implement a successful digital transformation

Overall recommendations

Identify the expected benefits of the digital transformation

A digital transformation should not be undertaken for its own sake. The expected gains and benefits must be clearly identified, formulated and prioritised. (This study is meant to help NSOs initiate and frame the process.)

Consider all four dimensions

When planning a digitalisation project and/or activity, consider the four dimensions (individuals, technologies, organisation and processes, system and/or environment) and, in the beginning, avoid focusing exclusively on the purely technological aspects.

Describe the status quo

Start with a multi-dimensional digital assessment to explicitly understand and describe the status quo and to identify the concrete barriers and drivers in the NSO, national statistical system and/or country/territory.

Know the specific legal and regulatory context

It is important, from the start, to be aware of any legal restrictions that could impact digital transformation. For instance, national laws prohibit some NSOs from obtaining administrative data from line ministries even when these data are digitally accessible. Big data and cloud computing especially raise new challenges with respect to data security and privacy that national data protection laws and regulations often do not sufficiently address. Gaps in the current legislation must therefore be identified and addressed alongside the relevant national institutions.

Position the NSO as a national/territorial data steward

Start by embracing data stewardship at all levels. With “stewardship”, we understand all the tasks and responsibilities aimed at coordinating and facilitating smooth data flows within the NSS. The digital future of an NSO will involve the acquisition, processing and integration of data from a wide array of sources (other ministries, big data, remote sensing, etc.). These require not only very specific skillsets but also the guarantee of a high level of compatibility and standardisation, e.g. with respect to data models, quality, ontologies or processing. NSOs should, therefore, also take a proactive role by actively engaging with other stakeholders, for instance, in the specific training of future statisticians (data science, remote sensing, artificial intelligence, etc.) and in the development and implementation of standards related to data collection, processing and dissemination.

Individual-level

Be user-driven and user-centric

Mostly aimed at achieving the objective of:

- user-centricity
- competitive advantage

Before designing a digitalisation project, key questions should be asked: Who will use the data and/or technology/portal? How will they use it, and for which needs or to solve which problems? What do these potential users actually need and want? Are the divergent needs of the various user groups sufficiently understood (e.g. those of data users versus those of solutions users)?

It is equally important to consider the requirements of internal users (NSO staff) when designing digital solutions, including by identifying the approaches, processes, tools and/or technologies that can improve the work of NSO staff and any current constraints in their daily work.

In general, preconceived assumptions about the user needs must be deconstructed very early on: Data and information providers often have a very biased understanding of users’ needs; even users themselves tend to be biased and not know precisely what they need. User requirements need to be broken down to the actual problem that is to be solved, regardless of the user’s past experiences with solutions to this problem.

Build on a long-term learning and development strategy for the staff

Mostly aimed at achieving the objective of:

- effectiveness and quality gains
- more capabilities for innovation

Elaborate on a comprehensive learning and development strategy focused on addressing future competency requirements. Remote sensing and data science, for example, will require advanced and specific analytical and technical skills that might currently not be available within the NSO and, in some cases, might be fully lacking within the country/territory. Even the deployment and maintenance of technologically advanced tools will necessitate specific profiles and expertise. Close co-operation with universities and training institutions might also be envisioned to develop the relevant curricula that will develop the next generation(s) of statisticians.

Technologies

Embrace an open source-by-default approach

Mostly aimed at achieving the objective of:

- effectiveness and quality gains
- more capabilities for innovation

Without ruling out proprietary technologies, free and open source technologies should be favoured. These can open new doors in terms of:

- the rapidity of technological adoption (open source tools can always be tested and evaluated without any prior administrative overhead in terms of licensing)
- long-term sustainability (due to the absence of license costs)
- expandability (an increase in the number of users does not directly involve higher costs, as can be the case with some licensing models)
- a greater chance for advancing the internal capacities (e.g. through self-hosting, maintenance and custom development around open source technologies).

It cannot be stressed enough, though, that open source does not necessarily mean free. As would be the case with proprietary tools, running an open source technological stack — for the dissemination of statistical data, for example — requires internal (workforce) or external (financial) resources for the hosting and maintenance of the technologies and for the training of users.

Organisations and processes

Ensure tight co-ordination across all NSO digital projects and activities

Mostly aimed at achieving the objective of:

- Effectiveness and quality gains
- more capabilities for innovation

Externally funded projects, in particular, can sometimes be driven by funders' ideas, agendas, objectives and tools, which tends to increase the digital chaos and entropy within NSOs. Regardless of the financing source, the steering, overview and co-ordination of any digital project must stay firmly in the hands of the NSO. It is important to seek and implement complementarity and synergies among projects, activities and partners and to avoid duplication of effort.

Be bold and agile

Mostly aimed at achieving the objective of:

- More capabilities for innovation

Digital technologies evolve very fast, ideas change constantly, and opportunities appear and disappear all the time. Therefore, experimentation and iteration are critical components of innovation. To respond to this

ever-changing environment, NSOs need to integrate some elements of agility into their structure. Since the very concept of agility is often contrary to the (very hierarchical and structured) way NSOs traditionally function, this could take the form of a small structure in parallel to the conventional statistical system. A data innovation lab, for instance, can allow the NSO to easily, flexibly and quickly try out and test new approaches and technologies before deciding if and how these might be integrated into the statistical system. Such a lab can offer NSO staff hands-on training and the freedom to fail when doing experiments (sandbox). This could be the best way for NSO staff to get comfortable with new ways of working and experimenting with various dataflow options and be a safe place to apply analytical methods to multiple data sources.

Pilot, learn and upscale

Mostly aimed at achieving the objective of:

- Effectiveness and quality gains
- more capabilities for innovation

Do not aim to accomplish the entire digital transformation at once but rather focus on specific pilot interventions (e.g. data innovation for one specific survey), which must be designed to fit into the NSO's digital strategy, and must be conceptualised in a way to increase the likelihood of ulterior upscaling (e.g. to other surveys).

System/environment

Develop and build upon a digital strategy

Mostly aimed at achieving the objective of:

- Effectiveness and quality gains
- more capabilities for innovation
- competitive advantage
- data stewardship

The six-country examples clearly highlight the need for comprehensive information technology or digital strategy, based on the status quo and long-term objectives, to steer digital projects and activities. Such a strategy should provide a clear framework that all digital projects should fit within, thus avoiding a multiplicity of ad hoc and uncoordinated projects.

Ultimately, this digital strategy should also be mainstreamed into the national strategy for the development of statistics to ensure that the digital transformation supports the NSO's core processes and objectives and is not running independently or disconnected from other core developments and activities.

Also, this digital strategy should be in harmony with the national digital plans if existing or in the pipeline. This also means that NSOs could actively contribute to their national digital plans. Examples include Statistics Norway, which shares experiences on the development and use of basic public registers, including population, business, property and address registers, in implementing the Digital strategy for Norwegian development policy. (Ministry of Foreign Affairs of Norway, 2018^[2]; Statistics Norway, 2018^[3])

Use the principles for digital development to frame sustainable digital transformation

Mostly aimed at achieving the objective of:

- Effectiveness and quality gains
- more capabilities for innovation

The *Principles for Digital Development* should be used as the overarching framework for conceptualising digitalisation interventions. The nine principles, fully compatible with the approach and suggestions of this

report, are designed to help integrate best practices into technology-enabled programmes. They include guidance for every phase of a digital project's lifecycle and are part of an ongoing effort among development practitioners to share knowledge and support continuous learning. The principles, which emphasise the long-term sustainability of digital solutions, are particularly well suited for institutions and projects with limited financial resources.

An example of a digital project developed with the Principles for Digital Development in mind is STATBUS, an open source technical solution for statistical business registers:

- A first version was developed to fit the needs of the Kyrgyzstan National Statistical Committee (principle: design with the user).
- The entire architecture of the system is designed to be expandable to other contexts and use cases (principle: design for scale).
- It meets the United Nations Economic Commission for Europe guidelines for statistical business registers (principle: understand the existing ecosystem).
- To facilitate future uptake, it has been released under an open source license (principle: use open standards, open data, open source and open innovation; principle: build for sustainability).
- It was adapted and is currently being deployed for other statistical offices in Europe and Africa (principle: re-use and improve).
- It is now administered jointly by representatives of Statistics Norway, Statistics Sweden and the African Union's StatAfric (principle: be collaborative).

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2. How digital transformation impacts public institutions

As demand from the public and private sector for digital goods and services increase, various public institutions are moving from analogue to digital. As public and private sector demands for digital goods and services increase, various public institutions are moving from analogue to digital. This chapter explores what this trend means for statistical processes across institutions, the ways in which national statistical offices will be implicated, and what the benefits of this process might be.

Successful digital transformation comes not from implementing new technologies but from transforming your organization to take advantage of the possibilities that new technologies provide. Major digital transformation initiatives are centered on re-envisioning customer experience, operational processes and business models. Companies are changing how functions work, redefining how functions interact, and even evolving the boundaries of the firm (Capgemini Consulting, 2011^[4]).

The dramatic growth of digital technologies and their adoption has transformed the way institutions function and the way people interact. Among other impacts, they have fostered innovation, revolutionised communications, increased trade, boosted investment, increased consumer choice, and facilitated better goods and services and easier technology transfers (OECD, 2019^[5]). Digital technologies also can increase public service efficiency, foster transparency, and enhance citizen trust and participation (OECD, 2019^[6]; European Commission, 2018^[7]), leading to digital transformation across economies and societies. Just as their customers, employees and competitors are putting pressure on companies to embrace a digital transformation (Capgemini Consulting, 2011^[4]), citizens, the private sector and policy makers are also urging governmental organisations to move from analogue to digital.

2.1. Digitalisation can fundamentally change statistical processes

Digital transformation refers to the adoption of digital tools and methods by an organisation, whether it is a business, government or other types of organisation (Observatory of Public Sector Innovation, 2020^[8]). Such a transformation integrates technology and data into all areas and functions, fundamentally changing how organisations operate and deliver value to their stakeholders. While private sector companies were the first to adopt digital technologies, many governments have started to move away from paper-based processes. More and more public entities are progressively interacting with citizens and businesses as e-governments or digital governments to improve efficiency by delivering services online (UN, 2020). Some now have recognised the need to shift to a more holistic approach to their digitalisation.¹

Modern digital technologies are needed to efficiently acquire, store, process, analyse, disseminate and make sense of newly available and complex data.

To address some of the world's most acute challenges — climate change, the Sustainable Development Goals, systemic poverty and global pandemics, to name only a few — governments are increasingly harnessing the power of data for evidence-based decision making (Vogl et al., 2019^[9]). Rigid, traditional and not fully digital statistical methods, coupled with outdated technological environments, can hinder their ability to produce those richer, real-time insights that decision makers now request (UNECE, 2021^[10]). Modern digital technologies are needed to efficiently acquire, store, process, analyse, disseminate and make sense of newly available and complex data. Such a fundamental digital transformation requires substantial initial investments, for instance, for procurement and capacity development and in new procedures and governance systems. But these investments will ultimately pay off — enabling the cheaper, faster production of more numerous and more relevant official statistics for governments and societies (European Commission, 2017^[11]).

At the same time, the challenges and crises facing societies highlight the risk of delaying the digital transformation of governments. The COVID-19 pandemic, probably more than any previous crisis, exposed the digital divide between high-income countries and low and middle-income countries while also highlighting the role digitalisation plays as a factor in social and geographic inequalities (De', Pandey and Pal, 2020^[12]). In many western countries, for example, public sector employees were able to switch to mainly home-based work when required, thanks to pre-existing digital infrastructure and work practices.

But the digital infrastructure in many low and middle-income countries did not allow secure remote access to government systems and databases, leaving government institutions to choose between asking civil servants to stay home (in effect, closing their operational activities) and maintaining normal ways of working (and risking greater and quicker contagion).

2.2. The key role of NSOs in government digital transformation

National statistical offices (NSOs), particularly in low and middle-income countries, have experienced significant changes in recent years. Many have benefited from noteworthy improvements in their statistical processes, as has been shown by the 6 country examples in this study. Examples of advances include faster data collection using handheld devices and flawless data processing with sophisticated software tools (PARIS21, 2021, p. 7_[1]).

NSOs are the primary government bodies collecting, processing and disseminating data at individual, local, regional and national levels. More than for other government institutions, their data-driven business model has a greater need for digitalisation and digital transformation, including the efficient management and processing of digital data; integration of cutting-edge technologies such as big data and remote sensing; and meeting the highest standards in terms of data security and privacy.

NSOs can lead in harmonising digital transformation

The growing diversity and complexity of data sources and of users' expectations require NSOs to undertake their own digital transformations

Traditionally, NSOs are responsible for the collection, processing, analysis, and dissemination of quality data needed for informed policy making (Open Data Watch, 2019_[13]). The growing diversity and complexity of data sources (remote sensing, big data, administrative data, Internet-of-things, web-scraping, etc.) and of users' expectations (timeliness, interoperability, granularity, etc.) require NSOs to undertake their own digital transformations. However, this cannot happen in a closed silo. The NSO's systems must connect with those of other institutions — for example, population statistics pull data from administrative sources that are owned, hosted and managed by other governmental bodies [country example, Senegal]. Some NSOs, therefore, take an active and proactive role in shaping the overarching digitalisation of government institutions by contributing directly to the design of national data strategies and digital plans. The following are some examples:

- In implementing its Digital Strategy for Norwegian Development Policy, Statistics Norway is sharing Norwegian experiences on the development and use of basic public registers, including population, business, property and address registers (Norwegian Ministry of Foreign Affairs, 2018_[14]).
- The Statistics Canada data strategy includes supporting and providing expertise on data to other federal, provincial and territorial government organisations; non-governmental organisations and academia; the private sector; and other national and international communities (Statistics Canada, 2018_[15]).
- Statistics New Zealand, as the national data steward, co-ordinates the development of data policy, infrastructure, strategy and planning to help other agencies increase their capability to manage and use data through digital approaches (New Zealand Government, 2020_[16]; Statistics New Zealand, 2021_[17]).

- Statistics Estonia, the national data steward, plays a central role in the country's overall national digital transformation, is tasked with co-ordinating the country's overall data governance and substantially contributes to reducing duplication of data (UNSD, 2021a, p. 195^[18]).
- In Senegal, the Agence Nationale de Statistique et de la Démographie has assumed a leading role in national data governance as well as in the digitalisation of data collection processes from other national and sub-national institutions [country example, Senegal].

In a few cases, NSOs are taking the lead in creating new digital products and services. Some are adapting to new working methods along the data value chain, using newly available sources of data and opening up to new fields of expertise directly linked to the digital transformation of societies (UNCTAD, 2021^[19]). In terms of methodology, NSOs have started using technologies like machine learning and artificial intelligence (AI) to improve their data compilation capacities (Biancotti et al., 2020^[20]) and to help balance the growing demand for timely data against often shrinking resources. NSOs are also learning to extract data from the Internet and from private producers. One typical example is their use of mobile phone data to generate official statistics in the fields of population, tourism and human mobility (UNESCAP, 2019^[21]) and even employment (UNSD, 2019a^[22]). These data can be used in combination with or as substitutes for data that are more conventionally collected through surveys or administrative records (OECD, 2019^[6]).

NSOs are moving ahead with digital transformation at different paces and with different approaches. For example, Statistics Denmark (2009^[23]) took a holistic approach by including a vision for “work processes” and information technology (IT) support in its 2015 strategy. By building on this vision through standardisation of processes and methodologies and through the implementation of a modern IT architecture, Statistics Denmark aims to become more user- and data supplier-friendly. At the same time, some NSOs are addressing digital transformation on an ad hoc basis, driven by priorities (e.g. immediate data needs) or by financing opportunities (e.g. a dedicated budget or grant for implementing a specific tool or approach) that might stem from and reinforce a lack of a long-term coherent and strategic digital vision [country example Kenya].

Sufficient financial resources are key

NSOs often do not have dedicated budgets for digital innovation that can improve the accuracy, timeliness and efficiency of statistical production instead of finding themselves competing with private data producers. All six-country examples highlight this lack of consistent and sufficient financial resources to sustain a digital transformation, as does the literature on the subject (MakStat, 2020, p. 83^[24]). This can pose a real threat to the very identity of NSOs at a time when new (and big) datasets and more complex indicators are needed to understand and monitor the main challenges of the 21st century, such as climate change and sustainable development. The traditional focus of NSOs on quality and transparency, often at the expense of timeliness, might make them less attractive in the eyes of decision makers who, in a fast-paced world, increasingly favour what might be termed “good enough” timely data over perfectly accurate but already outdated data. For this reason, the OECD (2014^[25]) has recommended that governments should engage in a digital transformation, also by balancing the need to provide timely official data with the need to deliver trustworthy data. Moreover, users themselves are increasingly pressuring NSOs to deliver high-quality data, statistics and services much more rapidly and in a variety of digital and interactive formats that can be consumed on smartphones or computers and that can be ingested by external applications (through machine-readable formats and application programming interfaces) (UNSD, 2021a, p. 429^[18]).

A wide digital divide persists

Digitalisation needs, institutional capacity and available resources vary across and within countries. Even as a government may advance on its digital agenda, some NSOs, especially those in low and middle-income countries, may lag behind due to a lack of information technology infrastructure, leadership, legislative frameworks, competencies, change management processes and cross-sectoral collaboration

(e.g. with other governmental agencies) (Ndou, 2004^[26]). In particular, change management [country example Mongolia] and access to the specific competencies, as well as infrastructure [country example Palestinian Authority], were often mentioned in the country examples as significant constraints (see Annex 1). Though digital technology has become more affordable in recent years, connectivity remains low; services such as banking and electronic payments are rarely digitalised, and the adoption of digital tools such as handheld tablets is still in its infancy in many developing countries (Casahuga, 2017^[27]; Dener et al., 2021^[28]). In terms of statistical processes, paper-based surveys are still much more common than computer-assisted interviews and surveys, for example, UNSD, 2019^[22], even though the latter have known quantified advantages in terms of increased efficiency and fewer errors (Asian Development Bank, 2019^[29]).

The COVID-19 pandemic highlighted the acute relevance of digital transformation for NSOs and accelerated the need for adaptation. Demand for data increased even as lockdowns and containment measures made it more difficult for national statistical systems (NSSs) to supply data (PARIS21, 2020^[30]). Alternative data sources that could be used when traditional survey-based data production is interrupted — such as mobile networks, traffic tolls and satellite data — raise ethical issues regarding data sensitivity, privacy and anonymisation, for which proper regulatory frameworks may be lacking (Oliver et al., 2020^[31]). The often limited statistical capacity and weak administrative data systems of low and middle-income countries (PARIS21, 2019^[32]) made it even harder for NSOs to ensure an inclusive response to the pandemic.

NSOs need well-designed plans to prepare their business models to operate digitally. These plans need to consider the environment, including the legal framework and the financial resources and stakeholders. In particular, the specific challenges and emerging opportunities that NSOs and NSS entities face in the digital age need to be systematically identified and properly addressed.

2.3. Aims and benefits of NSO digital transformation

Digital transformation requires NSOs to make substantial investments not only in terms of procurement of technologies (hardware, software, network infrastructure, etc.) but, first and foremost, in terms of rethinking and redesigning their value proposition, core processes and governance model. To make the digital transformation a purpose-driven endeavour, the NSO must understand and clearly describe its expected outcomes and benefits. Each situation will be different, and different NSOs might put a stronger emphasis on different aspects or identify specific and perhaps more subtle benefits. For a rough overview of possibilities, the following is a list of some potential long-term benefits stemming from a successful digital transformation alongside some country examples:

- **User-centricity.** A fully digitalised statistical production chain can facilitate the dissemination of statistical outputs (statistical tables, data services, etc.) in different flavours to match the diverse needs of its external users. While researchers might need clean microdata files, the general public, as well as policy makers, might favour real-time and interactive data services, both of which can be produced and disseminated from the same digital infrastructure. The National Institute of Statistics in Cambodia offers an example. Demonstrating a willingness to adapt its offer to the requirements of its (external) users, it involves them in the conceptualisation and design of dissemination platforms and provides regular training on these platforms to enable a wide and efficient usage of the statistical data in decision-making processes [country example Cambodia].
- **Effectiveness and quality gains.** Modern digital approaches enable NSOs to process unprecedentedly large amounts of raw data in a fraction of the time that was once required to code, input, clean, process, and analyse data from surveys and censuses. Overall data quality is also increased thanks to reduced manual errors and automated plausibility and quality control. For example, the National Administrative Department of Statistics (Departamento Administrativo

Nacional de Estadística) in Colombia has observed a much higher and faster response rate when deploying online surveys based on very robust and scalable technologies [country example Colombia]. In addition to the obvious advantages for the data collection itself, using digital tools to power survey and census management systems (such as web-based dashboards) can provide robust control in the hands of survey and census managers. This new level of efficiency can only be achieved, however, after the NSO's overarching digital capabilities are built or sharpened and a certain level of digital maturity has been reached.

- **More capabilities for digital and data innovation.** Digital and agile processes open the door to even more digital innovation: A robust and secure IT infrastructure, coupled with clear and agile policies and governance models, allows an NSO to innovate more easily by rapidly testing, evaluating and incorporating new digital technologies and approaches within the statistical production chain. In addition, such a digital environment can foster data innovation — that is, the application of complementary analytical methods to traditional and/or non-traditional data sources to generate new insights that might not otherwise have been apparent — faster and cheaper. All in all, innovation, in this case, can be understood as a new match between a need and a solution that creates value by saving time and money; and being effective. In Colombia, the National Administrative Department of Statistics has established an informal Lab of Innovation and Development, which gives it the ability to flexibly test and evaluate promising technologies [country example Colombia]. Not only does this facilitate the subsequent productive deployment of new technologies by building the necessary skills and formalising deployment and usage procedures developed during the testing phase. It also helps to coherently shape the NSO's digital landscape by avoiding opportunistic deployment of untested technologies and approaches.
- **Competitive advantage.** While the production of data and statistics has long been a prerogative of NSOs, the private sector is playing an increasing role in all spheres of the data value chain. From the automated and on-demand analysis of satellite images to the processing of big data sources (e.g. through web-scraping and AI), private companies can now provide insights, data, and statistics that directly compete with (and, in many cases, surpass) the official statistics. Failure to harness the opportunities offered by digital transformation might ultimately relegate NSOs to the role of second-zone players in this ever-growing arena. Google offers a prominent example of the new roles taken up by the private sector: Through its Google Earth Engine platform, it provides extremely powerful remote sensing and geographic information system capacities (Kaufman, 2021^[33]). These can be harnessed, for instance, for environmental analyses and monitoring and directly compete with some official datasets and statistics such as land cover or forest extent statistics.
- **Data stewardship.** A digital transformation offers NSOs a unique opportunity to adjust their value proposition — one of mostly producing data and statistics to one embracing data stewardship at the government level — and thus take a leading role in all aspects related to data collection, management and dissemination (i.e. standards, capacities, methods and approaches, modelling, integration, etc.). In Senegal, the Agence Nationale de Statistique et de la Démographie has established what it calls the visa statistique, which aims to standardise how other national institutions work with, produce and disseminate data and statistics. This authorisation strengthens the NSO's role as the national data steward responsible for establishing and safeguarding best practices [country example Senegal].

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Notes

¹ Both digitisation and digitalisation processes play an important role in digital transformation. Digitisation refers to the conversion of analogue to digital; digitalisation is the direct use of information technology and digitised data. For details, see <https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/?sh=3360e5362f2c>.

3. Assessing digital transformation progress

Digitisation and digitalisation are often used interchangeably. However, there are critical differences between them. This chapter explores the meaning behind digitisation and digitalisation and how to measure them. The chapter also outlines a methodology to evaluate the state of digitalisation in national statistical offices.

3.1. What is the digital transformation of statistical systems?

While the terms digitisation, digitalisation and digital transformation are widely used, often interchangeably (Bloomberg, 2018^[34]), there are critical differences between them in terms of their scale and objectives (Figure 3.1).

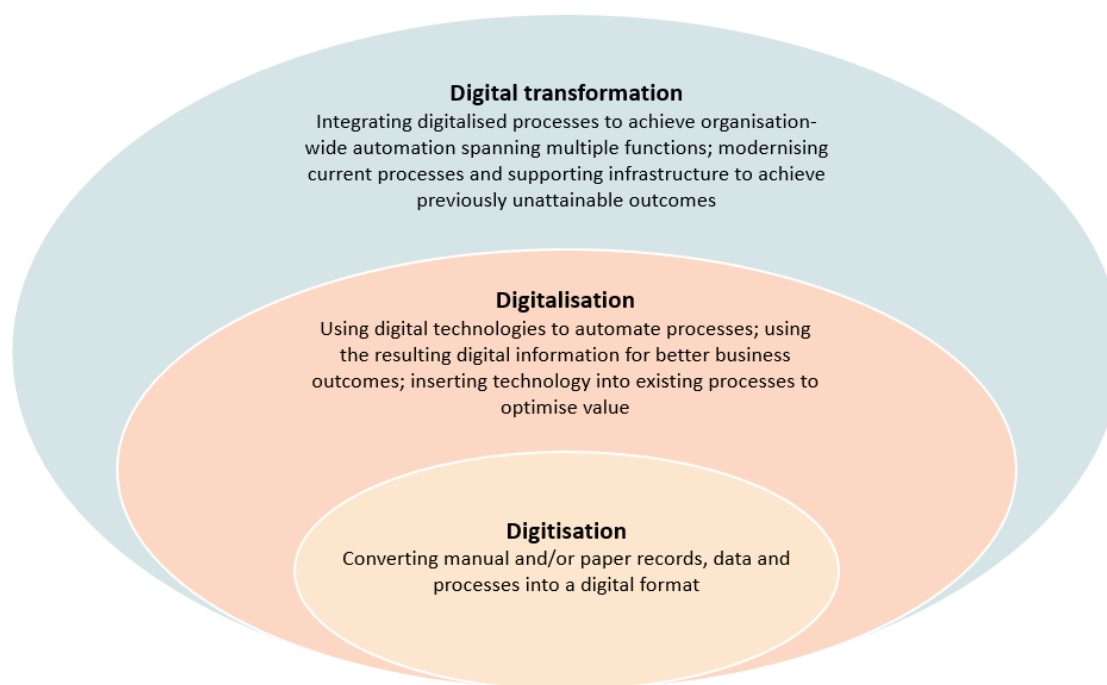
Digitisation mainly relates to the transformation from analogue to digital data (e.g. scanning of paper documents, with or without optical character recognition). This is an obvious and mostly technical step on the path towards digital societies, only loosely (but not necessarily) impacting actual working processes and interactions. Digitisation makes the information, not the process, digital (Bloomberg, 2018^[34]).

Digitalisation is a more complex endeavour whereby digital applications and processes leverage digital data. Typically, digitalisation will impact isolated or siloed business processes. In the world of official statistics, these could include being the switch from a paper-based survey to a fully digital process involving electronic data collection, storage, processing, analysis and dissemination. Successful digitalisation often results in sectoral improvements in terms of data quality and timeliness and efficiency gains. Such siloed and sectoral improvements, however, lack horizontal integration (e.g. with other statistics or surveys). Reusing the outputs and results of a fully digitalised survey in more traditionally computed statistics will often require some ad hoc manipulation of the data for which formal processes and tools have not necessarily been implemented, and this can lead to unexpected complications and limitations. Although digitalised statistical processes offer many advantages over their fully analogue counterparts, it must be recognised that their lack of transversality can also cause unwanted and unplanned challenges in the future.

For a long time, NSOs have used information technology (IT) to improve the efficiency of statistical processes. However, such innovations have remained confined only to specialised areas, creating islands where IT tools are less likely to interoperate, share data, and work together as a cohesive system. This fragmented environment of individual and disparate systems created what many researchers called silos within NSOs. Silos restrict the clarity of holistic vision, meaning that NSOs have struggled to have the significant impact desired with regard to using digital technologies. These reasons include a mismatch between IT systems and actual processes and a lack of seamless flow of data across its lifecycle (PARIS21, 2021^[1]).

- **Digital transformation** aims to address these very challenges by looking holistically at the processes at stake within the whole institution. A digital transformation is a fundamental change in the way statistics are produced. It is more than only introducing and using digital technologies. Rather, it should be seen as a technology-aided deep rethinking of the core work of an institution. Bosnia and Herzegovina provides a very telling example (MakStat, 2020, p. 87^[24]): The digital transformation of the national statistical system is being hampered by the complex institutional setup of three statistical institutions with different structures, each using different tools and having insufficient resources. A technological transformation alone cannot achieve much here, and the core governance and functioning of the statistical system need to be redesigned to accommodate the integrated deployment of digital approaches. Similarly, the key challenges and constraints to comprehensive digital transformation identified by the National Statistics Office of Mongolia key are more organisational than purely technological [country example Mongolia]. Chapter 3 highlights the need for a multi-dimensional approach toward digital transformation.

Figure 3.1. Digital organisation



Source: Authors

3.2. Measuring multi-dimensional digital transformation

Most of the existing methods, frameworks and tools to assess an organisation's digital situation and identify possible areas for improvement are designed for private sector institutions. As such, they do not directly apply to the situation of NSOs,¹ but their overarching philosophy is generic enough to serve as a general guideline or mindset for organising an NSO's digital transformation. Most, if not all, emphasise and consider the multi-dimensional character of digital transformation.

For example, the TM Forum's Digital Maturity Model² takes is a very comprehensive model along six dimensions, each one split into the sub-dimensions of the customer, strategy, technology, operations, culture and data. With its "digital quotient", the McKinsey Digital diagnostic takes a slightly simplified approach based on the four dimensions of strategy, culture, organisations and capabilities.³ Price Waterhouse, with the Industry 4.0 model, suggests a gradation of organisations from digital novice to a vertical integrator, horizontal collaborator and, ultimately, digital champion; it further evaluates organisations' performance in terms of business models, product and service portfolio; market and customer access; value chains, processes and systems; compliance, legal, risk, security and tax; and organisation and culture.⁴

Evaluating a statistical institution's digital maturity

Similarly, and more specifically related to the context of official statistics, the PARIS21 (2020b_[35]) Capacity Development Framework takes a multi-dimensional approach to describe a national statistical office's overall capacities, building on three levels (individuals, organisation, system) and five targets (resource, skills and knowledge, management, politics and power, incentives).

In addition, the Modernisation Maturity Model from the High-Level Group for the Modernisation of Official Statistics (HLG-MOS) refers to five levels of maturity (initial awareness, pre-implementation, early

implementation, corporate implementation, mature implementation) that can be applied to five dimensions (business, methods, information, applications, technology) (UNSD, 2021b_[36]). It should be noted that this model is primarily meant for the self-assessment by NSOs towards the HLG-MOS standards: the Generic Activity Model for Statistical Organizations, Generic Statistical Business Process Model, Generic Statistical Information Model and Common Statistical Production Architecture. However, to a certain extent, this model could also be adapted to analyse an NSO's digital maturity.

Finally, the Knowledge Management Framework developed by Oneoff-tech (Colombo, 2020_[37]), built on four organisational legs (people, processes, technology, governance), recognises that the ultimate aim of an NSOs' digital transformation is to produce action-oriented knowledge for sectoral experts and decision makers through improved collection, processing, aggregation and contextualisation of raw data into statistical information. A coherent combination of actions across those four legs is needed to accomplish this.

This paper focuses on four key dimensions, all found, in one form or the other, in the above-mentioned frameworks), to provide a methodological coherence without overcomplicating the study. These are:

- individuals
- technologies
- organisation and processes
- system and/or environment

While the number and descriptions of the dimensions can be debated, the choice of these four reflects this paper's central message — that a digital transformation has to do only partially with technology. Obviously, new tools and technologies will be introduced and implemented, but a full digital transformation can never be successful if the other dimensions are overlooked or not properly considered.

This approach aligns with the OECD (2014_[25]) Recommendation of the Council on Digital Government Strategies. The following table shows the correlation between the dimensions used in this paper and some of the related OECD recommendations.

Table 3.1. Correlated dimensions of digitalisation

Dimension	Related OECD recommendations
Individuals	• Reduce digital divides in societies • Be inclusive, involve stakeholders
Technologies	• No technology-first approach: factually evaluate the needs and requirements before procuring or developing technologies
Organisation and processes	• The establishment and enforcement of organisational and governance frameworks are prerequisites for implementing digital strategies • Real-life business cases shall guide the establishment and implementation of digital strategies • Institutional capacities, especially in terms of planning, management and monitoring, must be continuously reinforced
System and/or environment	• Identify incentives for external stakeholders to become active partners in the statistical production • Be open towards your environment (open data, transparency, public value creation, etc.) • Ensure or facilitate a coherent use of digital technologies across policy areas and levels of government • Harness international co-operation to maximize the added value of the statistical production • Ensure that the necessary policy and legal frameworks are in place for facilitating and enabling the digital transformation

Source: Authors' correlation

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Notes

¹ The success of a private company's digital transformation can be evaluated to some extent in terms of financial gains. NSOs usually are not able or allowed to fully operate in the free-market economy and generally see and measure the outcome of their digital transformation in terms of internal efficiency and user satisfaction. An NSO, therefore, interacts with its users (i.e. consumers of data and statistics) very differently than a private company interacts with customers who buy its goods or services. Moreover, the choice of outputs produced and disseminated by an NSO (statistics, interactive data services, etc.) is largely dictated by legal and policy constraints that may or may not match the actual requirements, needs and wishes of external users.

² See <https://www.tmforum.org/digital-transformation-maturity/>.

³ See <https://www.mckinsey.com/business-functions/mckinsey-digital/how-we-help-clients/digital-2020/our-assessments/strategy>.

⁴ See <https://www.pwc.nl/en/assets/documents/pwc-industrie-4-0.pdf>.

4. Barriers to and drivers of digital transformation

This chapter explores digital transformation across four dimensions individual, technological, organisation and process, and system and environment. Through interviews and surveys with NSOs, as well as literature reviews, this chapter outlines specific examples of drivers and barriers to digital transformation.

Although the situation in each country or territory is different, it is possible to identify a few typical barriers (that block, impede or slow down the digital transformation) and drivers (that enable, facilitate or accelerate the digital transformation). This chapter discusses some of these across different aspects within each of the four dimensions of digital transformation (individuals, technologies, organisation and processes, and system and/or environment) of national statistical offices (NSOs). As each context is different, the discussion of these drivers and barriers should not be understood as prescriptive for all.

4.1. Individuals

Recruitment and retention

Barriers

- Public sector salaries are often not competitive with private sector salaries, making it hard for NSOs to acquire talent and retain skilled staff over the long term.
- Rapid staff turnover causes knowledge gaps and discontinuity.

Drivers

- A modern information technology (IT) infrastructure creates a virtuous circle, enabling innovative approaches that make the NSO a more attractive workplace for recruiting and retaining skilled employees.
- The efficient storage, retrieval and exchange of knowledge are essential to any innovation within an organisation (Colombo, 2020^[37]). This allows sectoral units to work together and understand each other better; helps them avoid repeating the same mistakes or re-inventing the wheel; and facilitates knowledge retention, especially in contexts with high staff turnover. A comprehensive knowledge management approach, one that goes beyond a simple document management system and actively supports knowledge flows and knowledge uptake, can significantly speed up a digital transformation. At the same time, the digital transformation itself can also generate a virtuous circle of improving and facilitating knowledge sharing within the NSO and within a broader community of practice such as the national statistical system (Capgemini Consulting, 2011^[4]).

Capacity development planning

Barriers

- Capacity development measures in low and middle-income countries, more often than not, are donor-triggered - that is, supply-driven rather than driven by demand and need. Workshops, training and study tours are often designed to fit the needs of a specific project and may not fully fit the NSO's actual long-term needs and goals. A typical example is training on specific statistical software that has been implemented within a project but otherwise is not used more broadly by the NSO (e.g. because license costs are prohibitively high or another tool is well established in the NSO). In such a case, the capacity development measure could contribute to a worsening of unstandardised digital management rather than to a coherent and strategic usage of software and technologies.
- Capacity development measures can only deliver their full potential if the participants have an opportunity to apply the newly acquired skills in their everyday work. Supply-driven capacity development measures are often disconnected from the actual needs of NSO staff and/or cannot be applied directly (e.g. because the software on which staff were trained is not available or because the taught techniques and methods cannot be incorporated into the standard statistical

production chain). This hinders the actual adoption of the new skills and their integration into the NSO's work processes.

- Setting up a comprehensive recruitment plan is complicated by the speed at which technology is evolving, which makes it difficult to anticipate the skills and competencies that may be required the most in two, five or ten years.

Drivers

- A comprehensive learning and development strategy can boost the digital transformation by ensuring that the actual business needs (in terms of skills and competencies) drive the recruitment and implementation of capacity development activities. The Palestinian Central Bureau of Statistics has adopted this approach and takes it one step further by partnering with universities to actively shape and build the capacities of the next generation(s) of official statisticians. Its philosophy is that in the future, data scientists will be needed.

4.2. Technologies

Acquisition and maintenance of technologies

Barriers

- Substantial financial and human resources are needed to acquire and maintain the digital technologies and infrastructure needed for a coherent digital transformation, such as an internal network, internet connectivity, servers and personal computers, and software licenses. Such resources often are not readily available, especially for NSOs in low and middle-income countries.
- Dealing with digital (big) data requires specifically very substantial storage and processing capacities, which are not always to be found on NSO premises. While relocating the storage and processing on cloud infrastructure might appear initially to be an obvious, efficient and comparatively cheap alternative, this frequently conflicts with national data governance policies, for example, those stating that the national/territorial data must physically reside within the country/territory.
- Ad hoc technological development, which is often a consequence of externally driven projects, tends to result in a very disparate technological stack such as overlapping technologies running in parallel, low re-usability and maintainability, etc. This often occurs when technological approaches are designed specifically to meet a short-term need of a particular project, statistics, census or survey and not framed within a long-term, overarching digital strategy. The Kenya National Bureau of Statistics offers an example of this: Several (partly overlapping) dissemination platforms were deployed to accommodate the needs of specific projects, but the corresponding maintenance of all those platforms, as well as data integration and data quality assurance, are proving challenging.

Drivers

- A clear, specific and defined IT strategy, including a description of the NSO's digital landscape (status quo) and roadmap, can steer the choice and procurement of relevant technologies, therefore directly addressing some of the aforementioned barriers.
- Very high internal IT competencies and empowered IT departments can improve and speed up the identification, testing, deployment and long-term maintenance of demanding technologies.

The specific barriers to and drivers of implementing technologies depend strongly on the kind of technology in question.¹ Two specific technologies of particular relevance for NSOs - geospatial data and analysis and mobile phone data - are discussed in Box 4.1 and Box 4.2.

Box 4.1. The special case of geospatial data and analysis

Geospatial data are data that have a geographic component. Leveraging such data is a very powerful way to discover (spatial) relationships between (social, environmental and economic) phenomena. Satellite and aerial imagery, combined with positioning systems (e.g. the Global Positioning System, Glonass, Galileo), provides alternative sources of data for computing statistics.

Barriers

- Access to high-resolution satellite or aerial imagery can be very expensive, especially when full national coverage is required. Freely available lower-resolution satellite images can often offer a relevant and efficient alternative, but additional information provided by high or very high spatial resolution may be needed to conduct some specific activities and analyses.
- The lack of an open and comprehensive data-sharing policy or legislation can be a barrier to sharing with the NSO official spatial datasets (administrative boundaries, land use and/or land cover, etc.) owned and maintained by other government organisations. Even when available to the NSO, those datasets may not always offer sufficient quality or be up to date, which hinders their smooth integration into the statistical production chain.
- Advanced geospatial practices require very specific (and expensive) tools and very specific competencies (e.g. devices supporting stereoscopic vision) and involve very high entry costs at all levels (hardware, software, staff capacity development, design and implementation of new statistical methods, etc.).

Drivers

- The United Nations (UN) Economic and Social Council has established the Committee of Experts on Global Geospatial Information Management (UN-GGIM) for the purposes of making joint decisions and setting direction in terms of the production, availability and use of geospatial information within national, regional and global policy frameworks. Led by UN member states, the UN-GGIM aims to address global challenges regarding the use of geospatial information, including in the development agendas, and to serve as a body for global policy making in the field of geospatial information management.
- The wide availability of open source technologies — QGIS for desktop applications; PostGIS and GeoPackage for data storage, and Geoserver, GeoNode, Geonetwork and many others for data and metadata dissemination and sharing — drastically lowers the entry costs for NSOs that are starting to harness geospatial analyses in their statistical production. Open source does not necessarily mean free: Even open source technology can require investments in terms of capacity development, maintenance, etc. Yet, these technologies provide NSOs with a straightforward way to test, evaluate and start the integration of remote sensing and geographic information system, or GIS, technologies.
- Open geospatial data also are widely available to replace or complement the more traditional commercial and official datasets (e.g. OpenStreetMap, Natural Earth, Sentinel).

Box 4.2. The special case of mobile phone data

Mobile phone data have emerged in recent years as one of the most promising sources of (big) data for official statistics. Within the official statistics community, it is widely expected that mobile phone data can be harnessed to fill data gaps (mostly in developing countries) and produce very granular and timely statistics in a range of sectors, including, among others, population, tourism and migration. However, the technology used must be chosen wisely to avoid strong biases. A recent study found that in Uganda, smartphone mobility estimates may differ by as much as 40% from estimates related to more commonly used, basic mobile phones; the research further found that even relying on basic mobile phone data would leave a significant share of the population (mostly the poorer and more marginal groups) under-represented in the statistics (Milusheva, Björkegren and Viotti, 2021^[38]).

Barriers

- The lack of specific legal frameworks, especially regarding data protection (access to and anonymisation of very granular personal data), is a significant barrier for NSOs seeking to harness mobile phone data in connection with a digital transformation.
- Ideally, 100% of the population and the national territory should have mobile phone coverage in terms of network and access to devices and mobile phone plans. As this is usually not the case, the dynamics at stake must be extremely well understood to avoid introducing biases in the statistics (e.g. one geographic area or one social group being significantly under-represented). Similarly, the geographic distribution of telecommunication operators' customers must also be sufficiently well understood as different operators often hold very different market shares in each region or province.
- Establishing data access protocols with several telecommunication operators or ensuring sufficient representativeness of the data if working with only one operator is complex.
- Fragmented capacities and mandates create challenges regarding the use of mobile phone data. For instance, an NSO might have the capacity to process large amounts of data but lack both domain-specific knowledge of mobile phone data and a mandate to negotiate with telecommunication operators. At the same time, while the information and communication technology ministry (ICT) might have such a mandate, it may lack the technical expertise to facilitate data exchange and processing.
- Most NSOs have the right to access data only from public authorities. Gathering data from private sector sources could require specific legislation.
- NSOs may lack the required technical and human capacities, such as encryption and anonymisation, to securely process massive amounts of data.

Drivers

Many experiments have been conducted worldwide that provide valuable lessons and methodologies to build upon. These include NSOs in Estonia and Indonesia (UNSD, 2019^[39]) and COVID-19 analytics in Ghana (Li, 2020^[40]), among others.

This data source responds to the need for very specific and timely-limited analyses. Analysis of mobile phone data, for instance, has allowed the Ghana Statistical Service to analyse and visualise the effects of mobility restrictions due to COVID-19 (Ghana Statistical Service, 2021^[41]). The analysis provides national decision makers with extremely specific information that traditional methods, such as surveys, could not have provided in such a short time frame. Conclusions included the following:

- Relative changes in mobility (travel within regions, distance travelled, number of locations visited) were generally of larger magnitude than changes in presence, indicating that subscribers altered their daily mobility but did not necessarily relocate as the result of the lockdown and subsequent recovery. However, there appear to have been some relocations (migrations) related to seasonal, cyclical patterns and perhaps other factors, with regions appearing to gradually gain or lose subscribers from September 2019 to January 2021. [...] As people begin to return to their pre-pandemic movement patterns, the increased exposure raises challenges in containing the pandemic. This increased risk of infection reinforces the urgency of a successful vaccination campaign and for the public to continue to follow the COVID-19 protocols (Flowminder, Ghana Statistical Service and Vodafone Foundation, 2021^[42]).
- The broad array of statistics that can benefit from mobile phone data can generate long-term economies of scale (e.g. several statistics produced on the basis of one data source versus multiplying surveys).
- Partnerships with telecommunication operators can drive digital transformation and the use of mobile phone data for official statistics. Mobile phone operators may see many benefits to such partnerships, among them the production of insights and statistics that they might currently not be legally allowed to compute themselves, new government-to-business partnerships, and benefits to their image and public relations.

4.3. Organisation and processes

Data and information flows

Barriers

- The lack of unified resources, processes and policies to store and manage data, information and knowledge, can lead to a widespread scattering of information sources (across media, repositories, servers, systems, computers, etc.), hindering the digital transformation. Those data and information silos need to be reunited and consolidated prior to building complex and comprehensive digital systems (e.g. data warehouses, complex and cross-sectoral analytical applications, dissemination portals). While technological tools will ultimately enable such consolidation, clear organisational rules and processes are prerequisites without which even the best technologies will be helpless.

Drivers

- The global official statistics community has worked together to develop several models and standards² formalising the good practices related to the general and specific statistical processes, including the Generic Statistical Business Process Model (GSBPM), geospatial GSBPM and the Generic Activity Model for Statistical Organizations (GAMSO); information modelling such as the Generic Statistical Information Model (GSIM) and data and production architecture including the Common Statistical Data Architecture and the Common Statistical Production Architecture). Implementing these standards in an NSO implies a deep rethinking and restructuring of the way the NSO functions, which will also trigger specific discussions and decisions pertaining to the way the NSO harnesses the digital world. For example, in GAMSO, the activities “manage IT”, “manage data suppliers”, and “manage information and knowledge” are obviously related to the way digital tools, processes and competencies are implemented in the NSO. In this sense, GAMSO is a good candidate for structuring the first steps of an NSO’s digital transformation because it would force the NSO to explicitly evaluate, discuss and address elements across the four dimensions. Implementing GSIM at a technical level, on the other end, cannot be easily done without a solid

pre-existing methodological and digital infrastructure (databases, metadata systems, the NSO's own data models, etc.).

- Piloting cross-sectoral statistics (e.g. environmental accounting) can very quickly reveal the extent to which the data sources are scattered and, in the worst case, duplicate or contradict one another. Such a pilot can facilitate mapping of the data sources and data flows and help identify priority areas for data integration.

Data security

Barriers

- Ensuring data security is one of the central mandates of NSOs. But a weak institutional understanding of the ICT good practices regarding the security of data can lead to counter-productive policies, decisions and practices. For instance, storage of data on local servers (as opposed to storage in the cloud) is sometimes considered safe because the data are physically stored within the country/territory - on the NSO premises - although a non-mature NSO's IT infrastructure might actually suffer from many security weaknesses, putting data integrity at risk. Similarly, a lack of appropriate data security policies (and, in some cases, inefficient technological tools) may leave NSO staff tempted to exchange data files as email attachments using their personal email addresses, thus making the data actually transit through servers and cloud infrastructures that are located in third-party countries and thus also jeopardising the data's security.

Drivers

An ICT strategy integrating a strong and pragmatic data security concept can lead, at least partially, to the identification and implementation of effective data security measures. However, such a concept should be realistic and implementable in light of internal constraints such as available technologies and tools, digital competencies, etc. Forbidding the usage of personal email accounts, for example, only makes sense if NSO staff have access to a robust corporate email infrastructure. A data security concept must, therefore, be anchored in the reality of the NSO (as opposed to exclusively based on the industry best practices). It further must be understood as an evolutive document that will be regularly adjusted to the reality of the NSO's digital transformation by explicitly integrating security aspects related to the new tools, technologies and approaches that are gradually being deployed. Given the very nature of the data at stake, a data security concept for NSOs also directly impacts data privacy, as defined by the 6th of the Fundamental Principles of Official Statistics ("Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.") or by the OECD Privacy Framework.³

4.4. System and/or environment

Financial resources

Barriers

- All the NSO representatives interviewed emphasised that a chronic lack of sustained and dedicated financial resources hinders them from implementing their digital transformation. Institutional budgets are not sufficient to sustain a working IT infrastructure, while external funding often focuses on pilot activities or on particular sectors and time frames.

Drivers

- Though an ICT strategy cannot overcome all the challenges raised by insufficient financial resources, it can at least provide a coherent framework to avoid the duplication of resources and promote synergies (e.g. sharing technical infrastructure and software licenses across projects, statistics and departments). Especially in the case of low and middle-income countries, which largely rely on external funding to support their digital transformation, a clear ICT strategy can help guide and co-ordinate donors' interventions, thus reducing overlaps and increasing the value for money of this assistance. At a higher level, integrating the NSO's ICT strategy with the strategies of other ministries and state institutions can also help identify cost-saving measures such as pooling of financial resources (e.g. to procure a server, a floating software license or training that is of interest for more than one institution).

Co-operation and partnerships

Barriers

- Co-operation with other state institutions (e.g. with mapping authorities when implementing geospatial approaches) is often challenging due to a lack of institutional agreements and policies, especially pertaining to data exchange or implementation of data standards.

Drivers

- Active co-operation and partnerships with external stakeholders can play an important role in sustaining data ecosystems by making partners accountable to each other. Relevant partnerships could include those between NSOs and:
 - policy units of line ministries (as data users)
 - universities and training institutions (for talent acquisition and to contribute to the capacities of the next generations of statisticians)
 - the private sector (for specific expertise).

Data culture, data usage and data demand

Barriers

- A weak data-use culture can hinder the adoption of modern digital technologies and approaches (Hammer, Ottaviani and Kumar, 2021^[43]). Systematic use of data and data-based insights can contribute enormously to improving human and environmental systems. However, the transformative power of data and statistics can only be leveraged if a broad data use culture ensures that they are systematically and correctly understood, interpreted and taken into account in decision-making processes. Strengthened data literacy (in the political sphere, in the media and among the general public) that fosters increased awareness of the hidden power of data can help NSOs better advocate for their own modernisation and digitisation.

Drivers

- The increasing demand for multi-sectoral frameworks and statistics (for Sustainable Development Goal monitoring, for example) requires NSOs to bring together and harmonise data from various organisations. Responding to this demand can foster the development and implementation of integrated data ecosystems, including standard data models, interoperability, advanced technologies to process disparate and massive data sources, quality insurance, etc.

Institutional framework

Barriers

- National/territorial legal frameworks are often quite restrictive in terms of how national/territorial data must be handled. But often not well adapted to the new data protection challenges raised by big data and cloud computing. For example, NSOs are often required to physically store their data within the country/territory, which hinders the usage of cloud computing even when in-country computing capacities do not allow for the efficient and safe storage and processing of big datasets. Moreover, large-scale clouds often offer a level of security that is completely unreachable for most NSOs (UNSD, 2021a, p. 429^[18]).
- Given the institutional and organisational prerequisites and implications of a digital transformation, weak institutional leadership can become an insurmountable bottleneck. Top NSO management must provide clear direction and commitment and encourage a broad, positive mindset and attitude towards change. In this way, the leadership can help break old habits and ways of working to overcome individual and institutional inertia.

Drivers

- Governments and decision makers are asking for more timely, more disaggregated and more specific data and statistics, giving NSOs a clear justification for requesting the necessary support for their digital transformation.
- Some NSOs are taking up a new inter-governmental role as data stewards, becoming the key facilitator for data quality, data standards and data-based digital transformation within government organisations. Through this new role, NSOs are able to directly and proactively influence high-level digital policies and priorities that, over the long term, will provide them with more robust framework conditions for their own digital transformation.

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Notes

¹ For an overview of other technologies directly relevant for the digital transformation of NSOs, see chapter 14 at <https://unstats.un.org/wiki/display/HSO/Full+Handbook+v2.3>.

² For additional information, see <https://statswiki.unece.org/display/hlgbas/High-Level+Group+for+the+Modernisation+of+Official+Statistics>.

³ https://www.oecd.org/sti/ieconomy/oecd_privacy_framework.pdf.

Annex A. Examples of digital transformations in national statistical offices (country examples)

The authors and PARIS21 staff conducted an extensive literature review as well as interviews with representatives of a few select national or territorial statistical offices (NSOs) in October 2021. The small number of interviews, however, does not allow to imply any statistically significant representativeness. The interviewed NSOs have, however, been selected based on PARIS21 and the OECD's experience and shall provide meaningful insights to understand the key challenges that NSOs from low and middle-income countries and territories face towards a successful digital transformation.

Representatives of these NSOs were interviewed:

ANSD	Agence Nationale de Statistique et de la Démographie, Senegal
DANE	National Administrative Department of Statistics, Colombia
KNBS	Kenya National Bureau of Statistics
NIS	National Institute of Statistics of Cambodia
NSO-MN	National Statistics Office of Mongolia
PCBS	Palestinian Central Bureau of Statistics

National Statistics Office of Mongolia (NSO-MN)

NSO-MN is increasingly using digital technologies for data collection. While the tools and methods are not yet fully harmonised and integrated yet, computer-assisted personal interviewing, computer-assisted web interviewing and computer-assisted telephone interviewing are increasingly used for most surveys and censuses. The lack of dedicated resources and staff prevents the necessary harmonisation and integration of tools and approaches across statistical sectors. While some surveys have been successfully digitalised, others lag behind, which means paper must be used alongside digital tools. A few key blockers have been identified:

- A comprehensive change management unit or department to support a radical shift in the way surveys are conceptualised is lacking. In some cases, the surveys are built along with the same logic as when they were paper based (old planning templates) and only subsequently made digital, though the entire statistical chain should have been re-thought to accommodate digital approaches.
- Inertia is a constraint. In an NSO, as in any company or institution, people are often reluctant to change, especially when change comes (at first) with additional burdens but unclear and/or unknown benefits (leading to reactions such as “it’s not the right time for this” or “try this somewhere else first”).
- Some surveys need to be filled out by respondents. While they are given the option to do so either by completing a paper questionnaire or electronically through a smartphone application, many respondents refused the digital option, fearing that the application might secretly collect private information.

Lessons learned

Even when the technological tools exist and are in use — in this case, digital tools for data collection — a comprehensive digital transformation can only succeed if frame conditions that are not purely technical are in place. For instance, a strategic and holistic approach to digital transformation is needed. Doing business as usual and merely replacing the paper questionnaire with tablets and mobile apps might offer short-term successes (e.g. data will be collected more quickly and more efficiently). But other pitfalls will present themselves, including the difficulty to adapt the data collection tool to other surveys or integrating the collected data within the statistical production chain. Other requirements of a comprehensive digital transformation include:

- tools, methods, staff and processes to manage the change
- communication and trust building, both internally (to convince staff that the digital transformation will benefit them and their work) and externally (to demonstrate to respondents and the general public that the NSO is collecting data in a transparent way and for virtuous purposes and that privacy is fully respected).

All in all, strong political support and high-level co-ordination, within the NSO but also within the whole statistical system, are of paramount importance, especially to facilitate the resolution of situations that are not well underway.

Agence Nationale de Statistique et de la Démographie (ANSD), Senegal

The Senegalese NSS is decentralised, with some surveys and statistics conducted by the statistical departments of line ministries rather than the ANSD. Since the reform of the NSS in 2004, the ANSD has, therefore, in addition to its traditional role as a producer of statistics, taken on new roles to promote, co-ordinate, harmonise and improve the production of data and statistics in the country as well as across the African continent. These include:

- With the establishment in 2021 of the *visa statistique*, any institution performing a survey must first have the approval of the ANSD, which is to validate the survey's quality and coherence, among other aspects, and ensure the standardisation of data (e.g. the usage of standard and/or official coding systems and ontologies).
- Through the National School of Statistics and Economic Analysis that it hosts, the ANSD leads initial and continuing statistical training programmes aimed at strengthening the capacities of other institutions in terms of statistical production.
- The ANSD has established a certification programme for surveyors that, among other things, has provided new professional opportunities to staff (e.g. data entry officers) whose roles are becoming less relevant as a consequence of the ongoing digitalisation.
- The ANSD is one of the “centers of reference” for the Collection of Electronic Data initiative, which sets the bar for South-South co-operation in terms of digital transformation. In the frame of this initiative, the ANSD, together with its counterparts from Brazil and Cabo Verde, shares its experience as an African frontrunner in terms of electronic data collection and electronic censuses.

The shift in the ANSD's main areas of responsibility to include national and regional data stewardship is embodied in several laws and policies, including the following:

- Senegal's third national strategy for the development of statistics rests on four pillars aimed at increasing, among other things, the user-centricity of statistical production, digital transformation, and regional and international co-operation.

- The country's Digital Strategy 25 (Stratégie Numérique Sénégal) envisions a national digital transformation for all and for all usages within an efficient digital ecosystem. One of its priorities is to put a digital administration at the service of citizens and businesses.

Lessons learned

As the users of statistics are diversifying their needs and requirements, no NSS can limit itself to its traditional roles, tools and processes. Moreover, synergies and harmonisation between all NSS actors are needed to rationalise, improve and speed up the production and dissemination of data and statistics in various forms and formats.

To address those emerging needs and requirements, the ANSD has efficiently taken up new roles and responsibilities, advancing from being purely a producer of statistics to being the data steward and guardian of data best practices and expertise. Two core framework conditions supported this shift:

- strong political and institutional support in the form of laws, policies and strategies that explicitly call for new mindsets and approaches toward the digital transformation
- user-centricity to address the needs and expectations of both data producers and data users.

By diversifying its activities and providing technical support to other state institutions, the ANSD is directly contributing to a smoother and wider adoption of modern digital technologies and to a better and more harmonised data production within the entire NSS beyond the ANSD itself.

This diversification of the ANSD's activities and competencies is also strengthening its role in terms of co-operation with donors and development partners. Thanks to the clear digital vision and strategies, it is able to take a big-picture approach to evaluate suggestions and ideas from externally funded projects after examining them critically and transparently. Among other benefits, this can help avoid an unwanted multiplication of platforms or a breach of national laws and priorities (e.g. refusing or adapting a project that would host official data on servers outside of Senegal).

Cambodia National Institute of Statistics (NIS)

User needs and requirements are at the core of the strategy and operations of the NIS, as outlined in the first strategic objective of its National Strategy for the Development of Statistics 2019-2023: to “develop, implement, and maintain a core data set of high quality by all institutions of the NSS under the leadership of the NIS to adequately respond to the statistical requirements of development processes arising from [the National Strategic Development Plan, the Sustainable Development Goal and Association of Southeast Asian Nations] sectoral strategic plans commitments and the needs of other users”.

This core principle, therefore, guides the digital transformation of the NIS, particularly observed in the field of data dissemination. Several portals — among them CamStat (<http://camstat.nis.gov.kh/>) — are based on the Statistical Information System Collaboration Community's .Stat Suite and have been deployed to facilitate user interactions with statistical data. Specific training and workshops have been conducted to help line ministries and other partners use these portals (e.g. in the production of customised tables).

To decrease the risks of duplication of platforms and to simplify and rationalise their institutional and technical maintenance, the NSI is in the process of finalising an information and communication technology (ICT) policy and strategic plan that will set a flexible and coherent frame for further digital developments. This plan focuses heavily on data security and data governance.

Lessons learned

User-centricity is a core element of a successful digital transformation. However, since users and partners often have different and even contradictory needs and requirements, a fully frameless user-centricity would increase the risk of engaging in ad hoc, poorly co-ordinated developments (duplicated platforms and tools, incompatible approaches and formats, weak data governance due to an increasing diversification of data storage locations, etc.).

As the example of the Cambodia NSI shows, a clear and binding (albeit flexible) ICT strategic plan can ensure that digital developments always take place within a coherent frame. Besides increasing the security and maintainability of the digital ecosystem, such a plan also allows an NSO to stay in charge of its own data governance, for example, by ensuring that the statistical data along its entire value chain are stored and processed within a data warehouse and not distributed across a wide array of external servers and cloud infrastructures.

By facilitating data integration across statistical sectors and by minimising the extent of external user interfaces, implementing an ICT strategic plan will also help the NSO respond more efficiently to more complex and transversal user requirements and thus increase its level of user-centricity.

Palestinian Central Bureau of Statistics (PCBS)

The PCBS has achieved a very advanced level of digitalisation for both statistical processes and support and administrative processes:

- Most statistics and surveys are collected electronically using tablets aided by geographic information systems.
- There is a coherent digital data dissemination ecosystem consisting of:
 - a statistical catalogue (metadata) - <https://pcbs.gov.ps/Stat-Data-Catalogue/default>
 - co-operation within a national team to produce the interoperability portal - <http://zinnar.pna.ps/InteroperabilityPortal/>.
 - a central dissemination portal - https://pcbs.gov.ps/site/lang_en/507/default.aspx.
- Most administrative services are digitalised in a management information system (human resources, payroll, assets, etc.).

The digital development of the PCBS is strongly anchored in the 2018-22 National Strategy for the Development of Official Statistics, its third such strategy. The following expected outputs (and their corresponding number in the PCBS strategy) are fundamental to its continuous digital development:

- 1.2.2. Statistical databases for the national statistical system (NSS) are modernised, including Sustainable Development Goals.
- 1.2.3. Geospatial statistical databases are available to be utilised.
- 2.3.2. Updated version of computerised forms for administrative indicators.
- 3.1.2. IT infrastructure (including security for storage and data flow) is available and used in the NSS.

An indirect result of its ongoing digital transformation is that the PCBS is considered a regional leader in terms of open data, which highlights how digitalisation and open data are closely interlinked. To buttress its position as a local and regional frontrunner, the PCBS also invests in data science, mainly by contributing to the design and development of a data science curriculum for local universities.

Lessons learned

Cutting-edge digital technologies and approaches such as data science will require NSOs to acquire and retain specific technical skills in the coming years. As those skills are not widely available in most low- and middle-income countries, NSOs can take a proactive role to help build the next generation(s) of statisticians whose skills will be vastly different from those of the current generation. In addition to skilled developers, researchers and data miners, it will be necessary to train a new generation of managers and sectoral statisticians who better understand the potential of cutting-edge digital technologies as well but also their risks and challenges and who can better plan, design and integrate these in the statistical chain.

Kenya National Bureau of Statistics (KNBS)

The digital transformation of KNBS is very closely intertwined with the support and involvement of donors and development partners, especially in the field of data dissemination. Partners and projects have deployed various platforms used to visualise and disseminate official statistics. As a result, the KNBS website currently references eight data-sharing and dissemination platforms, all with some level of overlap. Not all of the platforms are fully functional and updated. The eight are as follows:

- KNBS Data Visualisation is geared to enhance the statistics bureau's data dissemination capabilities (<https://knbs.or.ke/visualizations/>).
- Kenya OpenData enhances the data dissemination capabilities of the KNBS to increase the openness of national data (<https://opendata.go.ke/>).
- KenInfo <http://devinfo.org/keninfo/>.
- Kenya Data Portal presents Kenya data (<https://kenya.opendataforafrica.org/>).
- Integrated Multisectoral Information System, used to visualise various published datasets (<https://statistics.knbs.or.ke/binken/RpWebEngine.exe/Portal>).
- KeNADA is the Kenya National Data Archive (<https://statistics.knbs.or.ke/nada/index.php/home>).
- FinAccess data includes financial access status (<https://sites.google.com/view/finaccess-kenya/financial-inclusion-status>).
- Socio-Economic Atlas of Kenya features high-resolution data (<https://www.kenya-atlas.org/index.html>).

The existence of multiple platforms presents challenges and difficulties for KNBS, including:

- keeping the data up to date on all platforms
- avoiding conflicting data between the platforms
- ensuring a high level of technical and institutional ownership over the platforms
- providing technical maintenance of the platforms
- less clarity for the users searching for official data and statistics.

Lessons learned

Externally funded and externally conceptualised projects tend to have a technology-first approach, mostly emphasising the advantages of a specific tool or technology over the tools and technologies already used within the NSO. Often, this approach overrides the other dimensions of a successful digital transformation and leads to inadequate ownership of the newly introduced technologies, duplication of efforts and poor sustainability. Decision makers can avoid such a situation by considering a set of core questions before determining whether an NSO should adopt a suggested new tool or technology:

- Are there tools in place that do the same or more or less the same?

- To what extent is the newly suggested tool really better?
- Which tool — the old or the new — offers more universality (given that a tool that is widely used by the statistical community will usually be easier and cheaper to use and maintain due to synergies, etc.)?
- Are the already existing tools and/or approaches well anchored and maintained in the NSO? Is there already strong ownership? If yes, the (presumed) technological benefit of the newly suggested tool should be weighed against the challenges it entails, and the following points should be considered:
 - integration and/or replacement (moving data and practices from the old to the new tool and adapting the processes within the data value chain)
 - capacity development (training staff who are proficient in the old system to be able to use the new one)
 - maintenance costs
 - change management (careful planning for and implementation of the technological change)
 - finances (i.e. is the new tool or approach cheaper or more expensive to maintain in terms of license costs, required skills, etc.?).
 - need to inform internal and external users about using the new tool (reasons for adopting a new tool, expected benefits, release calendar, impact on the users, etc.).

These questions are not meant to deter NSOs from making changes or consider technological changes to be bad. Rather, they are reminders that it is not advisable to deploy a new tool simply because it is believed to be technologically better before analysing, understanding and addressing the implications in other dimensions.

Additionally, a strong and transparent digital governance model can clearly frame and set boundaries for the usage and deployment of technologies:

- A clear information technology (IT) and digital strategy can provide a strong and coherent frame to avoid the ad-hoc deployment of new tools, approaches and technologies.
- An efficient and transparent co-ordination mechanism can help harmonise all internally and externally funded projects to avoid duplication of effort and increase synergies.
- Transparent co-operation is needed among donors, development partners and NSOs to ensure that the long-term vision, requirements and strategies of the NSO take precedence over the shorter-term needs and requirements of specific external projects.

National Administrative Department of Statistics (DANE), Colombia (Departamento Administrativo Nacional de Estadística)

DANE started its digital transformation in the field of data collection in 2003 and now relies heavily on digital tools and approaches, for instance, using tablets for face-to-face surveys and dedicated web applications for business surveys. Given the fast pace of technological change, one of DANE's highest priorities is to ensure the continuous updating and improvement of its web tools and platforms to stay ahead of unavoidable digital obsolescence, guaranteeing users' access to the services provided, and increase the efficiency of its digital infrastructure.

To speed up the adoption of new technologies, DANE has established an informal innovation and development lab aimed at evaluating advanced, promising technologies and methods such as NoSQL, Hadoop, Spark and machine learning and to assess the extent to which these technologies can improve the services DANE provides to its users. As an example, the online census carried out in Q1 2018 was

built on more advanced, scalable and robust technologies (Mongo) and had a much higher response rate than expected, reaching more than 4 million people in 40 days and lower overall costs of data collection.

Lessons learned

The direct and indirect benefits of a specific digital tool or approach are very difficult to anticipate: The same technology might allow a significant advance in one context but prove to be an unsustainable burden in another one. It is important to recognise that digital transformation should also be an enabling asset to achieve something as complex as organisational culture and even the mindset of civil servants of the NSO, which reminds us of the need of mainstreaming this progress across the NSO and not just in a specific unit.

Moreover, enabling flexible testing and piloting scenarios for promising technologies helps an NSO identify technologies that have good potential and will reduce the challenges and difficulties once the technology is put into use. Such an approach can build upon the following concepts:

- An innovation lab and/or department should be explicitly tasked to actively scout for technology in close collaboration with sectoral departments and with users.
- Agile project management (Scrum or similar) can vastly reduce the costs and duration of testing new technologies by ensuring that frequent feedback loops with all stakeholders are timely and wisely taken into account.

Putting the users at the centre of the testing process — considering what the users need and want and how the NSO can benefit them — determining which technologies are more hype than relevant will also ensure that technologies of low value can be discarded early on.

Digital Transformation of National Statistical Offices

Digital transformations bring about fundamental changes in how institutions – from governments to businesses – operate. National statistical offices (NSOs) face growing expectations from data users and need to adapt their digital capabilities accordingly. For NSOs in low and middle-income countries, who may have had limited exposure to digitalisation to date, keeping pace with rapid technological change is challenging.

This report uses examples from six NSOs to explore common barriers for NSOs in their digital transformations and identifies specific drivers. The report makes a case for digital transformations through more comprehensive institutional changes such as governance, procurement and human resources. In addition, the report outlines specific recommendations at the individual, technological, organisational and system level to guide NSOs and their partners towards a successful digital transformation.

About PARIS21

The Partnership in Statistics for Development in the 21st Century (PARIS21) promotes the better use and production of statistics throughout the developing world. Since its establishment in 1999, PARIS21 has successfully developed a worldwide network of statisticians, policy makers, analysts and development practitioners committed to evidence-based decision making. With the main objective to achieve national and international development goals and reduce poverty in low and middle-income countries, PARIS21 facilitates statistical capacity development, advocates for the integration of reliable data into decision making and co-ordinates donor support to statistics.



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