# Measuring ICT driven Public Sector Innovation

By

**KIM, Wooyoung**

**CAPSTONE PROJECT**

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Committee in charge:

Professor Lee, Taejun, Supervisor _____

Professor Lee, Junesoo _____

Professor Park, Jin _____

Approval as of May, 2022

## ABSTRACT

### Measuring ICT driven Public Sector Innovation

By

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The public sector has traditionally been viewed as a passive actor for innovations compared to the private sector. In recent years, however, public sector innovation has been increasingly recognized as a key facilitator to maintain a high-quality public services for businesses and citizens and not to mention, improving welfare and addressing environmental, societal and economic issues. ICT is recognized to be the driver for adding speed to this innovation, enabling efficient and effective digital environment and delivering public services in a simpler and more inclusive way. The study sought to examine various methodologies that may be useful in adapting to measure these ICT driven public sector innovations. Furthermore, against the call for internationally accepted measurement method, recomposed indicators under the 6 dimensions of OECD Digital Government Policy Framework (DGPF) have been proposed. Then, steps to adapt the standardized measurement to respective national context are elaborated, inducing a Common but Differentiated Measurement Method for ICT driven Public Sector Innovation. In the ever more connected world we live in, it is essential to comprehend the entire progress and potential of deploying ICT in the public service delivery sphere for enhanced governance capacity.

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## 1. Introduction

Public sector is the world's largest service conveyor and provider of effective governance to the general public. It plays an important role as a liaison between the government and the members of the society, impacting millions of people in it. While many of the perception today is focused on the private sector service delivery, Jackson (2020) supported the imperativeness of public sector by implying that "despite the importance of the private sector in leading economic growth and development, the principal actors or agents responsible for creating interconnections between service users in the economy are public services, which in short is the government". The process of delivering service and utility by this 'agent (Public Sector)' to the 'principal (Citizens)' would be not only the key metrics for achieving the ultimate objective of connected government in a national level, but also in a larger scope, a cross-cutting enabler of achieving the global agenda: 2030 Agenda for Sustainable Development (UN HLPF, 2019).

In acknowledgement of the significance of public service delivery, amid the turbulent era of the digital age and 4$^{th}$ industrial revolution, there have been constant efforts to boost the effectiveness, transparency, and accountability of governance and public sector services using 'Information and Communication Technology (ICT)'. Several agencies and governments have conducted case studies and practices, arguing that ICT can be used in various applications to accelerate information dissemination, improve the efficiency of public services, increase accountability and transparency in government administration, reduce corruption, and promote citizen participation in various dimensions of public governance (Subhash [ADB], 2014). To name a few, among many of the existing potentials of ICT-enabled public provision, the ability of ICT to address the asymmetry in access to information and thereof better managing the principal–agent problem (Gurbaxani and Whang, 1991) would be one standout benefit.

Adopting ICT intervention in an existing program for faster, broader and more accurate delivery of public services would be another (Subhash [ADB], 2014). It was also highlighted that ICT use in governance sector is essential for attaining the UN Sustainable Developments Goals (SDGs), "promoting economic growth, strengthening communications, improving energy efficiency, protecting the planet and improving people's lives" (ITU, 2018).

While the efficacy and capability of ICT-driven Public Service Delivery is evident and proved to be the way forward in coping with the digitized world, measuring its innovative change and impact is becoming all the more complex. A number of papers have recognized the potential benefits of electronic delivery of government services, but they also acknowledged the fact that it is not easy to coherently measure these potentials. A case in point, Bhatnagar's book (2013) on combating malfeasance has acknowledged ICT's critical role in reducing corruption but pointed out that it has not been easy to identify the critical success factors and measure the impact. This could be attributed to the lack of an objective 'price measure' of public sector innovation meaning that efficiency, effectiveness and impacts of innovations in the public sector are rarely if ever studied and mostly dependent on self-reported data and personal perceptions (OECD, 2020). Furthermore, most of the conducted measurement efforts have counted on survey channels and been presenting results from 'successful innovations'. Policymaking today is still largely focused on what is easier to measure (OECD/EUROSTAT, 2018) and size of their innovation and influence is not examined (OECD, 2020). Due to these varied factors, there is are challenges in measuring ICT driven Public Sector Innovation and not only that, there is also no global standardization for measurement which would enable an international comparison.

In this regard, this paper aims to analyze various methodologies of measuring public sector innovation from fore-runner institutions and existing studies that can be applied in the

ICT measurement context. Also, the paper presents a policy recommendation on establishing an internationally accepted barometer for measuring ICT capacity in the public sector through composite evaluation approach via the OECD Digital Government Policy Framework (DGPF). It also identifies the critical success factors for adapting this commonly acknowledged indicator to one's own national context for comparable ICT driven Public Sector Innovation measurement.

### 1.1 Statement of Problem

Emerging social, economic and environmental issues require innovative ideas and greater levels of multilateral co-operation between the people and the government. As innovation are playing a crucial role in myriads of sectors, policy makers are placing the 'innovation imperative' at the core of their policy agendas. The vast studies on innovation of the private sector businesses have immensely enhanced our comprehension towards the processes, results and impact the innovation can bring to contemporary economies. Nevertheless, the imperative role that the public sphere may play for the mass public has been largely excluded from this work and the lack of quantitative and qualitative measurement have limited the ability to better understand it.

While strenuous attempts were made to create a measurement tool for ICT driven public sector innovation, due to the 'service' nature that the public sector accompanies, skewed biases and lack of comparability, it has been especially difficult to measure the impact of its innovation. Here are some of the points for illustration (OECD, 2020):

i) **Intangibility of Services**: The service is intangible and is characterized by simultaneous consumption and production. Therefore, different proxies must be utilized to measure the real impact of ICT innovation on service productivity.

It is also difficult to provide aggregated measures or external validity measures for outcomes (OECD/Eurostat, 2018)

ii) **Lack of Market / Price Measure**: There is a lack of market and a price measure in the public sector innovation, meaning that efficiency, effectiveness and impacts of innovations in the governmental sector are difficult to be measured and studied.

iii) **Reliant on Survey Methodology**: Survey methodology may be useful for measuring success stories of innovation. However, the changes, size of influence, how factors are interlinked is difficult to measure. Also, the measurement depends on satisfaction surveys or perceptions at most and tend not to address broader legitimacy needs.

iv) **Subjectivity & Positive Prism**: Innovation may be seen as something that is always beneficial. Measurement efforts sometimes directly reflect the objectives the researchers want to see, as goes the maxim – "what gets measured gets done". From the respondent side also, there may be positive bias in the data as only successful innovations may be reported and internal answers may carry some element of subjectivity.

v) **Self-assessment bias & Negative Prism**: When making internal self-evaluation, managers tend to be more positive than other parties and stakeholders. Ironically, on the other hand, those who perform well and are more aware of innovation is likely to be more critical about their own work than respondents with limited public sector innovation knowledge.

vi) **Rely on Case Studies, Can't make comparison**: the failure or success of ICT driven public sector innovation is mostly focused on individual case studies. Therefore, they are difficult to make comparison to other settings. They have high internal validity, but low external validity and generalizability

vii) **Overreliance on private sector evaluation**: Current measurement on public sector innovation originates and much refers to the theories and experience of the private sector innovation assessment. There is a lack of public sector specific theory of change and linkage.

Against this backdrop, there is an essential need for discovering and analyzing appropriate methodologies and best practices of measuring public sector innovation. This will

serve as a benchmark for policy and decision makers in transitioning its approach to a tailored international ICT innovation measurement effort. As a result of these challenges, a globally accepted framework and tools for measurement of ICT innovation in the public sector are yet in place. Although internationally agreed concepts and barometers for measuring innovation exist for the private sector, there is not yet a similar framework for the public sector. Therefore, there is a need of effort to make a consensus on a commonly acceptable barometer for measuring ICT innovation in the public area.

### 1.2 Research Questions

Notwithstanding the imperativeness of ICT driven public service innovation, there are lack of studies on the methodology for the measurement approach and also, there is currently no sufficing measurement tools and indicators that can be adopted universally. It is important to note that once the common measurement is established it can not only provide a broad set of indicators that can enable international comparability in the field of ICT driven public sector innovation, but also help countries monitor its current state, efficiency and costs. The results will help governments improve on their lag factors, move closer to their goals and provide client-oriented services. That being said, this paper will attempt to answer these research questions:

1) What are the methodologies that the international community can benchmark on for measuring ICT driven public sector innovation?
2) How can we establish a universal measurement tool that can be internationally applicable yet locally adaptable?

### 1.3 Structure of Paper

The structure of the paper will be mapped as in the following order. Chapter 2 offers a literature review on the critical role of ICT and its potential as a facilitator for innovation in the public sector, followed by the fundamental question of why measuring ICT driven public sector would be a requisite. Chapter 3 delves in to 6 methodologies that provide benchmarkable reference of which the international community can adapt to ICT context. Chapter 4 provides policy recommendation on establishing a universal barometer via the OECD Digital Government Policy Framework dimensions and a guideline to adapt it to national context. The paper is then concluded with a summary.

## 2. Literature Review

### 2.1 Critical role of ICT in the Public Sector

The public sector serves to provide quality public services and responses to the needs of citizens and businesses while developing and maintaining government trust. Its responsibilities may include ensuring public order, safety, administration, education, health, and social care for citizens. The public sector is an important economic actor, accounting for between one-third and over one half of GDP in most OECD countries (Innovation Policy Platform, 2015).

In the contemporary society, the public sector is faced with increasing demands, such as addressing challenges deriving from demographic, climate change, sustainability issues and how to better respond to users' various needs. At the same time, the government across OECD countries are operating under tight fiscal constraint, making it necessary to deliver better outcomes at lower costs (Innovation Policy Platform, 2015). In this context, Information and

Communication Technologies receives spotlight as a silver bullet against the emerging challenges and as a facilitator and means of public sector innovation. ICT has long been considered as a trigger of modernization in public administrations (Seri, P., & Zanfei, A. (2013) as ICT empowers and avails governments to find new ways to deliver user-centered online services, reduce transaction costs and provide tailored services to individual needs. The government also utilizes ICT to change service delivery approaches and encourage users to plan or request services using Web 2.0 tools (OECD, 2012). The advent of COVID-19 crisis has even more highlighted the importance of ICT use as citizens who cannot leave their homes be it voluntary or involuntary, have relied entirely on digital delivery of public services. Ranging from enrolling in education, applying for jobs, running an enterprise, filing claims, vast dimensions of day-to-day life has transited online through ICT for millions of people.

In a nutshell, many of the digital and technological applications create services that are more user-friendly, demand-driven and well-defined. The application of ICT can be expected to: i) enhance openness, accountability, transparency and inclusiveness, ii) promote better interaction between citizen-government and iii) facilitate implementation of modern, cutting-edge techniques and methods in public management. Moreover, ICT usage can iv) introduce fundamentally new ways of addressing different phenomenon in the public sector. v) Careful application with big data, social media scraping, machine learning, artificial intelligence and crowdsourcing information can introduce innovative breakthroughs for the public sector.

Realizing the prospective potential and great ripple effect that ICT can bring to the public area, many countries have shown great efforts as a national strategy to mainstream ICT in the governmental area. As a case in point, Uganda has a legal framework for digital government that includes the holistic provision of data protection and open government for public service delivery. The e-Government Master Plan strategy of the country puts strong

emphasis on enhancing ICT usage in public institutions, making it mandatory that every government entity has its own online portal. Rwanda highlights on emphasis on catalyzing a knowledgeable and prosperous society using smart ICT strategies in line with the Vision 2050 strategy and the Smart Rwanda Master Plan. Despite having limited resources, the country has made strenuous efforts in electronic transformation of public services, allowing most public officials of Rwanda to have extensive use of ICT and internet in their everyday work. These efforts have led to two-way communication allowing interactive principal agent feedback, enabling not only e-service update from the government side but also engaging people to request the needs directly. (UN, 2019). In the Republic of Korea, the e-Government 2020 Master Plan focuses on the implementation of an open and innovative government for the citizens and guarantees that national policies are digital and ICT-based. Moreover, the Intelligent Government Master Plan endorses a framework for the utilization and development of Artificial Intelligence (AI) and data for innovation in public administration and a strategic plan to provide citizen driven services to especially accommodate the most vulnerable groups. Moreover, the Government provides open data (data.go.kr), e-procurement (KONEPS) and e-platforms for e-participation (e-People). (UN, 2020)

As such, many countries have acknowledged the critical role of ICT as the facilitator of information flow between governments and the public and have recognized the innovative power in the aspect of public sector performance that may include: connection technologies, innovative applications, promotion of knowledge exchange, technical cooperation and capacity-building for sustainable development (UN, 2022).

### 2.2 Innovation in the Public Sector

Innovation in the Public Sector as a concept has many definitions available. It may imply "creating and implementing new combinations that change existing practices, whether this change emerges incrementally or radically and whether the innovation is evolutionary or revolutionary" (Van Duivenboden, H., & Thaens, M., 2008). Likewise, the Oslo Manual of OECD defines innovation as something new or significantly improved and implemented into practice. The general definition of an innovation outlined in the Oslo Manual is as follows:

> *"An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).* (OECD, 2020)*"*

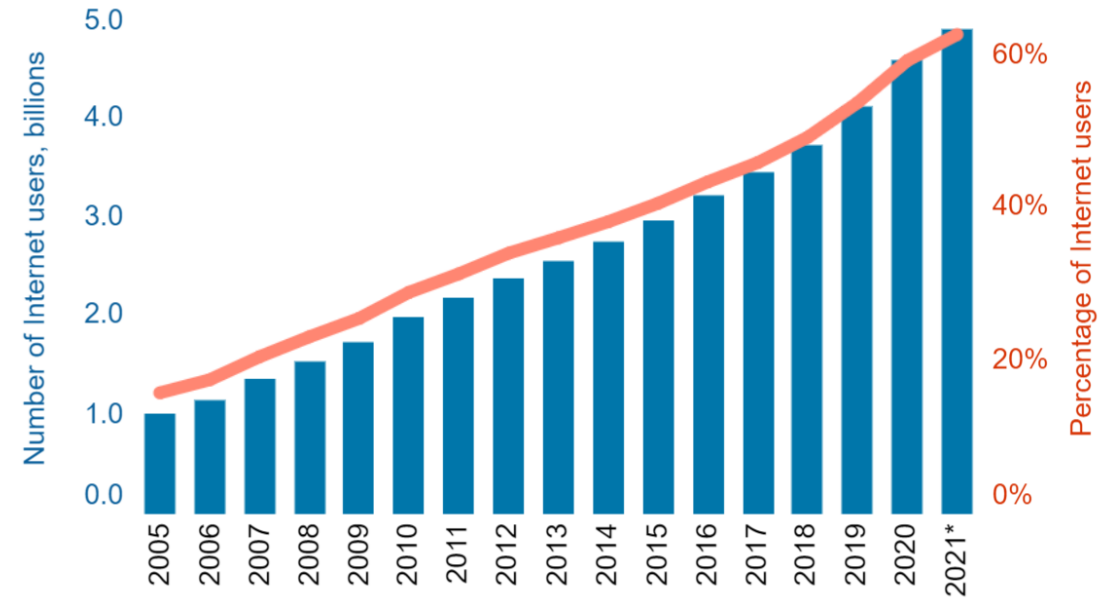
A common understanding of all these definitions highlights on the renewal of existing ways in which the work is carried out (sometimes also organizational structures) and creation, implementation of new services, processes and products that leads to substantial improvements of efficiency, effectiveness or quality.

The concept of innovation has its foundation in the private sector, but experts have pointed out that it is an equally important concept for the public sector as well. In the public innovation sphere, technology and innovation are often seen as interrelated concept. The utilization of modern technology can be leveraged to commence, stimulate or deliver changes within the government. It is one of the supportive factors and a sufficient condition that can bring up breakthroughs, and the specific technology implied is often ICT (Van Duivenboden, H., & Thaens, M., 2008). ICT can be a trigger for innovation in those certain ideas that were not realized in the past and put in to practice due to the enabling capacity opened up by modern technology. ICT has an innovative power to bring about extensive changes in the public sphere

and can become a tool that can be used to implement a more effective and efficient service delivery. In this context, the public organizations that do innovate can generate new and better ways for service delivery, increase value that the organization provides, be responsive to questions and demands from citizens and businesses, enhance efficiency and decrease costs for the organization. Although the impact of ICT in each innovative cases may differ, ICT commonly plays a role as a driving force (or 'enabler') for revolutionary breakthrough in each of them.

### 2.3 Importance of measuring ICT driven public sector innovation

**Figure 1** Individuals using the Internet (ITU, 2020)




Source: ITU
* ITU estimate

According to ITU facts and figures, individuals using the internet reached over 60% of the whole population, which is around 5 billion citizens making use of the internet services. In alignment with the increased availability and accessibility of ICT and digital technology in our everyday lives, it is all the more pertinent to make measurement efforts and understand on how

the government take advantage of this high online connectivity and adopt ICT for its full-fledged capacity in delivering transparent, inclusive and effective services.

In addition, it is important to measure ICT driven public sector innovation as through these efforts, we can expect a varied potential usages and objectives ranging from broader, general purposes to more specific ones. At the broad national/organizational level, innovation data can be used as a management tool. The outcome of measurement can be used in benchmarking, evaluations, international comparison, and analysis of good practices and therefore, help improve the public sector bodies to diffuse innovation within and foster potential ICT usages. On a general use, the measurement can support raising awareness, gain better understanding of what ICT driven public sector innovation is, and sharing general trends and possible policy discussions. On a more specific level, government officials need the data and signals to get a grasp of when innovation may be in need and, in that case, what resources may be required. Therefore, a more specific data shall be demanded. Such examples would be: research analyses (e.g. innovation cultures, knowledge transfer, productivity analyses), and data needs for specific policy initiatives (e.g. Specific programs, promoting private/public cooperation, innovative procurement) (OECD, 2020).

## 3. Measurement Methodologies

In 1991, Oslo Manual, the first edition of the OECD's manual on measuring and collecting statistical data on private sector innovation was published. Since then, several editions were published with updates. Based on the framework of the Oslo Manual, multiple efforts have been made to conduct similar measurements for the public sector innovation. For example, in 2011, the five Nordic countries conducted a joint pilot, Measuring Public Innovation in the Nordic Countries, known as MEPIN (Danish National Center for Public

Sector Innovation, 2021). The project aimed to adopt questionnaires to a public sector context but many of them were quite similar or more or less skewed towards measuring methods used for business sector innovation. Other efforts were set out by countries and institutions world-wide, but the lack of consensus has led to inconsistent and non-comparable methodologies.

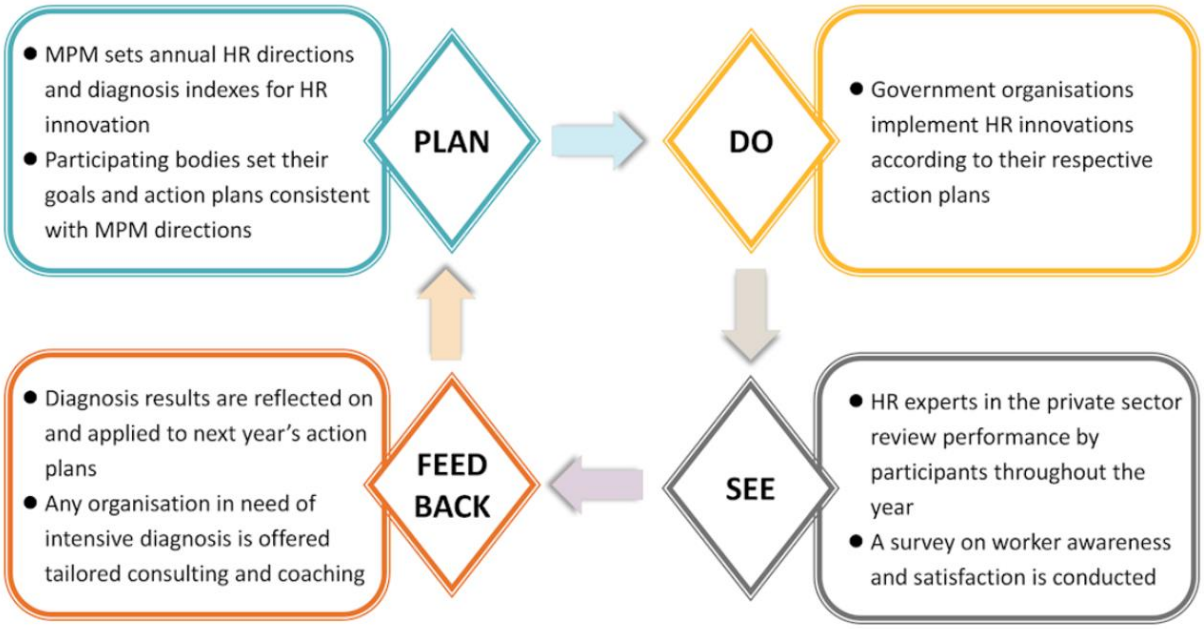
In this context, the paper would like to introduce and elaborate on various methodologies that could be adopted and benchmarked as a referential approach. The purpose of this Chapter is to delve in to the past and currently existing practices and takeaway prospective features and open the opportunity to adapt to specific needs. The paper has identified six categorization of distinctive measurement efforts in the public sector and will study the approaches and indicators utilized in structuring the framework for measurement, often a comprehensive outcome supported with sub-divisional pillars.

### 3.1 Self-Assessment

- Personnel Management Innovation Diagnosis Indicator (Ministry of Personnel Management, Republic of Korea)

One methodology to measure public sector innovation is through self-evaluation. In 2014, the Republic of Korea founded the MPM, the Ministry of Personnel Management in charge of HR innovation. With increased demands for effective personnel management, in 2015, MPM has initiated a development of the 'Personnel Management Innovation Diagnosis Indicator' with efforts to carry out objective assessment of public management innovations of each government and provide feedback to enhance its innovation capability (OECD, 2019). The innovation was made and measured through a iterative cycle of PLAN, DO, SEE, and FEEDBACK as could be found in the below Figure 2.

**Figure 2** The Public Management Innovation Indicator Cycle (OECD, 2020)




*Source*: Korea Ministry of Personnel Management, 2018

In the PLAN stage, participating entities set the goals and action plans of their own with regards to the direction and diagnosis indexes of the thematic focus. In the DO stage, the organization implement the innovative approaches set out in the action plan. In the SEE stage, external experts of the thematic focus review the performance by participants and conduct a survey on the workers to evaluate their satisfaction and awareness level towards the innovation plan. In the FEEDBACK stage, the results of the diagnosis are evaluated and reflected on the next year's action plan and any lagging entities in need of further diagnosis are given the opportunity for tailored coaching. The 4 stages will be in rotational cycle on a yearly basis.

**Figure 3** Methodological Approaches (OECD, 2020)

| Methods | Characteristics |
|---|---|
| **Quantitative diagnosis method** | 33 indicators (75%)<br>e.g. open position and non-public servant employment rate, increase in employment of female managers |
| **Qualitative diagnosis method** | 2 indicators (11%), used when the quantification and objectification of the performance is difficult<br>e.g. excellence in PM innovation plan, appropriateness of education and training plan |
| **Awareness and satisfaction survey method** | 6 indicators (14%), commissioned to an independent surveying agency<br>e.g. awareness of annual leave, awareness of flexible working, satisfaction in HRD |

In looking into the specifics, MPM utilizes various diagnostic methods to measure these indicators. Quantitative methods with 33 sub-indicators consists of open position and non-public servant employment rate and increased number of female seniors, etc. Qualitative methods with two indicators such as excellence in PM innovation plan, suitability of training and education plan complements the diagnosis and is utilized when the quantification and objectification of the performance is complex. Awareness and satisfaction survey method which is commissioned to an independent survey consists of 6 indicators such as awareness of leave policy, awareness of alternative working arrangement, satisfaction in HRD, etc. (OECD, 2020). With the findings, the ministry convenes a quarterly workshop to present best practices and implementations for benchmarking (Ministry of Personnel Management (2017).

The self-evaluation approach of MPM can be adapted to measuring ICT context of public sector innovation also. Through the 4 stages of PLAN-DO-SEE-FEEDBACK cycle, an iterative self-assessment and constant reflection of feedback can be made for determined ICT innovation pillars. Applying a composite quantitative, qualitative and complementary survey method in the context of digitized connectivity may enable a comprehensive and multifaceted understanding of the ICT driven public sector innovation that the organization seeks to achieve. In addition, the diagnosis can be adjusted and updated annually after reflecting the change of trends which will keep the measurement questions and methods up to date. All in all, the self-assessment approach will serve as an iterative self-contemplation that enables multi-dimensional understanding and measurement flexibility in a constantly changing ICT environment.

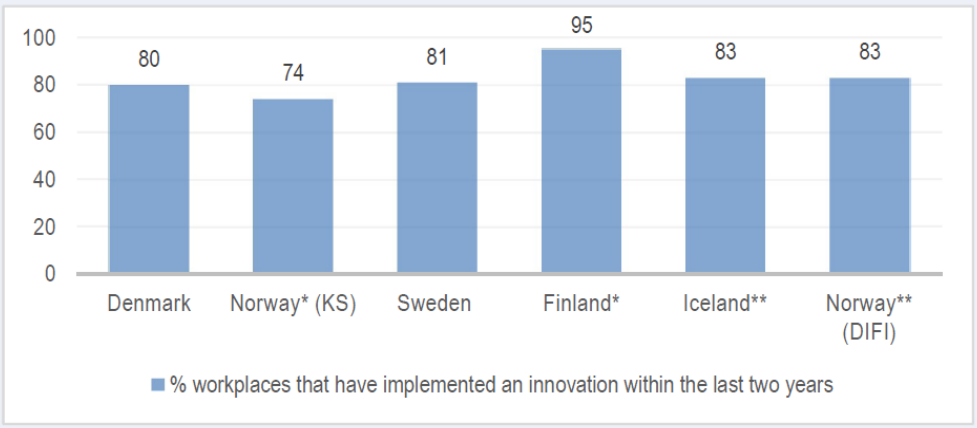
### 3.2 Regional Assessment

- Innovation Barometer: Measuring Public Sector Innovation in the Nordic countries. (MEPIN)

There have been efforts to measure public sector innovation in a regional dimension. Developed in collaboration with Statistics Denmark and The Danish Centre for Studies in Research and Research Policy, the Innovation Barometer is the worlds' first official statistics on public sector innovation which was applied in the Nordic countries (Denmark, Sweden, Norway, Finland, Iceland) through the common innovation network – Nordic Innovation Hub. Based on the input from the Oslo Manual, it measures the types of public sector innovation, types of values innovation addresses and the degree of newness, from survey data collected through a pre-developed questionnaire for public sector workplaces (OECD 2020).

The questionnaire is web-based and carefully designed to gain the insight and inspiration required by experts in the field, who may be public sector employees involved in innovation work and political decision making. The names and e-mail addresses of the leaders of each individual public sector workplaces were collected in advance via the internet or, if necessary, by phone. Then the e-mail was sent with a link to an online version of the questionnaire with extensive use of filter. To make the evaluation data consistent yet comparable across Nordic countries, questions regarding the character of the public innovation were asked in the same way and the definition of public sector innovation was presented identically (Danish National Center for Public Sector Innovation, n.d). This has allowed for a communicative, interdisciplinary and shared Nordic analyses.

**Figure 4** Nordic Analysis of % workplaces that have implemented an innovation within the last two years (Krogh Jeppesen, 2018)




*Note*: * Workplaces at local and regional level ** Workplaces at state level

*Source*: : Krogh Jeppesen, 2018

Continued efforts were made by Nordic countries on practicing similar but differentiated innovation measure in accordance with national agendas, contributing to methodological adjustments, and improving the original survey design.

**Figure 5** Communicative platform for innovation comparison across Nordic countries (Krogh Jeppesen, 2018)


*Source*: Krogh Jeppesen, 2018 and https://www.coi.dk/en/what-we-do/innovationbarometer/

As could be found from figure 5, the regional assessment has enabled regional level

innovation comparison across the Nordic countries and has led to the establishment of a communicative platform where countries can raise further queries and exchange feedback on each country's innovation performances and efforts.

As such, the regional assessment for ICT driven public sector innovation may take place and be beneficial in allowing for a more communicative environment within specific district. Thanks to geographical proximity, countries tend to have better understanding of the neighboring countries situation and are easily open to interaction in measuring and comparing ICT public services of each country. The communicative platform enables a mutual regional level comparison where public sector innovation can be practiced synergically. Moreover, the regional comparison eliminates exclusive generalizability and adds external validity to the measurement outcome than the self-assessment.

### 3.3 Survey

- ITU Core list of Indicators

As a traditional approach to measuring innovation and effective changes in the public sector, there are several pertinent 'survey-based' approaches that demonstrates ICT driven public sector evaluation. Launched in 2004, the 'Partnership on Measuring ICT for Development' is an international, multi-stakeholder initiative that was initiated to identify and enhance the quality of ICT data and indicators. The membership includes 14 international and regional organizations that have particular expertise in the collection and dissemination of ICT statistics. As one of its key achievements, the Partnership has identified the 'Core List of ICT indicators' which provides necessary ICT statistics to policy makers for informed decision-making. The list has been carefully reviewed and evolved over time and now has over 60 solid

indicators which are agreed upon via experts from governments and international organizations in the field of information society measurement.

This Partnership recommends the core list as a basis for country's ICT data collection, and one of the areas covered are: ICT in government (ITU, 2016). Endorsed by the UN Statistical Commission (last in 2014), the list was developed to help countries locate their status quo in ICT development and information society preparedness. Specific indicators that are utilized for respective core list are clearly defined and in line with statistical standards, allowing important comparative analysis across countries.

To measure ICT advancement in government area, ITU, ECA and the members of the Partnership and National Statistical Offices (NSOs) collects the core indicators on e-government (EG1 to EG7) through carefully designed survey questionnaire. (UN ECA, 2014) The below is the list of the core indicators set out to measure ICT advancement in government.

**Figure 6** List of the e-Government Core Indicators (UN ECA, 2014)

| Code | Name of the e-government indicator |
|---|---|
| EG1 | Proportion of persons employed in central government organizations routinely using computers |
| EG2 | Proportion of persons employed in central government organizations routinely using the Internet |
| EG3 | Proportion of central government organizations with a local area network (LAN) |
| EG4 | Proportion of central government organizations with an intranet |
| EG5 | Proportion of central government organizations with Internet access, by type of access |
| EG6 | Proportion of central government organizations with a web presence |
| EG7 | Selected Internet-based services available to citizens, by level of sophistication of service |

The above indicators can be classed into 4 pillars (UN ECA, 2014):

- Use of ICT by persons employed in government organizations. EG1 and EG2 are presented through measuring the proportion of persons employed in government organizations using ICT technology.

- Availability of ICT to government organizations. EG3 to EG5 are presented as the

proportion of central government organizations with (or using) ICT technology.

• Use of ICT by government organizations. Indicator EG6 is presented as the proportion of central government organizations with a web presence.

• Supply of e-government services to citizens (via publicly accessible websites). Indicator EG7 deals with selected Internet-based services offered by central and state government organizations.

As such, through the survey methodology, we can create a well-defined ICT relevant questionnaire and indicators for measuring public sector innovation in consultation with various experts in the field. This will help evaluators ask the 'right' question through collective intelligence of partners. As conducted from the above approach, by asking questions to the national statics division and government officers at the forefront of the work will offer a most direct and well-accumulated answers that can assist the evaluation of the ICT driven public sector innovation.

### 3.4 External Evaluation

External evaluation can help make objective assessment and comparison when measuring public sector innovation with regards to ICT. Sometimes, responses made by the insider is subject to biased representation and manipulated results. Against this backdrop, here are some methodologies implemented by two institutes.

- EU eGov benchmark (Mystery Shopper)

The eGovernment Benchmark 2021 measures and demonstrates a holistic, data-

centered assessment of development in the digital public service delivery across 36 European countries including 27 European Union Member States, UK, Norway, Iceland, Switzerland, Montenegro, Albania, North Macedonia, Turkey and Serbia referred to as 'EU27+' (Capgemini & European Commission, 2021). The EU eGovernment Benchmark analyses countries on respective nations' characteristics and availability of ICT driven public services and gives participating countries a better understanding of where they stand, where their strong points and weakness lie and where they may be able to accelerate better.

In order to present a holistic overview on how each country carry out in the Digital Government, 93 services are analyzed across eight Life Events: Starting a Small Claims Procedure, Studying, Career, Family, Moving, Business Start-Up, Regular Business Operations, and Owning/Driving a Car – a package of ICT driven government services that the average citizens or entrepreneurs are likely to be in need or would encounter at some point in their lifetime. To make valid comparisons, the measurement is conducted against four dimensions: i) User Centricity, ii) Transparency, iii) Key Enablers, iv) Cross-Border Mobility, which consists of 14 underlying indicators, broken down into 48 survey questions (Capgemini & European Commission, 2021)

**Figure 7** Four Top-level benchmarks (Capgemini & European Commission, 2021)

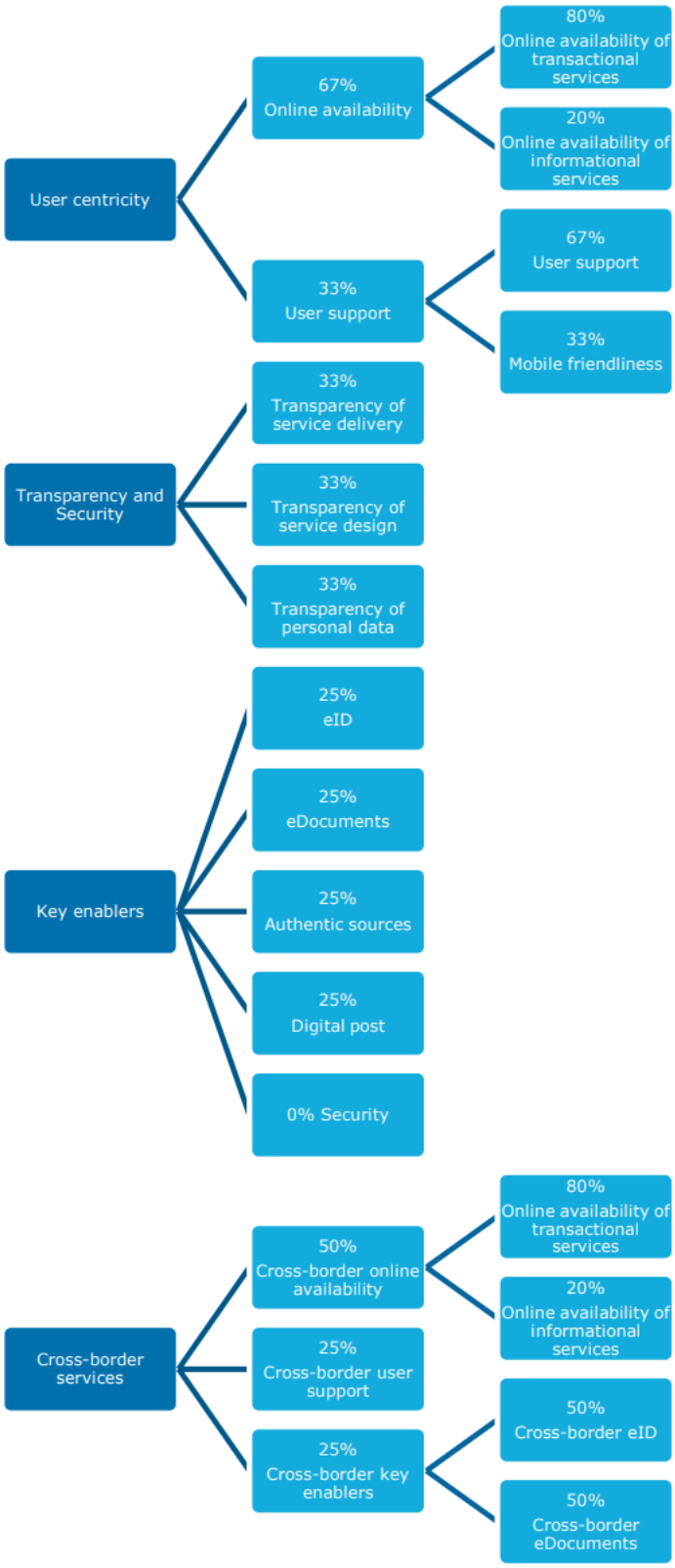
The digital services are scored according to the following top-level benchmarks:

1. **User Centricity** – To what extent are services provided online? How mobile friendly are they? And what online support and feedback mechanisms are in place?
2. **Transparency** – Are public administrations providing clear, openly communicated information about how their services are delivered? Are they transparent about the responsibilities and performance of their public organisations, and the way people's personal data is being processed?
3. **Key Enablers** – What technological enablers are in place for the delivery of eGovernment services?
4. **Cross-Border Mobility** – How easily are citizens from abroad able to access and use the online services?

In order to assess the afore-mentioned Life Events and without bias, deliberately trained Mystery Shoppers are selected from the participating countries, who are citizens of each of the countries. Before conducting the evaluation, they are briefed and trained to consistently measure and observe an identified public service process and act as an expected user for these digital public services. To ensure coherent landscaping, all these external evaluators are given the same training and briefed by the central research team. They evaluate the public sector services following a well-structured, detailed, and standardized checklist provided by the European Commission. These external evaluators are involved in every step of the assessment from deciding which website to study, identifying key features to be analyzed, correcting inaccurate information and collaborating with relevant entities. The results from the assessment are validated by representatives from all the participating member states. For the 2021 result, they have visited 7,877 webpages: 725 mobile apps/responsive websites, 350 cross-border portals, 352 national portals, 1,257 cross-border webpages from another government and 5,193 webpages from their own government (Capgemini & European Commission, 2021).

Additionally, based on the emphasis the evaluators want to put on each assessment pillars, the weight of the points can be differently imposed. The visual content, Figure 8 below, presents how the EU eGovernment benchmark has set out the weight difference for each pillar.

**Figure 8** Calculation of key dimensions (Capgemini & European Commission, 2020)



- UN DESA Online Service Index (UNV)

Since its inception in 2001, assessing the digital government development of the 193 Member States, the United Nations Department of Economic and Social Affairs (UN DESA) has surveyed and studied vast patterns of digital government around the world through the 'United Nations E-Government Survey'. The survey demonstrates respective governments' endeavors in providing accountable, effective and inclusive digital services to bridge the digital divide and leave no one behind. It has established itself as a prominent benchmarking criterion for e-government and a policy tool for decision-makers, enabling comparative analysis and contemporary research on ICT-led public services. It also aims to facilitate and inform discussion amongst intergovernmental bodies on issues related to digital government and the imperative role of ICTs in achieving the sustainable development goals (UN, 2020).

The methodological framework for the collection of the data is made through the E-Government Development Index (EGDI). The analysis is made through a survey data, literature review and innovative practices collected to illustrate ICT use for transforming to a user-friendly public administration. The index specifically assesses digital government development at the national level with a composite index based on the equally weighted average of three normalized indices: Human Capital Index (HCI), Telecommunications Infrastructure Index (TII), and Online Service Index (OSI). Among the three distinctive indexes, the Online Service Index evaluates the ICT driven capacity of the national online platform of all 193 United Nations Member States, collected from an independent Online Service Questionnaire (OSQ). The survey evaluates capabilities on the provision of online services, including whole-of-government approaches, open government data, electronic participation, multi-channel service delivery, mobile services, utilization and information gaps, and innovative partnerships using ICT (UN, 2020). The 2020 questionnaire consists of well segmented 148 questions and each

question calls for a binary response, with every positive answer generating a more in-depth question.

This data is compiled by a group of 'United Nations Volunteer (UNV)' researchers under UN DESA's supervision through a primary research and collection endeavor. For the 2020 Online Service Index (OSI) values, 215 online UNV researchers from 96 countries, covering 66 languages, evaluated respective country's national portals based on the Survey's Online Service Questionnaire (UN, 2020). The UNV researchers put in to the scene were competent graduate students and university volunteers with the background of public administration studies and were under supervision by the Data Team Coordinators who aided throughout. To make the assessment consistent and in alignment with objectivity, they were instructed to assume the mindset of an average citizen user in evaluating the government websites and were given specific training by online service delivery and digital government professionals to conduct the evaluation.

For successful multilevel monitoring and evaluation, all survey sites have been thoroughly evaluated by at least three people with sufficient experience in evaluating public sector online services and reviewed by one of the Data Team Coordinators. Upon completion of the assessment phase, the statistical board drafted the OSI rankings (UN, 2020).

All in all, with reference to the Mystery Shoppers and UN volunteers mentioned above, the approach of utilizing external evaluators to measure ICT driven public sector performance is beneficial in providing objective and consistent results. External Evaluation through a well-trained third party such as the Mystery shoppers and Volunteers, enable a standardized and unbiased assessment. An external evaluator can be identified, selected through standardized criteria and Q&A, helpdesk support and training will be fully consistent and centralized. Then,

they can be deployed to measure the extent of ICT development and innovation made in the government sector of each country. They will be expected to assume the position of an average citizen user to interpret what would be the actual hardships and opportunities, providing a genuinely important user-focused standpoint. The accumulated results may then be refined and validated through detection of discrepancies and reexamination by the data team. Through the external evaluation approach, the positive and negative bias of an insider report will also be expected to be addressed.

### 3.5 Composite Indicator Evaluation

To have a comprehensive understanding of ICT innovation of governments, there have been efforts to evaluate the capacities through composite calculation of segmented categories of indicators. The categorized pillars may differ from one composition to another but have similarities in that it aims to have a holistic quantitative result through analyzation of various dimensions of ICT use in the public area, for international comparability. Here are two examples:

- Digital Economy and Society Index (DESI) 2021

Starting from 2014, the European Commission has evaluated Member States' progress on digital government capacity and published 'Digital Economy and Society Index (DESI)' reports annually. The reports include country profiles helping Member States identify one's weak points, areas for priority action, and thematic chapters providing an EU-level analysis in the key digital and ICT policy areas, which are essential reference for underpinning policy decisions (European Commission, 2021).

The metrics is centered around the four main areas in the Digital Compass: i) Human

Capital, ii) Connectivity, iii) Integration of digital technology, and iv) Digital Public services, with its sub-division and indicators outlined as below.

**Table 1** DESI Structure (European Commission, 2021)

| Dimension | Sub-dimension | Indicator |
|---|---|---|
| 1 Human capital | 1a Internet user skills | 1a1 At least basic digital skills |
| | | 1a2 Above basic digital skills |
| | | 1a3 At least basic software skills |
| | 1b Advanced skills and development | 1b1 ICT specialists |
| | | 1b2 Female ICT specialists |
| | | 1b3 Enterprises providing ICT training |
| | | 1b4 ICT graduates |
| 2 Connectivity | 2a Fixed broadband take-up | 2a1 Overall fixed broadband take-up |
| | | 2a2 At least 100 Mbps fixed broadband take-up |
| | | 2a3 At least 1 Gbps take-up |
| | 2b Fixed broadband coverage | 2b1 Fast broadband (NGA) coverage |
| | | 2b2 Fixed Very High Capacity Network (VHCN) coverage |
| | 2c Mobile broadband | 2c1 4G coverage |
| | | 2c2 5G readiness |
| | | 2c3 5G coverage |
| | | 2c4 Mobile broadband take-up |
| | 2d Broadband prices | 2d1 Broadband price index |
| 3 Integration of digital technology | 3a Digital intensity | 3a1 SMEs with at least a basic level of digital intensity |
| | 3b Digital technologies for businesses | 3b1 Electronic information sharing |
| | | 3b2 Social media |
| | | 3b3 Big data |
| | | 3b4 Cloud |
| | | 3b5 AI |
| | | 3b6 ICT for environmental sustainability |
| | | 3b7 e-Invoices |
| | 3c e-Commerce | 3c1 SMEs selling online |
| | | 3c2 e-Commerce turnover |
| | | 3c3 Selling online cross-border |
| 4 Digital public services | 4a e-Government | 4a1 e-Government users |
| | | 4a2 Pre-filled forms |
| | | 4a3 Digital public services for citizens |
| | | 4a4 Digital public services for businesses |
| | | 4a5 Open data |

For Human Capital dimension, there exists 2 sub-dimensions: a) Internet user skills and b) Advanced skills and development. For Connectivity dimension, there exists 4 sub-dimensions: a) Fixed broadband take-up, b) Fixed broadband coverage, c) Mobile broadband,

and d) Broadband prices. For Integration of digital technology dimension, there exists 3 sub-dimensions: a) Digital intensity, b) Digital technologies for businesses, and c) e-Commerce. For Digital public services dimension, there exists 1 sub-dimension: a) e-Government.

The following would present the list of respective indicators that compose the dimensions/sub-dimensions in DESI.

**Table 2** Human Capital Dimension (European Commission, 2021)

| Indicator | Description | Unit | Source |
|---|---|---|---|
| **1a1 At least basic digital skills** | Individuals with 'basic' or 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months). | % individuals | Eurostat - European Union survey on ICT usage in Households and by Individuals |
| **1a2 Above basic digital skills** | Individuals with 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months). | % individuals | Eurostat - European Union survey on ICT usage in Households and by Individuals |
| **1a3 At least basic software skills** | Individuals who, in addition to having used basic software features such as word processing, have used advanced spreadsheet functions, created a presentation or document integrating text, pictures and tables or charts, or written code in a programming language. | % individuals | Eurostat - European Union survey on ICT usage in Households and by Individuals |
| **1b1 ICT specialists** | Employed ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers. | % individuals in employment aged 15-74 | Eurostat - Labour force survey (isoc_sks_itspt) |
| **1b2 Female ICT specialists** | Employed female ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers. | % ICT specialists | Eurostat - Labour force survey (isoc_sks_itsps) |
| **1b3 Enterprises providing ICT training** | Enterprises who provided training in ICT to their personnel | % enterprises | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_ITT2) |
| **1b4 ICT graduates** | Individuals with a degree in ICT | % graduates | Eurostat (table educ_uoe_grad03, using selection ISCED11=ED5-8) and and ISCEDF_13 [F06] Information and Communication Technologies |

The **Human capital** dimension evaluates both the Internet user skills of citizens and the advanced skills of experts.

**Table 3** Connectivity Dimension (European Commission, 2021)

| Indicator | Description | Unit | Source |
|---|---|---|---|
| **2a1 Overall fixed broadband take-up** | % of households subscribing to fixed broadband | % households | Eurostat - European Union survey on ICT usage in Households and by Individuals [H_BBFIX] |
| **2a2 At least 100 Mbps fixed broadband take-up** | % of households subscribing to fixed broadband of at least 100 Mbps, calculated as overall fixed broadband take-up (source: Eurostat) multiplied with the percentage of fixed broadband lines of at least 100 Mbps (source: COCOM) | % households | European Commission, through the Communications Committee (COCOM) and Eurostat - European Union survey on ICT usage in Households and by Individuals |
| **2a3 At least 1 Gbps take-up** | % of households subscribing to fixed broadband of at least 1 Gbps, calculated as overall fixed broadband take-up (source: Eurostat) multiplied with the percentage of fixed broadband lines of at least 1 Gbps (source: COCOM) | % households | European Commission, through the Communications Committee (COCOM) and Eurostat - European Union survey on ICT usage in Households and by Individuals |
| **2b1 Fast broadband (NGA) coverage** | % of households covered by fixed broadband of at least 30 Mbps download. The technologies considered are FTTH, FTTB, Cable Docsis 3.0 and VDSL | % households | Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic |
| **2b2 Fixed Very High Capacity Network (VHCN) coverage** | % of households covered by any fixed VHCN. The technologies considered are FTTH and FTTB for 2015-2018 and FTTH, FTTB and Cable Docsis 3.1 for 2019 onwards | % households | Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic |
| **2c1 4G coverage** | % of populated areas with coverage by 4G | % populated areas | Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic |
| **2c2 5G readiness** | The amount of spectrum assigned and ready for 5G use within the so-called 5G pioneer bands. These bands are 700 MHz (703-733 MHz and 758-788 MHz), 3.6 GHz (3400-3800 MHz) and 26 GHz (1000 MHz within 24250-27500 MHz). All three spectrum bands have an equal weight | Assigned spectrum as a % of total harmonised 5G spectrum | European Commission services, through the Communications Committee (COCOM) |
| **2c3 5G coverage** | % of populated areas with coverage by 5G | % populated areas | Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic |
| **2c4 Mobile broadband take-up** | Individuals who used a mobile phone (or smart phone) to access the internet | % individuals | Eurostat - European Union survey on ICT usage in Households and by Individuals [I_IUMP] |
| **2d1 Broadband price index** | The broadband price index measures the prices of representative baskets of fixed, mobile and converged broadband offers | Score (0-100) | Broadband retail prices study, annual studies for the European Commission realised by Empirica |

The **Connectivity** dimension measures fixed and mobile broadband capacity with indicators that measure supply and demand aspects along with retail prices.

**Table 4** Integration of Digital Technology Dimension (European Commission, 2021)

| Indicator | Description | Unit | Source |
|---|---|---|---|
| 3a1 SMEs with at least a basic level of digital intensity | The digital intensity score is based on counting how many out of 12 selected technologies are used by enterprises. A basic level requires usage of at least 4 technologies. | % SMEs | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises |
| 3b1 Electronic information sharing | Enterprises who have in use an ERP (enterprise resource planning) software package to share information between different functional areas (e.g. accounting, planning, production, marketing) | % enterprises | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_ERP1) |
| 3b2 Social media | Enterprises using two or more of the following social media: social networks, enterprise's blog or microblog, multimedia content sharing websites, wiki-based knowledge sharing tools. Using social media means that the enterprise has a user profile, an account or a user license depending on the requirements and the type of the social media. | % enterprises | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_SM1_GE2) |
| 3b3 Big data | Enterprises analysing big data from any data source | % enterprises | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_BDA) |
| 3b4 Cloud | Enterprises purchasing at least one of the following cloud computing services: hosting of the enterprise's database, accounting software applications, CRM software, computing power | % enterprises | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_CC_GE_ME) |
| 3b5 AI | Enterprises using at least 2 AI technologies | % enterprises | European enterprise survey on the use of technologies based on artificial intelligence by Ipsos and iCite |
| 3b6 ICT for environmental sustainability | The indicator measures the level of support that adopted ICT technologies offered to enterprises to engage in more environmentally-friendly actions. The level of intensity is measured based on the number of environmental actions (maximum 10) reported by enterprises to have been facilitated by the use of ICT. The following categorisation was achieved: low intensity (0 to 4 actions), medium intensity (5 to 7 actions) and high intensity (8 to 10 actions). | % enterprises having medium/high intensity of green action through ICT | Survey of businesses on the use of digital technologies by Ipsos and iCite |
| 3b7 e-Invoices | Enterprises sending e-invoices, suitable for automated processing | % enterprises | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_INV4S_AP) |
| 3c1 SMEs selling online | SMEs selling online (at least 1% of turnover) | % SMEs | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_ESELL) |
| 3c2 e-Commerce turnover | SMEs' total turnover from e-commerce | % SME turnover | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_ETURN) |
| 3c3 Selling online cross-border | SMEs that carried out electronic sales to other EU countries | % SMEs | Eurostat - European Union survey on ICT usage and eCommerce in Enterprises (E_AESEU) |

The **Integration of digital technology** dimension is configured to digital strength, intensity, take-up of selected technologies by entities and e-commerce.

**Table 5** Digital Public Services Dimension (European Commission, 2021)

| Indicator | Description | Unit | Source |
|---|---|---|---|
| 4a1 e-Government users | Individuals who used the Internet, in the last 12 months, for interaction with public authorities | % internet users | Eurostat - European Union survey on ICT usage in Households and by Individuals (I_IUGOV12) |
| 4a2 Pre-filled forms | Amount of data that is pre-filled in public service online forms | Score (0 to 100) | eGovernment Benchmark |
| 4a3 Digital public services for citizens | The share of administrative steps that can be done online for major life events (birth of a child, new residence, etc.) for citizens | Score (0 to 100) | eGovernment Benchmark |
| 4a4 Digital public services for businesses | The indicator broadly reflects the share of public services needed for starting a business and conducting regular business operations that are available online for domestic as well as foreign users. Services provided through a portal receive a higher score, services which provide only information (but have to be completed offline) receive a more limited score. | Score (0 to 100) | eGovernment Benchmark |
| 4a5 Open data | This composite indicator measures to what extent countries have an open data policy in place (including the transposition of the revised PSI Directive), the estimated political, social and economic impact of open data and the characteristics (functionalities, data availability and usage) of the national data portal. | % maximum score | European data portal |

The **Digital public services** dimension measure digital public services for citizens and businesses. The indicator details e-Government's supply, demand and data disclosure policies.

**Table 6** Data source and the role of national authorities (European Commission, 2021)

| Data source | Data collection process |
|---|---|
| **Eurostat** | Data collected and verified by the national statistical offices or by Eurostat. |
| **Communications Committee (COCOM)** | Data collected and verified by the national regulatory authorities (by data experts appointed by the members of the Communications Committee in every Member State). |
| **Broadband coverage studies** | Data collected by IHS Markit, Omdia and Point Topic and verified by the national regulatory authorities (by data experts appointed by the members of the Communications Committee in every Member State). |
| **Retail broadband prices studies** | Data collected by Empirica and verified by the national regulatory authorities (by data experts appointed by the members of the Communications Committee in every Member State). |
| **e-Government benchmark** | Data collected by Capgemini and verified by relevant ministries in every Member State. |
| **Survey of businesses on the use of digital technologies** | Data collected by Ipsos and iCite, survey results have been reviewed by the Digital Single Market Strategic Group. |
| **European data portal** | Data collected by Capgemini from representatives appointed by the relevant ministries in every Member State. |

As this methodology require a composite evaluation of indicators, it is important to

specify the data sources and the sub-indicator used. The above table illustrate the sources and process of its data collection.

- Network Readiness Index 2021 (Portulans Institute)

First published in 2002, the Network Readiness Index (NRI) provides a comprehensive framework for evaluating the drivers of the ICT revolution and multilateral effect of ICT on the development of countries. Over the last two decades, the NRI has reflected the growing importance of technology and innovation across the world, providing a comprehensive view of how the countries can deploy digital technologies and ICT to enhance global competitiveness.

The Network Readiness Index is a multidimensional concept formulated with the composition of various indicators with three levels: Primary level, Second level, Third level. The Primary level consists of four pillars: i) Technology, ii) People, iii) Governance, and iv) Impact that make up the fundamental dimension of network readiness. Each pillar consists of sub-pillars to constitute a Second level:

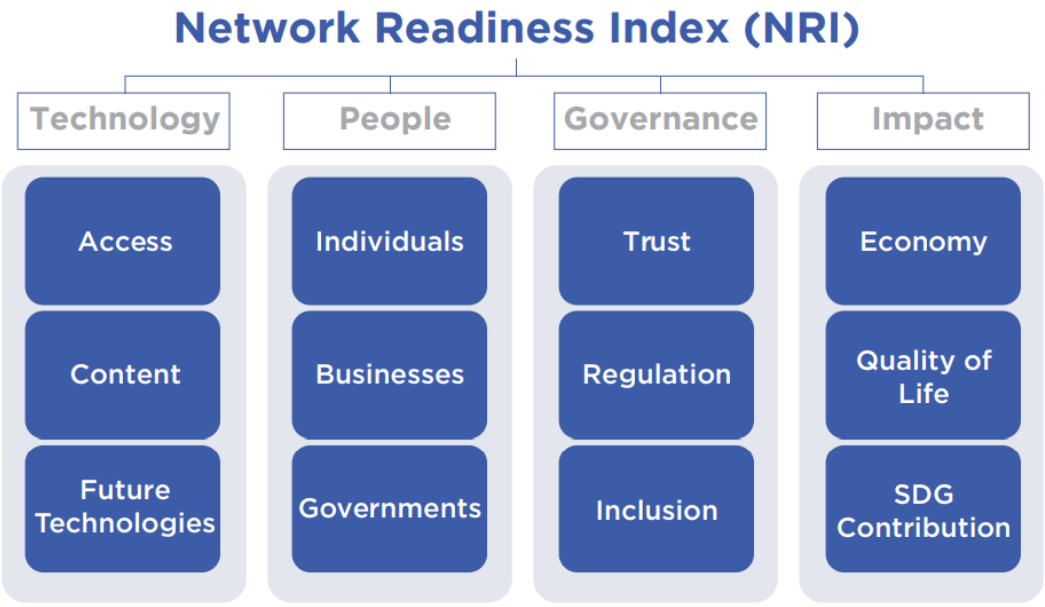
• *Technology*: Access, Content, Future Technologies

• *People*: Individuals, Businesses, Governments

• *Governance*: Trust, Regulation, Inclusion

• *Impact*: Economy, Quality of Life, Sustainable Development Goal (SDG) contribution (Portulans Institute, 2021)

**Figure 9** The NRI 2021 Model (Portulans Institute, 2021)




Source: Network Readiness Index Database, Portulans Institute, 2021.

**Technology**

Technology is the necessary condition for the network economy. As a major category of the Network Readiness Index, the Technology dimension assesses the technological capacity that is a fundamental requisite for a country to operate digital and ICT driven governance.

**People**

The pillar measures how people apply ICT in accordance with their status as: individuals, businesses, and governments. It assesses the skills, accessibility, and capacities of the users in utilizing technology resources in productive manner.

**Governance**

Governance is a systematic structure that works under integrated network. Within, the safety, security and inclusion of the customers is of grave importance. The pillar assesses the establishment and accessibility of systems within the network economy.

**Impact**

Impact pillar evaluate the social, human and economic impacts of participation in the network economy. ICT plays an important role within the network economy, with a particular focus on integrated indicators across environment, health and education.

The Third level consists of 60 indicators: 33 indicators being hard/quantitative data, 16 being survey/qualitative data and 11 being index/composite indicator data. The specific outline can be demonstrated as below figure:

**Table 7** Structure of the Network Readiness Index 2021(Portulans Institute, 2021)

| A. Technology pillar | B. People pillar |
|---|---|
| **1.1 Access** | **2.1 Individuals** |
| 1.1.1 Mobile tariffs | 2.1.1 Active mobile broadband subscriptions |
| 1.1.2 Handset prices | 2.1.2 ICT skills |
| 1.1.3 Internet access | 2.1.3 Use of virtual social networks |
| 1.1.4 SMS sent by population 15-69 | 2.1.4 Tertiary enrollment |
| 1.1.5 Population covered by at least a 3G mobile network | 2.1.5 Adult literacy rate |
| 1.1.6 International Internet bandwidth | **2.2 Businesses** |
| 1.1.7 Internet access in schools | 2.2.1 Firms with a website |
| **1.2 Content** | 2.2.2 GERD financed by business enterprise |
| 1.2.1 GitHub commits | 2.2.3 Professionals |
| 1.2.2 Wikipedia edits | 2.2.4 Technicians and associate professionals |
| 1.2.3 Internet domain registrations | 2.2.5 Annual investment in telecommunication services |
| 1.2.4 Mobile applications development | 2.2.6 GERD performed by business enterprise |
| 1.2.5 AI in scientific publications | **2.3 Governments** |
| **1.3 Future Technologies** | 2.3.1 Government online services |
| 1.3.1 Adoption of emerging technologies | 2.3.2 Publication and use of open data |
| 1.3.2 Investment in emerging technologies | 2.3.3 Government promotion of investment in emerging technologies |
| 1.3.3 Robot density | 2.3.4 R&D expenditure by governments and higher education |
| 1.3.4 Computer software spending | |

| C. Governance pillar | D. Impact pillar |
|---|---|
| **3.1 Trust** | **4.1 Economy** |
| 3.1.1 Secure Internet servers | 4.1.1 High-tech and medium-high-tech manufacturing |
| 3.1.2 Cybersecurity | 4.1.2 High-tech exports |
| 3.1.3 Online access to a financial account | 4.1.3 PCT patent applications |
| 3.1.4 Internet shopping | 4.1.4 GDP per person engaged |
| **3.2 Regulation** | 4.1.5 Prevalence of gig economy |
| 3.2.1 Regulatory quality | 4.1.6 ICT services exports |
| 3.2.2 ICT regulatory environment | **4.2 Quality of Life** |
| 3.2.3 Legal framework's adaptability to emerging technologies | 4.2.1 Happiness |
| 3.2.4 E-commerce legislation | 4.2.2 Freedom to make life choices |
| 3.2.5 Privacy protection by law content | 4.2.3 Income inequality |
| **3.3 Inclusion** | 4.2.4 Healthy life expectancy at birth |
| 3.3.1 E-participation | **4.3 SDG Contribution** |
| 3.3.2 Socioeconomic gap in use of digital payments | 4.3.1 SDG 3: Good Health and Well-Being |
| 3.3.3 Availability of local online content | 4.3.2 SDG 4: Quality Education |
| 3.3.4 Gender gap in Internet use | 4.3.3 Females employed with advanced degrees |
| 3.3.5 Rural gap in use of digital payments | 4.3.4 SDG 7: Affordable and Clean Energy |
| | 4.3.5 SDG 11: Sustainable cities and communities |

Through composite indicator evaluation such as DESI and NRI, one can draw a comprehensive analysis of ICT driven public sector innovation with different aspects and categories of the relevant field combined. The main theme can be broken down into few pillars and the pillars can be further divided by sub-pillar indicators to constitute a broad networked structured. When measuring ICT driven public sector innovation, various associated fields such as, organizational, technological, HR, economic areas can be measured and united to formulate one all-encompassing ICT relevant result value. The quantitative output will be a clear indicator for making both relative and absolute comparison.

### 3.6 Awards

- United Nations Public Service Awards

Another internationally comparable approach to measuring ICT driven public sector innovation is through open demonstration of successful practices and presenting awards. A good example as a case in point would be the 'United Nations Public Service Awards (UNPSA)'.

UNPSA is organized annually by the United Nations Department of Economic and Social Affairs (UN DESA) through its Division for Public Institutions and Digital Government (DPIDG), serving as a key global platform for public sector departments to exchange knowledge and experience, share innovative practices and global perspectives in the public administration sphere.

Acceleration of ICT and digital revolution in the 21st century has altered the way we live our daily lives and the way the government provides to citizens. In the coming years, and especially after the advent of the COVID-19 pandemic which called for the necessity of remote and user driven public service delivery, we will see more use of technology being leveraged in the public arena to make better decisions and support the citizens. Therefore, the objectives of the UNPSA would be to showcase the best practices conducted by governments for future readiness and inspire the world public sectors to develop institutional human and technological capacities, accelerate digital transformation, kick a momentum for innovative governance and as a result, deliver the 2030 Agenda and the Sustainable Development Goals.

Widely recognized as the most prestigious international award on public service delivery, UNPSA rewards the creative achievements and highlights the contribution of public service institutions that have shown effective, inclusive and digitally responsive public

administration. The winners of the recently held 2021 Awards would include innovative approaches such as but not limited to:

‘Hands-on Mobile ICT Classes Project’ by Ghana Library Authority (GhLA)

Due to lack of adequate access to digital devices such as computer, internet and electricity in schools, Ghana experiences lack of ICT familiar workers and ICT interested students. This may lead to low competitiveness in the national/international stage and eventually exacerbate poverty in the country. To resolve this matter, the ‘Hands-on Mobile ICT classes Project’ was implemented, especially in the poor and rural areas, to enhance quality of education on ICT skill development. It boils down to equipping a vehicle with low-power laptop computers runned by solar panels and visiting under-privileged schools with insufficient access to ICT. Then, a practical computer class is conducted, leading to better technology-oriented examination results from students and promoting ICT friendly atmosphere among prospective students (UN DESA, n.d).

As such, the international competition for awards can help promote the visibility, role and professionalism of public services. Measuring ICT driven public sector innovation of UN member states through public recognition and awards will enable a platform for the international community to demonstrate and learn best ICT driven practices in the public sector. Moreover, as it will be performed annually, it will be a stage to showcase the most up-to-date hands-on experience of countries and success stories in utilizing ICT for a more inclusive, accountable and transparent public service delivery. Nonetheless, as the Awards are given in rank order, the approach allows for a distinct relative comparison but may be less than feasible for providing absolute value.

## 4. Policy Recommendation

We have looked at various methodologies and efforts to measure Innovation in the field of ICT and other public sectors. The above was to demonstrate what kind of approaches can be taken to consideration as a benchmark and to be possibly modified and adapted when specifically measuring ICT innovation in the public area. While the 6 methodologies each have unique merit and potential advantages to be adapted to measure ICT innovation, the afore-mentioned approaches do not allow for an internationally agreed and adopted indicator that may provide an authentic global measurement. Self-Assessment and Regional-Assessment is a useful approach to have in-depth assessment and fast feedback-and-action consortium. However, the operation radius is less than international. Assessment through Surveys and Composite indicators allow for a broader range of comparison but with no valid international consensus. Awards by international organizations may have high validity but merely provides relative comparison through line up in ranking.

While there are national, regional, and continental efforts of measuring, and certainly with distinctive advantages, there is currently no universally adopted international indicator that can provide a genuinely global comparison and assessment of ICT use in the governmental area. If there is to be such universal indicator, the process must allow some flexibility in the approach as countries have different governmental priorities, focus and structure that needs differentiated measuring. That said, there is an urgent call for action on developing a “Common but Differentiated Measure Tool” that can assess the ICT-driven Public Sector innovation in a ‘glocalized’ manner. This would provide an operational framework that is applicable in and adaptable to most public sector settings. It would not be a definitive standard but may provide practical help and guideline for addressing international understanding of the measuring standards and also where governments stand with regards to effective ICT use in respective

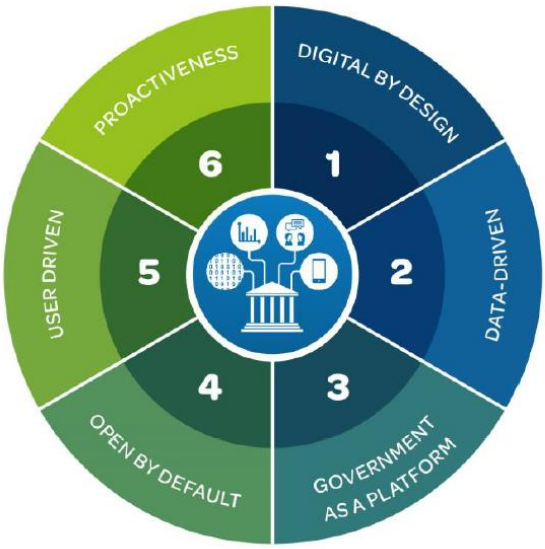
governments.

### 4.1 Establishing a common indicator

To formulate a globally accepted measurement, there must be an international consensus and acknowledgement for a universal index. To realize this initiative, there must be a recognized international gathering for discussion participated by public sector representatives of each nation, ICT experts, scientists and researchers. An international organization may also take part in the roundtable discussion as a third party for moderating and facilitating the convergence of ideas and also playing a role of making official declaration of the finalized common ground and adding public credibility to the decision.

Once the partnership is made, the discussion on what and how it will be measured must take place. When creating a new ICT innovation measurement index, it is important to ensure that it includes generally accepted dimensions that could be applicable and is of grave importance to all nations. 'OECD Digital Government Policy Framework (DGPF)' is an internationally recognized standard that could lay a foundation as a potential barometer for measuring ICT driven Public Sector Innovation and help us get started. Presented to E-Leaders during the 2018 meeting in Korea, OECD developed a DGPF which is a policy instrument that identifies key determinants for the transition towards effective and digitally matured public sector (OECD, 2020). It supports both qualitative and quantitative assessments across countries and projects.

**Figure 10** 6 Dimensions of DGPF (OECD, 2020)




- Digital by design
- Data-driven
- Government as a platform
- Open by default
- User-driven
- Proactiveness

The DGPF demonstrates six-dimensional layout that comprise a fully ICT oriented government of which the first four dimensions (digital by design, data-driven public sector, government as a platform and open by default) can be categorized as “Foundational” and the latter two (user-driven and proactiveness) as “Transformational” (OECD, 2020). A government that manifests high level of maturity across these six-dimensions is in an advantageous state to acquire internal transparency and efficiency, but also to deliver public services that is demand

driven and people centered. The framework strongly upholds that fostering governments in line with these six pillars will pave a road to making a sufficient condition for public sectors to become ICT friendly and digitally matured to contribute to reshaping interactions between the agent and principal through expanded engagement of citizens, efficient communication and empowered stakeholders. The DGPF provides the groundwork to advance these transformative efforts and to build agile, adaptable, and responsive public sector.

(Continued below)

With that said, a globally accepted composite measurement of ICT driven Public Sector Innovation can be made with these 6 pillars consisted of various pertinent indicators. The following is the elaboration on respective pillars and presents reconstitution of relevant ICT dimensions and indexes from different data sources that can provide a guideline for taking the initiative:

'Digital by design' emphasizes the degree of which a government leverages digital and ICT technologies to re-engineer public processes and procedures to create the digital environment from the 'start' into government's public service delivery efforts. A digital by design approach refer to a strategic mechanism to ensure that organizational coordination and service provided is in foundation, coherently digital based. When the public service delivery is digitized, it will promote innovation in simplified procedures, connection of channels for communication, inclusive engagement and eradication of silos. As a result, it will deliver a more citizen driven and efficient policy results.

**Table 8** Recomposed ICT Indicators for measuring Digital by Design

| Dimension | Sub-division | Indicator | Data collection process | Data Reference |
|---|---|---|---|---|
| Human Capital | Advanced skills and development | ICT specialists | Employed ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers. | Digital Economy and Society Index (DESI) 2021 |
| | | Female ICT specialists | Employed female ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers | Digital Economy and Society Index (DESI) 2021 |
| | | Enterprises providing ICT | Enterprises who provided training in ICT to their personnel | Digital Economy and Society Index (DESI) |

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|---|---|---|---|---|
| | | training | | 2021 |
| | | ICT graduates | Individuals with a degree in ICT | Digital Economy and Society Index (DESI) 2021 |
| | Capacity building/training programmes in place to sensitize legislators and raise awareness of the implication of new legislation on the use of digital technology by the public sector | | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| Connectivity/Investment | Proportion of central government organizations with an intranet | | The proportion of central government organizations with an intranet is calculated by dividing the number of central government organizations with an intranet by the number of central government organizations. The result is then multiplied by 100 to be expressed as a percentage. | ITU Core list of Indicators |
| | Proportion of central government organizations with a web presence | | The proportion of central government organizations with a web presence is calculated by dividing the number of central government organizations with a web presence by the number of central government organizations. The result is then multiplied by 100 to be expressed as a percentage. | ITU Core list of Indicators |
| | Annual investment in telecommunication services | | The Annual investment in telecommunication services indicator refers to the investments made within the financial year by entities that provide telecommunication networks and/or services (including fixed mobile and Internet services and the transmission of TV signals). Investments are considered any spent funds on the acquisition and upgrading of assets (usually referred to as CAPEX) | Networked Readiness INDEX 2021 |

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| | | less disinvestment owing to disposals. Fixed assets include tangible assets such as buildings and networks and intangible assets such as computer software and intellectual property. The indicator corresponds to the gross fixed capital formation concept defined in the System of National Accounts 2008. The indicator also includes expenditures on initial installations and additions to existing installations where the usage is expected over an extended period of time. It excludes expenditures on fees for operating licenses and the use of radio spectrum. All values are notated in US$ | |
| Integration of digital technology | Electronic information sharing | Enterprises who have in use an ERP (enterprise resource planning) software package to share information between different functional areas (e.g. accounting, planning, production, marketing) | Digital Economy and Society Index (DESI) 2021 |
| | Cloud | Enterprises purchasing at least one of the following cloud computing services: hosting of the enterprise's database, accounting software applications, CRM software, computing power | Digital Economy and Society Index (DESI) 2021 |
| | AI | Enterprises using at least 2 AI technologies | Digital Economy and Society Index (DESI) 2021 |
| | The use of emerging technologies to improve ICT procurement processes | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| Readiness and Regulations | Cybersecurity | The Global Cybersecurity Index (GCI) measures the level of cybersecurity commitments made by individual countries. It is a composite index | Networked Readiness INDEX 2021 |

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| | | consisting of 25 indicators distributed across five main pillars: (1) Legal Measures, (2) Technical Measures, (3) Organizational Measures, (4) Capacity Building Measures, and (5) Cooperation Measures. Scores are standardized to a scale of 0–1 | |
| | ICT regulatory environment | The ICT regulatory environment indicator is based on the ICT Regulatory Tracker composite index that provides a measure of the existence and features of ICT legal and regulatory frameworks. The index covers 50 indicators distributed across four pillars: (1) Regulatory Authority, (2) Regulatory Mandate, (3) Regulatory Regime, and (4) Competition Framework. Scores are standardized to a scale of 0–2. | Networked Readiness INDEX 2021 |
| | Legal framework's adaptability to emerging technologies | Average answer to survey questions concerning the extent to which the legal framework is adapting to five types of emerging technology (Artificial intelligence, Robotics, App- and web-enabled markets, Big data analytics, and Cloud computing) | Networked Readiness INDEX 2021 |
| | Policy instruments in place to support the use of emerging technologies in the public sector | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Strategy, framework and formal requirements for digital skills, as well as mechanisms to forecast the needs for digital skills in the public sector | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Mechanisms in place to assess the implications of new legislation on governments' digital needs | | OECD Digital Government Index (DGI): Methodology |

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| | | | and 2019 Results |
| Impact | Research on the national economic impact on businesses of the implementation of digital government services | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Government-wide consultations on the effect of digital(ICT) tools/technologies for improving government services | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Measurement/estimation of the direct financial benefits and/or costs produced by ICT projects (exante and ex-post) | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Measurement of non-financial benefits of public ICT projects | | OECD Digital Government Index (DGI): Methodology and 2019 Results |

'Data-driven public sector' highlights the extent to which a government may utilize data as a key strategic asset to create public value through the reuse of data in planning, delivering and monitoring public policies. The approach will ensure that public sector data is open and effectively shared inside and out in a transparent and trustworthy fashion, with clear protection, security rules and ethical principles.

**Table 9** Recomposed ICT Indicators for measuring Data-driven Public Sector

| Dimension | Sub-division | Indicator | Data collection process | Data Reference |
|---|---|---|---|---|
| Open Government | Existence of metadata or a data dictionary | | | Open Government Development Index |

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| Data | | | (OGDI), UN 2020 |
| | Acceptance of public requests for new data sets | | Open Government Development Index (OGDI), UN 2020 |
| | Offer guidance on using OGD | | Open Government Development Index (OGDI), UN 2020 |
| | Engage in promotional efforts and data application (e.g. Hackathons) | | Open Government Development Index (OGDI), UN 2020 |
| | Data availability of various sectors such as Health, Education, Employment, Social Security, Environment and Justice | | Open Government Development Index (OGDI), UN 2020 |
| | Authentic sources | the extent to which Authentic Sources, base registries used by governments to automatically validate or fetch data relating to citizens or businesses, can be used during the service process | EU eGovernment benchmark 2021 |
| Strategy | Policy initiatives to share and analyse data to boost public sector productivity and efficiency | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Strategies and initiatives in place to manage security risks related to government data and information | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Key Performance Indicators (KPI) linked to the National Digital Government Strategies (NDGS) to monitor progress in its implementation | | OECD Digital Government Index (DGI): Methodology and 2019 Results |

'Government as a platform' underlines the extent to which a government provides a user-driven and user-focused platform with articulated and transparent sources of guidelines, software, tools and data to deliver consistent and integrated service delivery standards. It focuses on the deployment of extensive channel to deliver seamless and cross-sectoral services through the well-established framework.

**Table 10** Recomposed ICT Indicators for measuring Government as a Platform

| Dimension | Sub-division | Indicator | Data collection process | Data Reference |
|---|---|---|---|---|
| User-driven service | Existence and features of the national website | | Assessment of national portal, e-services portal and e-participation portal, as well as the websites of the related ministries of education, labor, social services, health and environment, as applicable | Online Service Index (OGDI), UN 2020 |
| | Selected Internet-based online services available to citizens, by level of sophistication of service | | This indicator refers to both central and state/provincial levels of government. This is necessary to ensure international comparability as the services selected may be offered by different levels of government across countries. As the approach taken to measuring Internet-based services is relatively untested and because responses may be somewhat subjective, the indicator is initially considered to be experimental.<br>The main indicator is weighted by population in order to show the significance of government Internet-based services at the national level. It is expressed in terms of the percentage of a country's citizens who are theoretically able to access each Internet-based service. The ability to access each service will usually be linked to the relevant jurisdiction. For example, a citizen residing in a | ITU Core list of Indicators |

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| | | particular state will theoretically be able to access Internet-based services offered by that state government, though may not need to, wish to, or be technically capable of doing so.<br><br>The Internet-based services are classified by level of sophistication, as follows:<br>Level 1 – obtain the necessary information from publicly accessible websites<br>Level 2 – request the necessary printed forms or download forms (e.g. in pdf format) from publicly accessible websites<br>Level 3 – fill in the necessary forms online on (or via) publicly accessible websites<br>Level 4 – undertake the complete process, via publicly accessible websites.<br>The Internet-based services for which information is sought are:<br>- Enroll to vote for the first time in government elections.<br>- Complete and lodge personal income tax return, least complex situation.<br>- Obtain unemployment income benefits, least complex situation.<br>- Obtain child support allowance, least complex situation.<br>- Renew an international passport, least complex situation. | |

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| | | - Renew a driver's license, least complex situation.<br>- Make an official declaration of theft of personal goods (excluding motor vehicle and burglary) to the relevant police.<br>- Obtain a copy of a birth certificate for self.<br>- Obtain a copy of a marriage certificate for self.<br>- Renew registration for a motor vehicle, least complex situation. | |
| | Cross-border services | Cross-border online availability (Online availability of transactional services, online availability of informational services) | EU eGovernment benchmark 2021 |
| | | Cross-border user support | EU eGovernment benchmark 2021 |
| | | Cross-border key enablers (Cross-border eID, Cross-border eDocuments) | EU eGovernment benchmark 2021 |
| Engagement | Use of digital platforms (consultations; digitally-enabled decision making; opening up government data and fostering re-use) to proactively engage stakeholders external to the public sector in policy making and service delivery processes | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Platforms to engage the public and the private sector in discussing policy challenges and co-finding solutions | | OECD Digital Government Index (DGI): Methodology and 2019 Results |

'Open by Default' refers to the extent to which government system, data, information and process are transparently disclosed to help build bridges between all stakeholders through ICT adoption in order to enable interactive environment and collect insights for a more knowledge based public sector. The openness and inclusiveness of the government will be by default and available for the public to participate within the scope of the law and in balance with the interests of the state and the public.

**Table 11** Recomposed ICT Indicators for measuring Open by Default

| Dimension | Sub-division | Indicator | Data collection process | Data Reference |
|---|---|---|---|---|
| Policy | Open Data | | This composite indicator measures to what extent countries have an open data policy in place, the estimated political, social and economic impact of open data and the characteristics (functionalities, data availability and usage) of the national data portal. | Digital Economy and Society Index (DESI) 2021 |
| | Existence of national OGD policy | | | Open Government Development Index (OGDI), UN 2020 |
| Open system | Existence of national OGD portals | | | Open Government Development Index (OGDI), UN 2020 |
| Transparency | Transparency of service delivery | | the extent to which the service process and expectations are clarified. | EU eGovernment benchmark 2021 |
| | Transparency of service design | | the extent to which user are informed on and involved in policy and service design processes. | EU eGovernment benchmark 2021 |
| | Transparency of personal data | | the extent to which user can manage their personal data held by government organisations. | EU eGovernment benchmark 2021 |

'User-driven' elaborates on the extent to which a government bestow the people a central role as a key player and decision maker to policy implementation and place the citizen's needs at the center for decision making and therefore enabling an inclusive and citizen-centered policy process and output. The citizen's convenience and demand is the core implication for the successful user-driven approach. The Key elements of user-driven approaches are: Engagement by default, Learning, Accessibility and inclusion, Talent and leadership, Service design and delivery, Linkages with the other dimensions

**Table 12** Recomposed ICT Indicators for measuring User-driven

| Dimension | Sub-division | Indicator | Data collection process | Data Reference |
|---|---|---|---|---|
| User Centricity | Online Availability | | the extent to which informational and transactional services and information concerning these services is provided online, and can be reached via a portal website. | EU eGovernment benchmark 2021 |
| | User Support | | the extent to which online support, help features, and feedback mechanisms are available. | EU eGovernment benchmark 2021 |
| | Mobile Friendliness | | the extent to which services are provided through a mobile-friendly interface, an interface that is responsive to the mobile device. | EU eGovernment benchmark 2021 |
| Service Design | Digital public services for citizens | | The share of administrative steps that can be done online for major life events (birth of a child, new residence, etc.) for citizens | Digital Economy and Society Index (DESI) 2021 |
| | Digital public services for businesses | | The indicator broadly reflects the share of public services needed for starting a business and conducting regular business operations that are available online for domestic as well as foreign | Digital Economy and Society Index (DESI) 2021 |

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| | | users. Services provided through a portal receive a higher score, services which provide only information (but have to be completed offline) receive a more limited score. | |
| E-Engagement | E-information | Enabling participation by providing citizens with public information and access to information without or upon demand | E-Participation Index (EPI), UN 2020 |
| | E-consultation | Engaging citizens in contributions to and deliberation on public policies and services | E-Participation Index (EPI), UN 2020 |
| | E-decision-making | Empowering citizens through co-design of policy options and coproduction of service components and delivery modalities | E-Participation Index (EPI), UN 2020 |
| | Online and offline channels to engage different actors when designing new digital services | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| Digital Empowerment | Program or plan that aims to increase digital skills of citizens (e.g. different actions for different potentially vulnerable segments of the population or generic actions targeting all segments) | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Public engagement foreseen in the NDGS to leverage mobile platforms to proactively engage citizens to gather their inputs to shape/design new services and/or policy; use data to foresee people's needs and interests; use online platforms to upskill citizens on digital opportunities | | OECD Digital Government Index (DGI): Methodology and 2019 Results |

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|---|---|---|---|
| Adaptation | Initiatives to adapt central/federal level public services according to the analysis of data on citizen needs, preferences and use patterns | | OECD Digital Government Index (DGI): Methodology and 2019 Results |

'Proactiveness' indicates the extent to which the government has the potential to anticipate and spontaneously and actively put effort to understand citizen's needs and rapidly respond to their requests and demands. As a new paradigm for the next generation of public services it builds upon the five dimensions indicated above and targets the offering of immaculate and accessible delivery of services to citizens.

**Table 13** Recomposed ICT Indicators for measuring Proactiveness

| Dimension | Sub-division | Indicator | Data collection process | Data Reference |
|---|---|---|---|---|
| Proactive Transformation | Adoption of emerging technologies | | Average answer to a survey question concerning the extent that adopt five types of emerging technology (Artificial intelligence, Robotics, App- and web-enabled markets, Big data analytics, and Cloud computing) | Networked Readiness INDEX 2021 |
| | Government promotion of investment in emerging technologies | | Average answer to survey questions concerning the extent to which governments foster investment in five types of emerging technology (Artificial intelligence, Robotics, App- and web-enabled markets, Big data analytics, and Cloud computing) | Networked Readiness INDEX 2021 |
| Outreach | Social Media | | Enterprises using two or more of the following social media: social networks, enterprise's blog or microblog, multimedia content sharing websites, wiki-based knowledge sharing tools. Using social | Digital Economy and Society Index (DESI) 2021 |

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| | | media means that the enterprise has a user profile, an account or a user license depending on the requirements and the type of the social media. | |
| | Training for public servants on the use of digital tools for engaging the public (e.g. social media, website design, data analytics, data mining, open government data) | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Means of informing the general public regarding existing opportunities to engage in the design of digital government services (e.g. official government publication - paper; government Websites; social media accounts - government accounts; traditional media; individual communications) | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| Readiness | Centrally available list with all fully transactional digital services provided in the public sector | | OECD Digital Government Index (DGI): Methodology and 2019 Results |
| | Mechanism in place providing a comprehensive overview of on-going digital government initiatives (e.g. dashboard of ICT projects) | | OECD Digital Government Index (DGI): Methodology and 2019 Results |

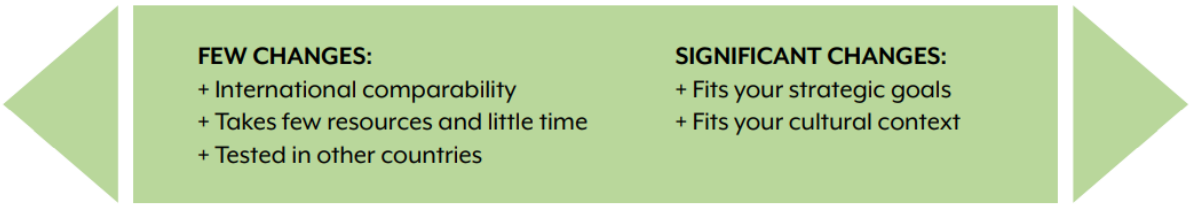
### 4.2 Adapting the Questionnaire

Above, we have looked at some recommended indicators that is recomposed and allocated to respective dimensions of DGPF as a guide map for internationally measuring ICT innovation in the public sector. When the fundamental agreement on the core indicator is made and deployed, there should be a carefully planned out initiative from respective countries to select the right balance to adapt the questionnaire in national context and test the questionnaire for successful output to achieve a 'Common but Differentiated Measurement' approach for ICT innovation in the public sector.

Finding the right balance to adapt the questionnaire

When adapting the questionnaire, it must involve a considerate balance of what is to be changed and what is to be maintained. In that connection, it is critical to find a right balance to make only a few changes for international comparability and at the same time, adapt to fit to the nation's strategic, structural, and cultural context, if needed. Each nation should consider which questions from the agreed barometer are answerable and of great importance to them.

**Figure 11** Changes for the balance (The Danish National Center for Public Sector Innovation, 2021)




Note that when a few changes are made, there will be more areas that national data can see its international comparability in the global community with fewer resources and time spent. On the other hand, with significant changes, there will be more nation-focused data that fits its

strategic goals and cultural context but with less comparability (Danish National Center for Public Sector Innovation, 2021). That said, the nation should find a right balance that best fits one's interest.

Selecting Questions

Depending on the national strategic goals, some questions might be relatively more or less important than others. If such is the case, questions can be added, dropped or modified to fit the needs. When this is the case, it would be advisable to report the changes made to the central board for their reference. However, as indicated above, one should note that modifying and developing new questions will add more work and hinder international comparability. On the other hand, omitting questions that are not relevant to one's country may reduce burden on both the workers and respondents as this will decrease the time needed to fill out more of the questionnaire (Danish National Center for Public Sector Innovation, 2021). Again, international comparability may be preserved with minor modifications, but larger modifications can compromise it. With this in mind, it is strongly recommended that some core questions are determined and kept to permit international comparison.

Translating the Questionnaire

As the questionnaire will be made for international comparability, it is important that the right words and phrases are correctly translated in a national language to ensure the intentions and meaning of the wordings are universally the same. However, this is not an easy task. If it is somewhat difficult to translate as accurate compared to original questionnaire, one must prioritize and make decisions based on the reactions of the respondents and make the questions as similar as possible in each language (Danish National Center for Public Sector Innovation, 2021). Also, when translating, it is crucial to use consistent terminology. For

example, ‘private businesses’ and ‘private enterprises’ should not be used interchangeably. One term should be selected and used consistently. This will likely eliminate confusion when communicating with the respondents and make the accumulated results more accurate and coherent.

Moreover, there could also be differences in the structure of the organization, personnel and population. In these cases, wordings may have to change and adapt to fit the respondents’ real world flexibly. One must also take cultural norms into consideration when determining how it will be interpreted by the nationals and how formally or informally the question could be addressed to the respondents. Yet again, this should be to the extent that does not compromise the international comparability

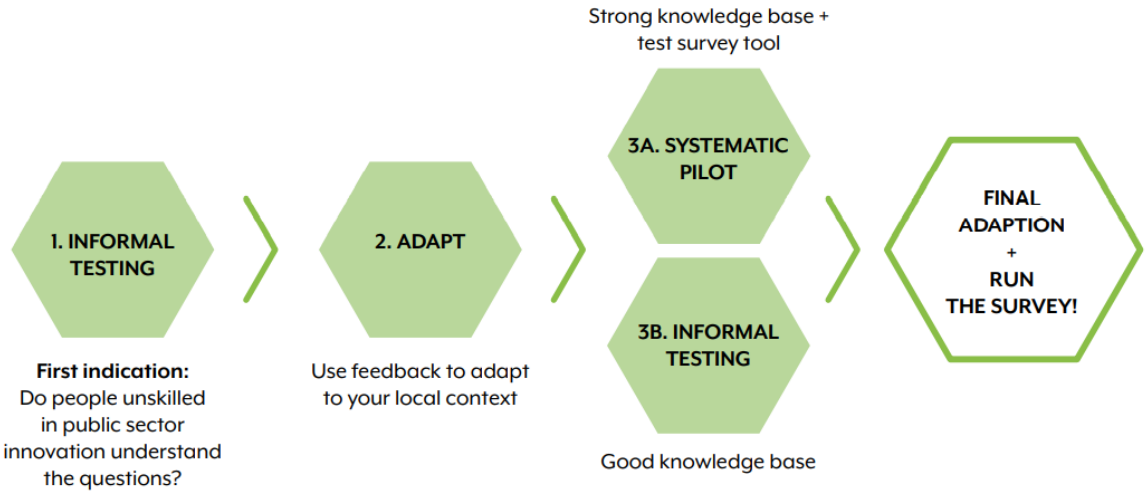
Testing the Questionnaire

The most important part of adapting the questionnaire to one’s national context is to actually have the selected questionnaire tested with public sector employees. What is crucial to highlight is that these employees must be general staffs with no innovation specialties (Danish National Center for Public Sector Innovation, 2021). To save the resources, one may start by introducing the questionnaire to a few people (e.g. co-workers, networks) to have a quick glance on the applicability and see if they understand the questions and are able to answer them. Additionally, one may ask for feedback on whether these questions would be pertinent in the context of their work area. This comment would guide as a great starting point for question selection and adaption to the national context. It is always important to remember that the respondent’s viewpoint is the utmost priority. The data collectors should not put their stereotype and opinion at the center when developing the questionnaire. After all, if the respondents do not understand the questions as intended, the results will be of little or no use.

Pilot Study an Informal Testing

Once the questionnaire has been adapted, one may conduct a systematic pilot study, testing the draft questionnaire on a small sample of respondents. Their critical qualitative feedback can be used to make amendments to questions if needed (Danish National Center for Public Sector Innovation, 2021). The opportunity to make necessary changes before the actual implementation will save numerous resources and possibly a shocking change to the whole dynamics of the question. Informal testing is also useful in that it can help to test whether the survey software from contacting respondents and collecting data is properly working.

**Figure 12** Steps involved in testing the Questionnaire (The Danish National Center for Public Sector Innovation, 2021)




Once the above process is successfully carried out, the final adaption of questionnaire to the national context will be in place with minimized errors. Then, the nations will be ready to start the initiation of data collection for measuring and in the end, will be given international comparability for their respective performance on ICT driven public sector innovation.

## 5. Summary and Conclusion

While there have been emerging efforts from countries and institutions to formulate the ideal method of measuring ICT driven public sector innovation, many problems were surfaced for the world to address and more importantly, there were no global consensus for a universal measurement barometer. Against this backdrop, the paper has looked at 6 methodological approaches which can be applied in measuring: Self-Assessment, Regional Assessment, Survey, External Evaluation, Composite Indicator Evaluation and Awards. Respective approaches had its own strategies and structure of assessment, with potential to be transited in the ICT measurement context which can help policy makers to benchmark on in accordance with their objectives and needs. However, as there is an absence of a universally adoptable measurement, various ICT related indexes are recomposed and suggested under the 6 dimensions (Digital by design, Data-driven public sector, Government as a platform, Open by default, User-driven, Proactiveness) of the Digital Government Policy Framework providing a foundational reference for initiating the effort. The goal of the development of the indicators is to promote a better understanding of the actual innovation process, its drivers and hindrances, and to design policy actions for public sector innovation within the broader realms of current policy interest. (Bloch, C., Bugge, M., & Slipersaeter, S., 2010).

Once the consensus is made on the common indicator, it is important for the member states to adapt the standard barometer into one's own country context while balancing the extent of the modification to maintain the international comparability. A careful moderation can be made through the steps of selecting the right questions, translating, testing the questionnaire and conducting pilot studies. As a result, the world will have successfully adopted a Common but Differentiated mechanism for Measuring ICT Driven Public Sector Innovation.

Meanwhile, it is important to note that the public sector innovation measurement is incessantly a moving target (Bloch and Bugge, 2013). Even with a spotless idea of conceptual framework for measurement, innovation is a dynamic process which continues to change. What has worked in the past, may not work in pass of time as innovations stop being innovative over time. Therefore, the innovative measurement should be in flux and with utility. The framework needs adjusted tuning and iterative approach for essential update and renewal.

This means that the proposed composite evaluation method through DGPF may also need complementary approaches over time. There exist many tools, methods and metrics to support ICT innovation evaluation, ranging from quantitative methods based on statistics, numbers and economic modelling to qualitative methods such as interviews and observation. Both of these approaches are imperative in making evaluation efforts and it is not conducive to argue which produces ‘better’ results, rather the argument should be how can we make the measurement more meaningful and up to date.

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