INFORMATION AND COMMUNICATIONS TECHNOLOGY AND
DISASTER RISK REDUCTION DIVISION

PROCEDURE MANUAL:
Enabling E-resilience Monitoring Dashboard Frameworks

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Abstract

The current pandemic has further underlined the need for a knowledge-based digital plan which may help to manage with crisis periods as well as lead and accelerate digital transformation.

Through the Asia-Pacific Information Superhighway (AP-IS) initiative, ESCAP supports member States in increasing the availability and affordability of broadband Internet across Asia and the Pacific. ESCAP is also supporting the implementation of the Regional Economic Cooperation and Integration (RECI) initiative which aims to develop knowledge products such as analysis reports and on-line knowledge tools, and build capacity of member States in developing seamless regional Information and communications technology (ICT) connectivity while managing external disturbance, environmental risks and shared vulnerabilities.

The ability to properly measure e-resilience[2] is a key component of successful disaster risk management and adaptation in the recovery period. Quantitative, indicator-based assessments can be applied to evaluate e-resilience by combining particularly relevant ICT and disaster risk reduction (DRR) related indicators of performance into a single composite dashboard.

Bearing in mind all the above, ESCAP created an on-line e-resilience dashboard to solidify the common awareness and shared understanding of e-resilience and ways to measure it at the national level from pandemic management perspective, which may be seen as a step forward, towards digital transformation.

ESCAP's new interactive toolkit on e-resilience is aimed to support and accelerate action plan 2022-2026 under the Asia-Pacific Information Superhighway (AP-IS). This dashboard is an example, which may be updated and replicated based on the specific needs of a member-state under specific circumstances, requiring the knowledge-based planning and sound actions from the policymakers.

This document is aimed to describe general workflow needed to create a simple monitoring dashboard, augmented by practical examples taken from of development ESCAP's new e-resilience monitoring dashboard.

Keywords: e-resilience, monitoring dashboard, procedure, manual.

[2] As the third pillar of the Asia-Pacific Information Superhighway (AP-IS), e-resilience is defined as the ability of ICT systems to withstand, recover from and change in the face of an external disturbance.

Abbreviations and Acronyms

AP-IS	Asia-Pacific Information Superhighway initiative
DRR	Disaster Risk Reduction
ESCAP	Economic and Social Commission for Asia and the Pacific
ICT	Information and Communications Technology
SPECA	UN Special Programme for the Economies of Central Asia

1. Introduction

The resilience of ICT infrastructure and networks in Asia and the Pacific assumed extremely high importance in the face of the COVID-19 pandemic. Since March 2020, data traffic has increased all over the world and surged the demand for broadband Internet connection to overcome economic lockdowns, while challenging the adaptive capabilities of underlying Information and Communications Technology (ICT) infrastructure. In this connection, quality, stability and the resilience of ICT infrastructure and networks, the so-called "e-resilience", in Asia and the Pacific appears as a more critical agenda in the pandemic and recovery phase.

As the important component of the Asia-Pacific Information Superhighway (AP-IS) action plan 2022-2026, e-resilience is defined as the ability of ICT systems to withstand, recover from and change in the face of an external shock. ESCAP (2020) views e-resilience from two lenses: ICT for its own resilience and ICT for societal resilience, which are inter-dependent and especially critical in times of crisis. Assessing and monitoring these two sides of e-resilience on a regular basis is a key component of successful disaster risk management, disaster adaptation and recovery. It can provide governments with the inputs for analysis and practical basis for developing policy responses to overcome present as well as future major challenges.

It is in this context that the UN ESCAP designed the toolkit called **"E-Resilience Monitoring Dashboard"** and launched it in 2021. Through the online visualization, E-resilience monitoring framework and dashboard aims to inform the policymakers and professionals of the available and relevant e-resilience indicators and help assess digital performance across the region that ensure safe, affordable, and reliable digital connectivity is available to all to handle future crises.

The new ESCAP E-resilience monitoring dashboard is an example, which may be updated and replicated based on the specific needs of a member-state under specific circumstances, requiring from the policymakers the knowledge-based planning and sound actions. The process of developing the monitoring dashboard framework comprises a number of generalized steps. This process will be described in the next chapters, along with the practical examples and screenshots which ESCAP team collected during the research and development of E-resilience monitoring dashboard.

2. Methodology

A literature review is an essential component that may precede any new development work. It represents a survey or desk review, including through Internet, of different sources on the particular subject and aims to obtain an overview of current knowledge, relevant development processes, theories, gaps in the existing methodics and even opportunities for collaboration.

During the development process for the E-resilience Monitoring framework, the ESCAP team reviewed a number of ICT related and general resilience-specific indices, and compared the purpose, concept and methodology used[3]. A clear conclusion they drawn from this research is that in spite of continues efforts being done in the field of evaluation of different aspects of ICT contribution in economic and social resilience of the countries, an e-resilience model that encompasses the performance of all ICT components on country level from immediate impact through the recovery phase of a disaster is not yet available. However, measuring e-resilience is a key component of successful disaster risk management, disaster adaptation and maintaining the recovery period. This encouraged ESCAP team to develop the model that encompasses the ICT performance in line with the above concept.

STEP BY STEP APPROACH IN FRAMEWORK DEVELOPMENT

The main steps in the process of developing the general Monitoring Dashboard are represented in the Figure 1 below.

Figure 1: Step By Step Approach In Framework Development

[3] United Nations, Economic and Social Commission for Asia and the Pacific, "Understanding E-Resilience for Pandemic Recovery in Asia and the Pacific", working paper, 23 November 2020, available at: https://www.unescap.org/resources/understanding-e-resilience-pandemic-recovery-asia-and-pacific

1. Set Concept

The first step in the framework development is to set the clear concept of the measurement framework. It may include the exact determination of the most influential matters, expressed through the set of specific questions:

- why is this monitoring dashboard necessary ?
- what it is supposed to measure?
- what is the goal of the monitoring?
- who are the main beneficiaries of the monitoring framework and what are they working on to achieve?
- how the developed product may support the beneficiaries and what questions it may help them to answer, as a potencial outcome of applying the monitoring framework?

2. Select Pillars

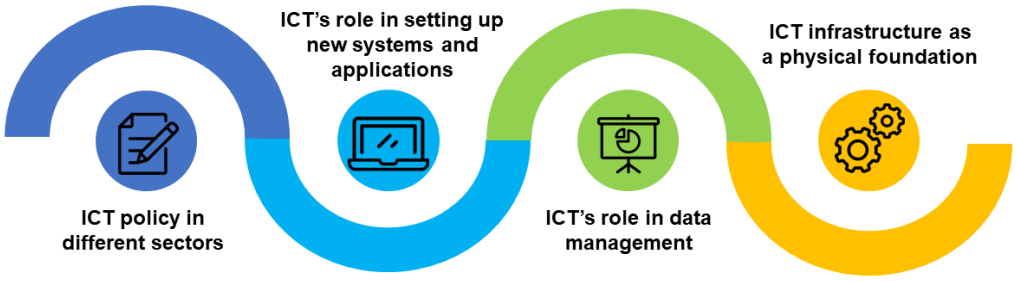
It make sense to identify several global areas, or pillars, that will represent specifically required aspects of the field being monitored, will ensure the modular structure of the designed monitoring framework, which in turn may facilitate scaling up/down the construction if necessary. These pillars are likely interdependent and can be partially overlapping, and should entirely cover the monitored area. At the same time they could be further brocken down into corresponding smaller components (indicators) to structure data collection and analysis.

During the E-resilience monitoring framework four important areas in which ICT plays a critical role at the national level have been identified (see Figure 2). The first area is governmental ***ICT related policy in different sectors*** that is the foundation for e-resilience.
The second one is ***ICT's role in setting up new systems and applications*** that can play
a role in e-adaptation and recovering from the pandemic.
The third area is ***ICTs' role in the cycle of data managing*** (gathering, analysis, and decision making) that then leads into actions and policies which influence disaster resilience and adaptability.
Finally, the forth area is a direct measurement of ***ICT infrastructure as a physical foundation*** for all the above.

3. Choose Indicators

One needs to consider the following principles to create a quick and relatively easy framework that allows the comprehensive and clear view of the specifically required aspects of national development landscape, e.g. e-resilience in the

Figure 2 : E-resilience Monitoring Dashboard Pillars



example currently being examined.

- The validity of the statistical data is of the utmost importance in the evaluation of the country needs and perspectives, thus the statistical base needs to be trusted, carefuly collected, reported and post-processed. It is a labourous and time consuming exercise requiring a lot of institutional resources and agreements between countries, which in it's turn may not be in hand. In view of the above considerations it makes sense to ***leverage already existing indices*** *and indicators* that are mostly well known and accepted by professionals and policymakers of the majority of UN member-countries.

- ***The criterions for selection of indicators*** should be carefully pondered and the way how they fall under the required framework categories clearly traced and explained.

  At the EGM conducted by ESCAP on 10 November 2020[4] the participated experts suggested, that the best way to identify indicators is to ask the following questions – 'Is there a clear impact pathway from the indicator to the e-resilience outcome' or 'what is the theory of change associated with each of the indicators'.

- ***The selected indicators should cover most (80% and more) of ESCAP member-countries***, as, notwithstanding the fact that this work was initially supposed to be done under the framework of RECI[5] project for three project target countries: Kazakhstan, Kyrgyzstan and Mongolia, the possibility to scale up the e-resilience monitoring to the whole ESCAP region may be considered.

- The last but not least important point for selection of indicators should be ***the regularity of its collection and publishing*** by responsible institution (e.g. data should be collected annually), which is important for maintaining continuity of the measurement for coming years and monitoring the progress towards national e-resilience improvement.

Based on these criterions ESCAP team has narrowed down the list of potencial sources of data, and decided to use the data from following International Organizations to contribute to E-resilience Monitoring dashboard:

- ✓ ICT Development Index (IDI), ITU [6]
- ✓ E-Government Development Index (EGDI), UN DESA[7]
- ✓ Network Readiness Index (NRI), Portulans Institute [8]
- ✓ World Economic Forum Global Competitiveness Index (WEF GCI), WEF[9]
- ✓ INFORM Risk Indicator[10]

Some of the data providers listed above are not the primary sources of the statistics data but carefully analyze and systematize it. In some cases, e.g. for future dashboard updates the decision can be made to refer to original data sources (listed in the Reference Chapter below), subject of their timely update and resources availablity.

[4] More information available at: https://www.unescap.org/events/digital-connectivity-and-e-resilience-better-crisis-preparedness-virtual-meeting

[5] Regional Economic Cooperation and Integration (RECI) project under the framework of the Asia-Pacific Information Superhighway (AP-IS).

[6] https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

[7] 2020 United Nations E-Government Survey | Multimedia Library - United Nations Department of Economic and Social Affairs

[8] Network Readiness Index, https://networkreadinessindex.org/

[9] http://reports.weforum.org/global-competitiveness-index-2017-2018/

[10] INFORM Risk Indicator Methodology

Figure 3: Screenshot of Excel spreadsheet filled in with E-resilience statistical data

	DRR Background	ICT Policy in Different Sectors												
	Hazard & Exposure	Ease Of Doing Business (0-100 Max)	Legal Framework' s Adaptability To Emerging Technologies (1-7 Max)	E-Commerce Legislation (0 -4 Max	ICT Regulatory Environment (0-100 Max)	Secure Internet Servers (Per Million Population)	Cybersecurity (0-1max)	Regulatory Quality -2.5 - 2.5 (Max)	Adult Literacy (0-100% Max)	Mean Year Of Schooling	R&D Expenditure By Governments And Higher Education (%)	Public Trust In Politicians 1–7 (Max)	Government Effectiveness -2.5 - 2.5(Max)	DRR Implementation 0 - 10
Afghanistan	8.8	44.1	N/A	N/A	N/A	N/A	N/A	N/A	43.02	3.9	N/A	N/A	-1.46	6.3
Azerbaijan	5	76.71	4.27	3	70.5	368.84	0.65	-0.38	99.79	10.5	18.03	4.65	-0.14	N/A
Kazakhstan	2.4	79.56	3.38	3	54	2358.98	0.78	0.14	99.8	11.8	5.72	3.76	0.12	3.8
Kyrgyzstan	5	67.82	2.15	3	74.5	287.91	0.25	-0.35	99.59	10.9	7.57	2.84	-0.68	3.7
Tajikistan	5.2	61.27	2.84	3	14	71.13	0.26	-1.05	99.8	10.7	9.7	4.25	-1.05	4.6
Turkmenistan	2.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	99.7	9.8	N/A	N/A	-1.16	N/A
Uzbekistan	3.8	69.9	N/A	N/A	N/A	N/A	N/A	N/A	99.99	11.5	N/A	N/A	-0.51	2.6

Source: ESCAP (Authors)

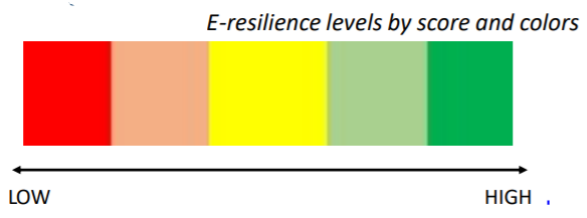
4. Collect Statistical Data

This may be a very laborious step. During this step the data for the indicators selected previously should be collected and put into a table. The ESCAP team used the ordinary Excel spreadsheet to collect and store the data for E-resilience monitoring dashboard. The example of data storage is presented on the Figure 3 above.

5. Vizualize Monitored Data Through Dashboard

It may be useful to leverage traffic light coloring to illustrate the values of the indicators, achieved by countries (see Figure 4). For this purpose, and in order to ensure consistency of measurement, all indicators can be normalized to have a value within a range of 0 to 100 (or 0.00 to 1.00). Some indicators may need to be transformed to have the same orientation, i.e. a higher score representing stronger performance.

Figure 4 : Traffic light coloring rules



Source: ESCAP (Authors)

The following meanings of the colors were used for E-resilience Monitoring Dashboard:

RED: 0 – 30.9 the least network-ready economy in the pillar or component concerned. Requires more investments, inclusiveness, or support from other member states to achieve e-resilience.

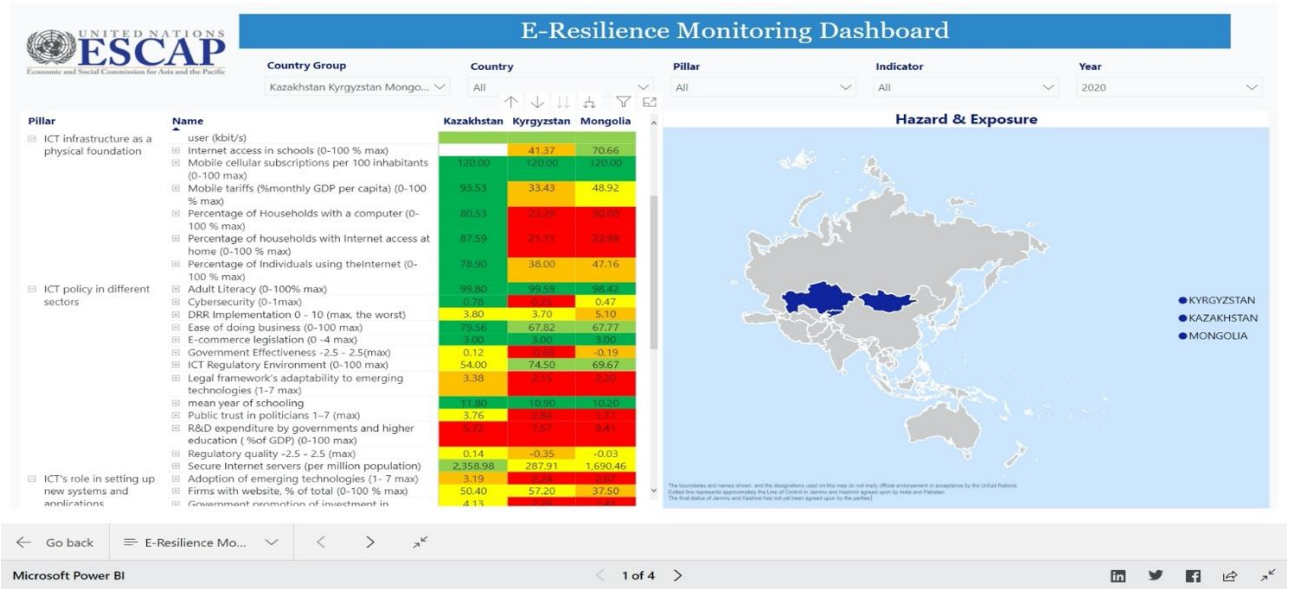
ORANGE: 31 – 44.9 the economy does not perform well enough in the pillar or component concerned. In transition and requires more resources and capacity building and investments to achieve better e-resilience.

YELLOW: 45- 59.9 the economy is a good performer when it comes to the pillar or component concerned, nevertheless there is room for improvement which requires some more resources and capacity building to become more e-resilient.

LIGHT GREEN: 60 – 74.9 the economy is a strong performer as a result of solid showings in the pillar or component concerned. Ready for sharing experiences, services and tools (ex. e-platforms and e-market spaces) at interstate level, and there is some room for improvement to become more e-resilient.

DARK GREEN: 75 – 100 the economies, which are the global leaders and most networkready societies performing at the highest level in the index pillar or component concerned. Which in turn demonstrates high e-resilience and readiness for interstate share of experience and services.

Figure 5: Frontpage of the ESCAP E-resilience monitoring dashboard



Source: ESCAP (Authors)
Note: More information and actual link to Dasboard available at https://drrgateway.net/e-resilience-monitoring-dashboard

It may not be enough to represent E-resilience levels by score and colors. There are different services and applications that may come handy for developing visually appealing and suitable for analysis monitoring dashboard frameworks through better visualizing, highlighting, and presenting big volumes of data. The simplest way is to use Charts functionality in Microsoft Excel application. Another good application for vizualising data is Microsoft PowerBi - the one ESCAP team have choosen for interactive E-resilience dashboard (see Figure 5 above). Below are just a couple of additional applications that may be used, subject to specific needs, expertise and preference of the researchers:

- **Google Data Studio** is a service that turns data into informative reports and dashboards that are easier to read, fully customize, and share with colleagues.
- **Tableau** is a Business intelligence service allowing to build the dashboards that can be published or shared.

6. Review outcomes

It may be very helpful to amend the data collected via statistical indicators with perception based data (vs. official statistics) through the conducting the Questionnaires or Surveys on the similar topics. Matching and comparing the perceptional survey results with official statistics may help to verify the dashboard oucomes, provide additional direction for monitoring or spot the "bottle necks" that may be not visible to official statistics.

ESCAP has conducted the Perception-based Survey, aimed to identify public perceptions on the operational capacity of countries to prevent, respond, and recover from public health disasters through ICT infrastructure resilience and ICT for societal resilience. The Survey has been conducted for Kazakhstan, Kyrgyzstan and Mongolia[11] (under RECI project framework) and SPECA[12] group of countries[13].

[11] The Survey results report available at: https://www.unescap.org/sites/default/d8files/event-documents/Annex%203_Survey%20A%20results%2C%20updated.pdf

[12] SPECA participating countries: Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan

[13] The Survey results report is available at: https://www.unescap.org/sites/default/files/SPECA_E-Resilience_Survey%20results-English_0.pdf

3. Policy Implications

Policymakers can utilize the outcomes of monitoring dashboard as information to foster an enabling environment to build resilient ICT infrastructure and ICT for social resilience and develop policy measures that could support a collaborative response to future crises.

For example:

- Member states can assess the progress made in terms of the development, upgrading and harmonization of national and sub-regional broadband policies and regulations,
- States can report on the progress that has been made in building e-resilience, including enabling of broadband policies, regulations, programmes and legislations that have been identified by e-resilience monitoring for national and sub-regional policy updates and harmonization,
- Members can share information on relevant case studies and on analysis around monitored indicators, based on good practices and lessons learned.

Box 1: **Three Areas for Policy Application**

1. The COVID-19 pandemic and climate change pose credible collective risks and danger to member States, but they also present an incredible shared opportunity for collaboration, learning, and capacity-building. This could be derived in the form of harnessing E-Resilience in the phases of Disaster Risk Reduction, especially through risk mitigation and adaptation. **ESCAP's E-Resilience Monitoring Dashboard assists policymakers to identify both strengths and gaps in policy, infrastructural and data systems, and to learn from best practice within the region and across the world,** especially as multi-hazards of pandemics and climate have become transboundary in nature.

2. E-Resilience embodies (i) ICT infrastructure resilience, and (ii) ICT for societal resilience. **Leveraging on E-Resilience enhancement provides member States the opportunity to scale up on innovation and adaptability through a whole-of-societal approach as means to respond to an increasingly uncertain future**. Rapid innovation is the panacea of the digital transformation age. ESCAP's E-Resilience Monitoring Dashboard provides a single window for policymakers and professionals to leverage on well-trusted and real-time information and case studies, and also as means to launch further collaborations with international organizations and the private sector, particularly deployed across sectors such as energy, water, and transport.

3. E-Resilience forms one of the four essential pillars of the Asia Pacific Information Superhighway (AP-IS), particularly through enhancing disaster management systems and disaster communications. **Strengthening cybersecurity infrastructure and systems should be a priority for countries, not only to enhance their own national security interests, but also that of the region.** Weaknesses potentially exacerbated by disasters and emergencies must not provide means of certain international malicious actors to capitalise on.

4. Framing Cooperation: Who is Doing What on E-Resilience?

The thorough research on the Internet revealed the absence of comprehensive evaluations of the E-resilience on national, subregional or regional levels by any International Organizations or ThinkTanks. This served as additional push and encouragement for starting the research by ESCAP. Some examples of various works being done by different parties that may be considered relevant to E-resilience or may contribute as a components of e-resilience assessment and suggest the fields of multilateral cooperation are briefly listed below.

The International Telecommunication Union (ITU) explores the contribution of the ICT infrastructure to building social and economic resilience in the context of the pandemic. ITU has developed the Global Network Resiliency Platform (#REG4COVID) with interactive map where ICT community of regulators, policy makers and other stakeholders share information on what initiatives and measures have been introduced worldwide to help communities remain connected during the COVID-19 crisis[14].

European Commission European Commission adopted a digital finance package on September 24, 2020, which includes a digital finance strategy and legislative proposals on crypto-assets and digital resilience[15].

Focusing on the latter legislative package, it formulated new common rules mitigating risks of digital transformation into a Proposal for a Regulation on digital operational resilience for the financial sector (DORA)[16], accompanied by a directive.

Lastly, private sector organizations, based on the lessons learned from the major disturbances caused by COVID-19 pandemic, realized that the organizational processes and infrastructure require digital resilience to quickly respond to possible future crisis. Digital resilience has become a significant subject of investment in 2020, according to Research group IDC, whose Digital Resilience Investment Index[17] provides a composite view of the progress organizations are making in their investments towards digital resiliency.

[14] More information available at: https://reg4covid.wpengine.com/

[15] More information available at: https://www.whitecase.com/publications/article/few-words-dora-proposal-regulation-digital-operational-resilience-financial

[16] More information available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0595

[17] More information available at: https://www.idc.com/getdoc.jsp?containerId=prUS46989720

5. Conclusion / Recommendations

In conclusion, it may be worth to highlight that the unprecedented importance of the resilience of core Internet infrastructure networks for mitigating the crisis and adaptation in the pandemic has become indisputable fact.

In view of that, the ESCAP Secretariat would recommend :

1. **The expert networks to continue developing and expanding the methodology** to monitor the e-resilience by country (Ref CICTSTI[18] paper AI2). The composite monitoring framework in the form of e-resilience related indicator dashboard would visualize the extent of e-resilience and serve as a monitoring tool for governments to assess the resilience (or vulnerability) of their digital infrastructure to inform and ensure that digital systems have the capacity to handle the crises of the future.

2. **Develop Models for technology collaboration.** The Asia-Pacific region is home to some of the most technologically advanced economies in the world, as well as to some of the most technologically deprived. Collaboration at the regional level can be a critical force for improving the e-resilience through increasing broad innovation capacity and scaling up effective technologies, digital inclusion, while addressing the digital gaps in the fight against current COVID-19 pandemic, as well as possible future crisis.

3. ESCAP Secretariat would recommend and encourage **member-countries to contribute and support the Asia-Pacific Information Superhighway (AP-IS)** through implementation on the national levels as well as through region-wide cooperation.

   E-resilience is an essential component of the Connectivity pillar of AP-IS second action plan 2022-2026[19] - the sole region-wide intergovernmental cooperation platform which promotes inclusive digital transformation of Asia and the Pacific through self-initiated implementation and cooperation from member States.

[18] CICTSTI, Agenda Item 2: "Collaborative actions to harness technologies during pandemics" https://www.unescap.org/sites/default/files/CICTSTI_1_item%202_E.pdf

[19] ESCAP (2021), First draft group meeting for developing the action plan 2022-2026 of the Asia-Pacific Information Superhighway (AP-IS). Available at: https://www.unescap.org/events/2021/first-meeting-drafting-group-developing-action-plan-2022-2026-asia-pacific-information#

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- EU Law,

  https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0595

Annex I: List and Overview of Indices comprising the E-resilience Dasboard

We have grouped all indicators under the main four pillars. Section below provides brief overview and justification for ICT indices and indicators grouped under each of the four respective pillar.

Pillar One: ICT Policy in Different Sectors

It's represented by 13 indicators, assessing mostly the government's efficiency, including its perception and trust by citizens; the extent to which political, legislative and regulatory environment supports and encourage the initiatives, innovative measures and business development in the countries; governmental adaptiveness to new technologies. Education, including basic and life-long learning, capacity and development of critical thinking among the citizens is also can be considered under this pillar, as in many cases the level of knowledge and skills of citizens may support their perception and acceptance of digital tools, beneficial applicability in everyday life, and even contribute to improve cybersecurity.

1.1. Ease of doing business

Part of NRI, the ease of doing business index aggregates a country's percentile rankings on 10 topics covered in the World Bank's Doing Business report series[20]. The topics are starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. A high ranking indicates that the regulatory environment is more conducive to setting up a business.

This indicator may be reflecting the favorable environment for launch and developments of technologic and digital businesses and start-ups, contributing in general ICT environment in the countries, and also contributing to quicker post-crises economic and social restoration through creation new workplaces and the services most required by population.

1.2. Legal framework's adaptability to emerging technologies

Part of NRI, Indicator is originally sourced from World Economic Forum, Executive Opinion Survey 2018–2019[21], Global Competitiveness report[22]. The extent to which the legal framework is adapting to five types of emerging technology: to Artificial intelligence, Robotics, App- and web-enabled markets, Big data analytics, and Cloud computing.

Advances in technology, often referred to as "disruptive innovation" changing people's lives and, undoubtedly, led to new and improved and more accessible conventional services and the quality of products being offered to consumers today. The world lately has become more integrated and inclusive because of liberalization and globalization. Although these innovations have contributed to the digital space, they have also raised legal and regulatory concerns around the world[23].

So, the countries' legal framework should be adaptive enough to encourage innovation while protecting the interests of consumers, small and medium-size local producers, thus eventually supporting building technological ecosystem and foundation.

[20] World Bank, Doing Business 2020: https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020

[21] http://reports.weforum.org

[22] http://reports.weforum.org/global-competitiveness-report-2019/

[23] World Economic Forum (weforum.org) https://www.weforum.org/agenda/2019/02/how-can-we-regulate-disruptive-technologies/

1.3. E-commerce legislation

Part of NRI, Indicator is originally sourced from United Nations Conference on Trade and Development (UNCTAD), Global Cyberlaw Tracker[24].

Indicator provides information on whether a country has adopted legislation (or has a draft law pending adoption) in four areas: electronic transactions, consumer protection, privacy and data protection, and cybercrime. Scores range from 0 (no legislation) to 4 (adopted legislation in all four areas).

This indicator may be part of the social perspective of e-resilience, as legal protection of the different aspects of electronic commerce is an important contributor to building foundation of people's trust and eventually more confident use of e-commerce opportunities, which in turn may support maintaining of the close-to-habitual lifestyle of citizens during crisis, as for example during latest COVID-19 pandemic lockdowns.

1.4. ICT Regulatory Environment

Part of NRI, this indicator provides a measure of the existence and features of ICT legal and regulatory frameworks. The index covers 50 indicators that are distributed across four pillars: Regulatory Authority, Regulatory Mandate, Regulatory Regime, and Competition Framework, based on ITU ICT Regulatory tracker[25].

The Tracker does not measure the quality, the level of implementation or the performance of regulatory frameworks in place but records their existence and features. It helps track progress and identify gaps in regulatory frameworks, making the case for further regulatory reform towards achieving a vibrant and inclusive ICT sector. That is also a valuable contributor to the both Social and ICT for own resilience aspects of e-resilience which may help governments to assess and their gaps and achievements on the way to better ICT environment and possibly consider the areas for cooperation with countries – best performers.

1.5. Secure Internet servers

Part of NRI, Indicator is originally sourced from World Bank, World Development Indicators[26]. Secure Internet servers (per million population) are servers that use encryption technology (SSL/TLS, SSH) in Internet transactions, which prevents data or money being stolen.

It's a quantitative indicator, the higher numbers of which may demonstrate more secure use of internet for different sensitive operations, e.g. internet shopping, mobile banking, etc., showing how the internet's infrastructure is getting better and more reliable, which finally also affect the trust of society to use of the digital services and eventually means better E-resilience.

1.6. Cybersecurity

Part of NRI, this indicator is ITU's Global Cybersecurity Index (GCI)[27], which provides a measure of the level of cybersecurity commitment of countries. It is a composite index made up of 25 indicators that are distributed across five main pillars: Legal Measures, Technical Measures, Organizational Measures, Capacity Building Measures, and Cooperation Measures.

Sustainable development in Cybersecurity area should ensure the resilient and adequate use of ICTs as well as economic growth, which is a definitely essential component of E-resilience.

1.7. *Regulatory quality*

The regulatory quality indicator captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Scores are standardized to a scale from -2.5 (worst) to 2.5 (best).

[24] The UNCTAD Global Cyberlaw Tracker, https://unctad.org/en/Pages/DTL/STI_and_ICTs/ICT4D-Legislation/eCom-Global-Legislation.aspx

[25] ITU , ICT Regulatory Tracker, https://www.itu.int/net4/itu-d/irt/#/about-tracker

[26] World Bank, World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators

[27] ITU, Global Cybersecurity Index 2018, https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2018-PDF-E.pdf

Being takes from NRI report, the original data is based on The Worldwide Governance Indicators (WGI) project by Worldbank[28], which reports aggregate and individual governance indicators for over 200 countries and territories over the period 1996–2019, for six dimensions of governance: Voice and Accountability; Political Stability and Absence of Violence; Government Effectiveness; Regulatory Quality; Rule of Law; Control of Corruption.

The six composite WGI measures are useful as a tool for broad view and for evaluating broad trends over time. However, they are often too blunt a tool to be useful in formulating specific governance reforms in particular country contexts. The interested stakeholders also encouraged to consult the disaggregated individual indicators underlying the composite WGI scores to gain more insights into the particular areas of strengths and weaknesses identified by the data.

1.8. Adult Literacy

"Adult literacy rate" is defined as the percentage of the population aged 15 years and over who can read, write, and understand a short, simple statement on his/her everyday life.
Part of UN EGDI Surveys editions since 2002, it's originated from UNESCO[29].
Adult literacy is a fundamental component of human capacity in using of digital technologies. Also, along with education, and life-long learning, capacity and critical thinking development it can be considered under this pillar, as in many cases the level of knowledge and skills of citizens may support their perception of digital tools, beneficial applicability in everyday life, and even contribute to improve cybersecurity.

1.9. Mean year of schooling

Same as the above component, mean years of schooling, part of UN EGDI Surveys, originated from UNESCO[30]. It also can help to define general level of citizens' knowledge and skills and can be seen as a contributor in human capacity in using of digital technologies.

1.10. R&D expenditure by governments and higher education

Gross domestic expenditure on R&D performed by government and higher education institutions (% of GDP).
This indicator refers to the combined expenditure by governments and higher education institutions on research and development (R&D) as a percentage of GDP. Higher education institutions are those that primarily focus on providing formal tertiary education. R&D expenditure is defined as all current expenditure plus gross fixed capital expenditure for R&D performed by government and higher education institutions, whatever the source of funds. It can be seen as a measure of Science and Technology in a country from the perspective of government involvement and efforts in it's development and also the structure of S&T.
It's a part of NRI report, originally sources from UNESCO statistical Institute[31].

1.11. Public trust in politicians

Indicator is a component of World Economic Forum Global Competitiveness Index[32].
Measuring trust in politicians can be seen as both technology and human dimension of e-resilience readiness, emphasizing the importance of citizens' and business community abilities to trust and abide the mitigation measures performed by authorities in the crisis period, including the leverage digital tools for this purpose, including, for example, measures of digital physical surveillance, contacts tracing, digital badges, etc.. being exercised by authorities during COVID-19 pandemic crisis.

[28] World Bank, The Worldwide Governance Indicators (WGI), http://info.worldbank.org/governance/wgi/
[29] UNESCO Institute for Statistics, UIS.Stat, available at http://data.uis.unesco.org/
[30] Ibid
[31] Ibid
[32] WEF GCI, available at http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=EOSQ041

1.12. Government Effectiveness

Government Effectiveness is part of Worldwide Governance Indicators, measured by World Bank[33], captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The indicator shows the effectiveness of the government's efforts for building the resilience across all sectors of society.

1.13. DRR implementation

Being a part of INFORM- risk indicator[34] it represents Hyogo Framework for Action scores.
The indicator for the Disaster Risk Reduction (DRR) activity in the country comes from the score of Hyogo Framework for Action self-assessment progress reports of the countries. HFA progress reports assess strategic priorities in the implementation of disaster risk reduction actions and establish baselines on levels of progress achieved in implementing the HFA's five priorities for action. The indicator quantifies the level of implementation of DRR activity which also may be seen as a general estimation of e-resilience.

Pillar Two: ICT's Role in Setting Up New Systems and Applications

The pillar is represented by 11 indicators.

Setting up new systems and applications through ICT can play a role in e-adaptation during crisis period and later recovering from the pandemic. Indicators under this pillar showcase the availability, development level and the acceptance and use of the new systems among the population of the respective countries.

2.1 ICT PCT patent applications

Part of NRI, its' originally sourced from World Intellectual Property Organization (WIPO) PCT Data, sourced from Organization for Economic Co- operation and Development (OECD), Patent Database[35], and Population data sourced from World Bank, World Development Indicators[36].
The indicator refers to the count of applications filed under the Patent Cooperation Treaty (PCT), per million population, in the technology domain of information and communication technologies by priority date and inventor nationality.
The classification for ICT-related patents is based on the International Patent Classification (IPC), as described in Inaba and Squicciarini (2017).
Indicator may be used in analysis of technological inventions: e.g. digital tools, systems; and of the activity and contribution of country population in the digital environment development; governments and business may consider it as a contributor to decision making while determining the areas for investments, just to name a few.

2.2 Firms with website (% of total)

Part of NRI, but originally data for this indicator are based on enterprise surveys conducted by the OECD[37] and the World Bank[38]. The former source is used for OECD countries and accession countries or key partners, while the latter source is used for all other countries.
Websites may be seen as a direct measure of e-resilience of SMEs (as well as their potential customers) allowing them to operate and expand business during usual operations and ensure business continuity in many crisis situations, including quick transformation to new state.

[33] Worldwide Governance Indicators, WorldBank, available at http://info.worldbank.org/governance/wgi/
[34] INFORM- risk indicator, available at http://preventionweb.net/applications/hfa/qbnhfa/
[35] OECD Patent Database, available at http://www.oecd.org/sti/inno/intellectual-property-statistics-and-analysis.htm
[36] World Bank, World Development Indicators, available at http://data.worldbank.org/data-catalog/world-development-indicators
[37] OECD, ICT Access and Use by Businesses, OECD Telecommunications and Internet Statistics (database) https://doi.org/10.1787/9d2cb97b-en
[38] World Bank, Enterprise Surveys www.enterprisesurveys.org

2.3 R&D expenditure by businesses

Part of NRI, but original data for this indicator are based on OECD, Statistics[39] and World Bank, Enterprise Surveys[40].
This indicator refers to business enterprise expenditure on research and development (R&D) as a percentage of GDP. This includes both private enterprises and public enterprises. R&D expenditure is defined as all current expenditure plus gross fixed capital expenditure for R&D performed by businesses, whatever the source of funds.
May help to overview the general involvement of business and public spheres into technical progress, may support governments and business in decision making on investments.

2.4 Government promotion of investment in emerging technologies

Part of NRI with original source of data the World Economic Forum, Executive Opinion Survey 2018–2019[41]. The World Economic Forum's Executive Opinion Survey (EOS) is conducted on an annual basis to gather information from business leaders on topics for which hard data sources are scarce or nonexistent.
It represents average answer to survey questions concerning the extent to which governments foster investment (public and private) in five types of emerging technology: Artificial intelligence and machine learning, Robotics, App- and web-enabled markets, Big data analytics, Cloud computing.
It is part of the effort to supplement The Global Competitiveness Report in assessing issues that drive national competitiveness in new technologies. Indicator may be interesting as it's based on people perception (business leaders) rather than on official data, which may provide additional perspective for the estimation and designing of next steps in country's ICT development.

2.5 Investment in emerging technologies

Part of NRI with the World Economic Forum[42] as the original source of data.
Average answer to the question: In your country, to what extent do companies invest in emerging technologies (e.g. Internet of Things, advanced analytics and artificial intelligence, augmented virtual reality and wearables, advanced robotics, 3D printing)?
Indicator may be interesting as it's based on people perception (business leaders) rather than on official data, which may provide additional perspective for the estimation and designing of next steps in country's ICT development.

2.6 Adoption of emerging technologies

Part of NRI with the World Economic Forum[43] as the original source of data.
Average answer to survey questions concerning the extent to which companies adopt five types of emerging technology: Artificial intelligence, Robotics, App- and web-enabled markets, Big data analytics, Cloud computing?
Indicator may be interesting as it's based on people perception (business leaders) rather than on official data, which may provide additional perspective for the estimation and designing of next steps in country's ICT development.

2.7 Internet shopping

Part of NRI report, it originally comes from World Bank[44] and calculates number of People who used the Internet to buy something online in the past year.
This indicator refers to the percentage of

[39] ICT Access and Use by Businesses, OECD Telecommunications and Internet Statistics (database) https://doi.org/10.1787/9d2cb97b-en
[40] World Bank, Enterprise Surveys, available at www.enterprisesurveys.org
[41] World Economic Forum, Executive Opinion Survey http://reports.weforum.org
[42] World Economic Forum, Executive Opinion Survey 2017–2018, http://reports.weforum.org
[43] World Economic Forum, Executive Opinion Survey 2017–2018, http://reports.weforum.org
[44] Source: World Bank, Global Findex database (https://globalfindex.worldbank.org/)

respondents aged at least 15 years old who have used the Internet in the past year to buy something online. The data stem from a triennial survey that is carried out in more than 140 economies.
For e-resilience measuring purpose, the availability of internet shopping option and familiarity of the population with it means that people are ready to leverage and benefit the opportunity to continue buying essential items and maintain an habitual lifestyle during period the crisis, like the lockdowns of the COVID-19 pandemic.

Note: Buying something online does not necessarily mean paying for it online. In many developing economies people reportedly commonly pay in cash on delivery for internet orders.

2.8 Medium- and high-tech industry

This indicator refers to the percentage of the value added of medium- and high-tech industry out of the total value added of manufacturing. The manufacturing sector relates to sector D in the International Standard Industrial Classification of all Economic Activities (ISIC) revision 3 (1990)[45] or sector C in ISIC revision 4 (2008). The definition of "medium- and high-tech industry" is based on the R&D intensity of economic activities.
Part of NRI report, it originally comes from several sources: United Nations Industrial Development Organization (UNIDO)[46], Open SDG Data Hub[47] United Nations (2019), UN statistics [48], OECD[49] .

2.9 High-tech exports

"High-value exports" refers to high-technology manufactures (electronic and electrical and other), as calculated according to the Lall classification, out of all exports of manufactured goods.
Part of NRI report, it originally comes from World Bank[50].
May suggest the country's contribution into new technology-based systems and applications development worldwide, and in turn contribution in e-resilience.

2.10 Prevalence of gig economy

Part of NRI report, it originally comes from World Economic Forum[51], Executive Opinion Survey.
Gig economy term refers to a labor market that is specific to digital platforms and to working arrangements that are focused on short-term contracts and task-based work. While it may be a controversial type of employment, having it's pro's and contra's, we can refer to this indicator from the e-resilience perspective to view the digital ecosystems and platforms (which are the must for this type of economy) availability and readiness in the countries.

2.11 Mobile apps development

Part of NRI report, this indicator is included in the Mobile Connectivity Index published by the GSM Association[52] . It is one of four indicators that make up the Local Relevance sub-index, which, in turn, is part of the Content & Services pillar. The original data is sourced from AppFigures.[53]
Number of active mobile applications developed per person Number of active mobile applications developed per person.
Direct measure of the new applications development on the country level, which can be seen as a contribution into e-resilience.

Pillar Three: ICT Role in Data Management

[45] See United Nations (2019) or Galindo-Rueda & Verger (2016) for details on the classification.
[46] UNIDO CIP 2018 Database, https://stat.unido.org
[47] Open SDG Data Hub, http://www.sdg.org
[48] https://unstats.un.org/sdgs/metadata/files/Metadata-09-0B-01.pdf
[49] OECD Taxonomy of Economic Activities Based on R&D Intensity, OECD Science, Technology and Industry Working Papers, 2016/04, OECD Publishing, Paris http://dx.doi.org/10.1787/5jlv73sqqp8r-en
[50] World Development Indicators http://data.worldbank.org/data-catalog/world-development-indicators .
[51] World Economic Forum, Executive Opinion Survey 2018–2019, http://reports.weforum.org
[52] http://www.mobileconnectivityindex.com
[53] https://appfigures.com/

This pillar is represented by 12 indicators. With the help of three last indicators, this component may also reflect the social aspect of digital divide.

3.1 Online Service Index (OSI)

Part of UN DESA E-government Survey, produced by UN DESA[54], which assesses the national online presence of all 193 United Nations Member States. Online Service Indicator assesses a number of countries' features related to online service delivery, including whole-of-government approaches, open government data, e-participation, multi-channel service delivery, mobile services, usage uptake and digital divides, as well as innovative partnerships through the use of ICTs.

It also include evaluation of national website in the native language, including the national portal, e-services portal and e-participation portal, as well as the websites of the related ministries of education, labor, social services, health, finance and environment, as applicable.

It can be regarded as a direct measure of e-resilience, as it demonstrates to which extent the government ready to provide and citizens ready to use the services in electronic form in national language.

3.2 GitHub commits per 1,000 population

The Indicator is a part of NRI, where data originally collected from several sources, including The GHTorrent dataset and tool suite, Data accessed through Google BigQuery. Data on population are sourced from World Bank World Development Indicators [55].

GitHub is the world's largest host of source code, and a "commit" is the term used for a saved change on this platform.

It is a proxy indicator for programming skills and number of ICT professionals, that deemed to constitute the e-resilience from social perspective, indirectly assessing the ICT skills and interest of citizens and the role, influence and contribution of country in the worldwide SW development and dissemination process.

3.3 Wikipedia edits

The Indicator is a part of NRI, where data originally collected from several sources, including Wikimedia Foundation[56]; United Nations, Department of Economic and Social Affairs, Population Division[57]. Data have been sourced from INSEAD, Cornell University, and World Intellectual Property Organization, The Global Innovation Index 2020[58] .

Wikipedia yearly page edits (per million population 15-69 years old) / "Wikipedia edits" refers to data from economies with more than 100,000 edit counts on the Wikipedia website for the given year.

The Indicator may give some more hints on the intensity and productivity of populational use of the internet, indirectly assess the population educational level, areas of interest, horizon of knowledge and knowledge application, and also value adding to educational and knowledge sharing function of Internet, etc, and eventually characterizes the population online creativity which in turn might be considered as a part of e-resilience.

3.4 Availability of local online content

Being part of NRI, the Indicator is based on the World Economic Forum's Executive Opinion Survey (EOS)[59], conducted on an annual basis to gather information from business leaders on topics for which hard data sources are scarce or nonexistent. Indicator value is an average answer

[54] 2020 United Nations E-Government Survey https://www.un.org/development/desa/publications/publication/2020-united-nations-e-government-survey

[55] http://data.worldbank.org/data-catalog/world-development-indicators

[56] https://wikimediafoundation.org

[57] https://esa.un.org/unpd/wpp/

[58] https://www.globalinnovationindex.org

[59] World Economic Forum, Executive Opinion Survey, 2018–2019, available at http://reports.weforum.org

to the question: In your country, to what extent are Internet content and services tailored to the local population (e.g. in the local language, meeting local demand)?
May be a direct measure of e-resilience trough possibility of up-to-date reliable emergency information dissemination among population during crisis period (subject of access to ICT facilities availability). Indicator may be interesting as it's based on people perception (business leaders) rather than on official data, which may provide additional perspective for the estimation and designing of next steps in country's ICT development.

3.5 Use of virtual social networks

Number of active social media users (% of population).
This indicator refers to the penetration of active social media users, expressed as a percentage of total population. Indicator is a part of NRI, but the original data come from a variety of sources, including company statements and reports in reputable media[60].
Indicator directly measures e-resilience from social lens, like involvement and trust of population in information exchange through Internet with potential of up-to-date reliable emergency information dissemination among population during crisis period.
Social medias can serve as online support to SME[61] especially during crisis periods, keep people connected with their friends, relatives and loved ones, just to name a few.

3.6 ICT skills

Being part of NRI, the Indicator is based on the World Economic Forum's Executive Opinion Survey (EOS)[62], conducted on an annual basis to gather information from business leaders on topics for which hard data sources are scarce or nonexistent. Indicator value is an average answer to the question: In your country, to what extent does the active population possess sufficient digital skills (e.g. computer skills, basic coding, digital reading)? [1 = not at all; 7 = to a great extent] | 2018-19
Indicator may be interesting as it's based on people perception (business leaders) rather than on official data, which may provide additional perspective for the estimation and designing of next steps in country's ICT development.

3.7 Publication and use of open data

Being part of NRI, the indicator is originally refers to the fourth edition of the Open Data Barometer[63], an index that provides a measure of how governments publish and use open data based on the following three dimensions (weights given in parentheses):
Readiness for open data initiatives. (35 percent)
Implementation of open data programs. (35 percent)
Impact that open data is having on business, politics and civil society. (30 percent).
The indicator can be useful to see the governments efficiency in applying digital tools for publishing and use of important data, opening up information to the public, make government more accountable, and give citizens new ways to participate in their communities.

3.8 Online access to financial account

Being part of NRI, the indicator is originally sourced from World Bank Global Findex database. [64]

Represents the number of people who used a mobile phone or the Internet to access a financial institution account in the past year (% with a financial institution account, age 15+).
Online access to Bank accounts is direct measure of e-resilience, an essential part of people's everyday life, allowing to make and receive payments, shop online, and pay utility bills

[60] We Are Social and Hootsuite (2020) Global Digital Report 2020 (https://wearesocial.com/digital-2020)
[61] Small and Medium Enterprises
[62] World Economic Forum, Executive Opinion Survey, 2018–2019, available at http://reports.weforum.org
[63] World Wide Web Foundation (2017), Open Data Barometer 4th Edition – Global Report https://opendatabarometer.org/4thedition/
[64] World Bank, Global Findex database, https://globalfindex.worldbank.org/

anytime without need to physical presence in bank or shop.

3.9 E-Participation

Being part of NRI, it's originally sourced from UN DESA E-Government Knowledgebase [65].
The E-Participation Index assesses, on a 0-to-1 (best) scale, the quality, relevance, and usefulness of government websites in providing online information and participatory tools and services to their citizens. Within the E-Participation Index, countries are benchmarked in three areas: e-information, e-consultation, and e-decision-making.
As such, the index indicates both the capacity and the willingness of the state in encouraging the citizen to promote deliberative, participatory decision-making in public policy and of the reach of its own socially inclusive governance program.

3.10 Gender gap in Internet use

The next three indicators can serve as evaluation of digital gaps in use and manage data through digital technologies in the countries from three different perspectives: Gender gap, rural gap and socioeconomic gap.
Gender gap in Internet use is a part of NRI, with original source in ITU World Telecommunication/ICT Indicators database 2020.[66]
It demonstrates the difference between female and male population in using the Internet in general.
This indicator refers to the share of, respectively, women and men in a country that use the Internet. Scores are calculated as the ratio of the share related to the female population over the share related to the male population.

3.11 Rural gap in use of digital payments

Indicator is part of NRI, with original source in World Bank, Global Findex database[67].
The Indicator demonstrates difference between the rural population and the total population that made or received digital payments in the past year. Making a digital payment includes "using mobile money, a debit or credit card, or a mobile phone to make a payment from an account, or report using the Internet to pay bills or to buy something online." Receiving a digital payment includes receiving money "directly from or into a financial institution account or through a mobile money account." Scores are calculated as the ratio of the share related to the rural population over the share related to the total population.

3.12 Socioeconomic gap in use of digital payments

Indicator is part of NRI, with original source in World Bank, Global Findex database[68].
It demonstrates difference between rich and poor income groups that made or received digital payments in the past year (% age 15+) /
This indicator refers to the share of, respectively, the poorest 40 percent and richest 60 percent in a country that made or received a digital payment in the past 12 months.
Making a digital payment includes "using mobile money, a debit or credit card, or a mobile phone to make a payment from an account, or report using the Internet to pay bills or to buy something online." Receiving a digital payment includes receiving money "directly from or into a financial institution account or through a mobile money account." Scores are calculated as the ratio of the share related to the poorest 40 percent over the share related to the richest 60 percent.

Pillar Four: ICT Infrastructure Resilience is a Physical Foundation

It's represented by 13 indicators.
Based on the enabled indicators, this component

[65] United Nations Department of Economic and Social Affairs (UNDESA), UN E-Government Knowledgebase https://publicadministration.un.org/egovkb/en-us/
[66] ITU World Telecommunication/ICT Indicators database 2020, http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
[67] World Bank, Global Findex database, https://globalfindex.worldbank.org/
[68] Ibid

may also reflect the physical aspect of digital divide.

4.1Mobile cellular subscriptions per 100 inhabitants

Being a part of UN DESA E-government Survey[69] (EGDI) report, it's originally collected by ITU[70] "Mobile subscribers per 100 inhabitants" is the number of subscriptions to mobile service in the last three months. A mobile/cellular telephone refers to a portable telephone subscribed to a public mobile telephone service using cellular technology, which provides access to the PSTN.
This includes analogue and digital cellular systems and technologies such as IMT-2000 (3G) and IMT-Advanced. Users of both post-paid subscriptions and prepaid accounts are included.
It's a direct measure of the extent to which citizens are in advance supplied with the mobile/ digital communications facilities, with can be used in many ways for emergency communications.

4.2Percentage of Individuals using the Internet

With the source is the same as above, the term "individuals using the Internet" refers to people who used the Internet from any location and for any purpose, irrespective of the device and network used, in the previous three months. Usage can be via a computer (i.e. desktop computer, laptop computer, tablet or similar handheld computer), mobile phone, games machine, digital television, etc.). Access can be via a fixed or mobile network.
It's a direct measure of the extent to which citizens are in advance supplied with internet access (and indirectly – have some devices to access Internet, and some skills, required to access Internet), with can be used in many ways for emergency communications, and temporary, for maintaining lifestyle close to habitual during crisis period (teleworking, meeting friends and relations, online shopping, learning, etc..) if network quality allow this.

4.3Fixed broadband subscriptions per 100 inhabitants

With the source is the same as above, "Fixed broadband subscriptions per 100 inhabitants" refers to fixed subscriptions to high-speed access to the public Internet or a TCP/IP connection, at downstream speeds equal to, or greater than, 256 kbit/s. This includes cable modem, DSL, fiber-to-home/building, other fixed/ wired- broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband. This total is measured irrespective of the method of payment. It excludes subscriptions that have access to data communications, including the Internet via mobile-cellular networks. It should include fixed WiMAX and any other fixed wireless technologies. It includes both residential subscriptions and subscriptions for organizations.
The same as above, it's a direct measure of the extent to which citizens are potentially supplied with internet access (and indirectly – may have some devices to access Internet, and some skills, required to access Internet), with can be used in many ways for emergency communications, and temporary, for maintaining lifestyle, close to habitual, during crisis period (teleworking, meeting friends and relations, online shopping, learning, etc..) with some more guaranties of the network quality/ rate availability, at some fixed spots (home, school, at work) to allow these activities.

4.4Active mobile-broadband subscriptions per 100 inhabitants

The source is the same as above. The term "active mobile-broadband subscriptions" refers to the sum of data and voice mobile-broadband subscriptions and data-only mobile-broadband subscriptions to the public Internet. It covers subscriptions actually used to access the Internet at broadband speeds, not subscriptions with potential access, even though the latter may have broadband-

[69] 2020 United Nations E-Government Survey https://www.un.org/development/desa/publications/publication/2020-united-nations-e-government-survey

[70] ITU Statistics https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

enabled handsets. Subscriptions must include a recurring subscription fee to access the Internet or pass a usage requirement – users must have accessed the Internet in the previous three months. It includes subscriptions to mobile-broadband networks that provide download speeds of at least 256 kbit/s (e.g. WCDMA, HSPA, CDMA2000 1x EV-DO, WiMAX IEEE 802.16e and LTE), and excludes subscriptions that only have access to GPRS, EDGE and CDMA 1xRTT.
Similar to above indicator. It's a direct measure of the extent to which citizens are supplied with internet access and actually use it (and indirectly – have some devices to access Internet, and some skills, required to access Internet).
It can contribute to e-resilience as may be used in many ways for emergency communications, and temporary, for maintaining lifestyle, close to habitual, during crisis period (teleworking, meeting friends and relations, online shopping, learning, etc..) with more guaranties of the network quality/ rate with some grade of mobility, to allow these activities.

4.5Mobile tariffs

Being part of NRI report, this indicator is originally based on the Mobile tariffs sub-index that is included in the Affordability pillar of the Mobile Connectivity Index published by the GSM Association[71]. The sub-index relates to the cost of three different basket profiles that are partly distinguished by monthly usage allowance (100 MB, 500 MB, and 1 GB, respectively). The tariffs are given as a percentage of monthly GDP per capita. The NRI applies the min-max normalization method so that all values fall into the [0, 100] range, with higher scores representing better outcomes.
It evaluates financial affordability of ICT infrastructure, the affordability of Internet traffic for citizens, which is can be social aspect of ICT infrastructure, defining population's preparedness to withstand crisis through e-resilience.

4.6Handset prices

Cost of cheapest Internet-enabled device (% of monthly GDP per capita).
Being part of NRI report, this indicator is also originally based on one of the indicators included in the Affordability pillar of the Mobile Connectivity Index published by the GSM Association[72]. It relates to the cheapest smartphone or feature phone that allows users access to the Internet. The NRI applies the min-max normalization method so that all values fall into the [0, 100] range, with higher scores representing better outcomes.
It evaluates financial affordability of ICT infrastructure, the affordability of Internet access Hardware for citizens, which is can be social aspect of ICT infrastructure, defining population's preparedness to withstand crisis through e-resilience.

4.7Computer software spending

Total computer software spending (% of GDP)
Part of NRI report, this indicator initially sourced from INSEAD, Cornell University, and World Intellectual Property Organization The Global Innovation Index 2020[73] .
"Computer software spending" includes the total value of purchased or leased packaged software such as operating systems, database systems, programming tools, utilities, and applications. It excludes expenditures for internal software development and outsourced custom software development. The data are a combination of actual figures and estimates. Data are reported as a percentage of GDP.

It evaluates availability of ICT infrastructure, from the perspective of availability and affordability of Internet access Software for citizens, which can be social aspect of ICT infrastructure, defining population's preparedness to withstand crisis through e-resilience.

[71] Mobile Connectivity Index, GSMA, available at http://www.mobileconnectivityindex.com
[72] Ibid
[73] The Global Innovation Index, WIPO, available at https://www.globalinnovationindex.org

4.8Percentage of households with Internet access at home

This is the share of households with Internet access at home via a fixed or mobile network. A household with Internet access is defined as the Internet being available for use by all members of the household at any time. This indicator can include both estimates and survey data corresponding to the proportion of individuals using the Internet based on results from national household surveys.
It's included to dashboard, as it may be important indicator of e-resilience through Internet access availability to population at any time. The COVID-19 pandemic lockdowns revealed an alarming fact, that not all Internet users used to access the Internet from their home. Others used Internet from work or school, so they lost Internet access during lockdown period, which could worsen the Digital divide figures worldwide. Paying attention on this area may help to prevent this from happening in future, affecting the e-resilience in general.

4.9Percentage of Households with a computer

Percentage of households with computer, as part of IDI Index, calculated by ITU[74] .
"Computer" refers to a desktop computer, laptop (portable) computer, tablet or similar handheld computer. It does not include equipment with some embedded computing abilities, such as smart television sets, or devices with telephony as a main function, such as mobile phones or smartphones.
Household with a computer means that the computer is available for use by all members of the household at any time. The computer may or may not be owned by the household, but should be considered a household asset.
It's included to dashboard, as it may be important indicator of e-resilience through Internet access availability to population at any time. The COVID-19 pandemic lockdowns revealed an alarming fact, that not all Internet users used to access the Internet from their home. Others used Internet from work or school, so they lost Internet access during lockdown period, which could worsen the Digital divide figures worldwide. Paying attention on this area may help to prevent this from happening in future, affecting the e-resilience in general.

4.10 4G mobile network coverage

This indicator measures the percentage of inhabitants out of the total population who are within range of an advanced mobile cellular signal, such as LTE/LTE-Advanced and mobile WiMAX/WirelessMAN networks, irrespective of whether they are subscribers.
Part of NRI report, this indicator initially sourced from ITU[75].
It's a definite contributor to e-resilience monitoring since it represents the availability of mobile radio infrastructure, required for of the good quality and rate Internet access for citizens.

4.11 Fixed-broadband subscriptions

Being part of NRI report, this indicator initially sourced from ITU[76].
Fixed-broadband subscriptions that are equal to or above 10 Mbit/s (% of total subscriptions)
This indicator refers to the number of fixed subscriptions by residences and organizations to high-speed access to the public Internet (a TCP/IP connection) at downstream speeds equal to or greater than 10 Mbit/s, expressed as a percentage of total fixed-broadband subscriptions.
A next step in determining the quality of fixed internet access. In addition to Indicator 2.3 "Fixed broadband subscriptions per 100 inhabitants" it may help to assess the need to further improve and extend the high-speed access for those who already have it and leapfrog to modern infrastructure for those who still lack this type of subscription.

[74] IDI, ITU, https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
[75] ITU statistics, http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
[76] Ibid

4.12 International Internet bandwidth per Internet user (kbit/s)

Being part of NRI report, this indicator initially sourced from ITU[77].
Used international Internet bandwidth refers to the average traffic load of international fibre-optic cables and radio links for carrying Internet traffic. The average is calculated over the 12-month period of the reference year and takes into consideration the traffic of all international Internet links. If the traffic is asymmetric, i.e. if there is more incoming (downlink) than outgoing (uplink) traffic, the average incoming (downlink) traffic load is used. The combined average traffic load of different international Internet links can be reported as the sum of the average traffic loads of the individual links.
International Internet bandwidth (bit/s) per Internet user is calculated by converting to bits per second and dividing by the total number of Internet users.
This indicator may help in evaluation of general internet quality in the country and participation of the country and its population in the World Wide Web.

4.13 Internet access in schools

Proportion of primary schools with access to Internet for pedagogical purposes (%)
This refers to the share of primary schools with access to the Internet via fixed narrowband, fixed broadband, or mobile network. Internet for pedagogical purposes means Internet that enhances teaching and learning and that provides pupils with access to a number of communications services through various devices.
Being part of NRI index, it's originally sourced from UNESCO Institute for Statistics[78].
Reasoning for inclusion to monitoring dashboard:
1st – It may help to predict how the school children and teachers are prepared for confident use of digital technology in general and including in difficult situations.
2nd – it may indirectly help to assess the availability of emergency internet access in remote areas, as internet in schools may serve as a public hotspot in crisis situations in remote villages, where private access may be not available / affordable for everyone.

[77] Ibid
[78] UNESCO UIS.Stat, http://data.uis.unesco.org/