INFORMATION AND COMMUNICATONS TECHNOLOGY AND
DISASTER RISK REDUCTION DIVISION

E-resilience Monitoring Toolkit: Methodological Notes and Pilot Countries' Profiles

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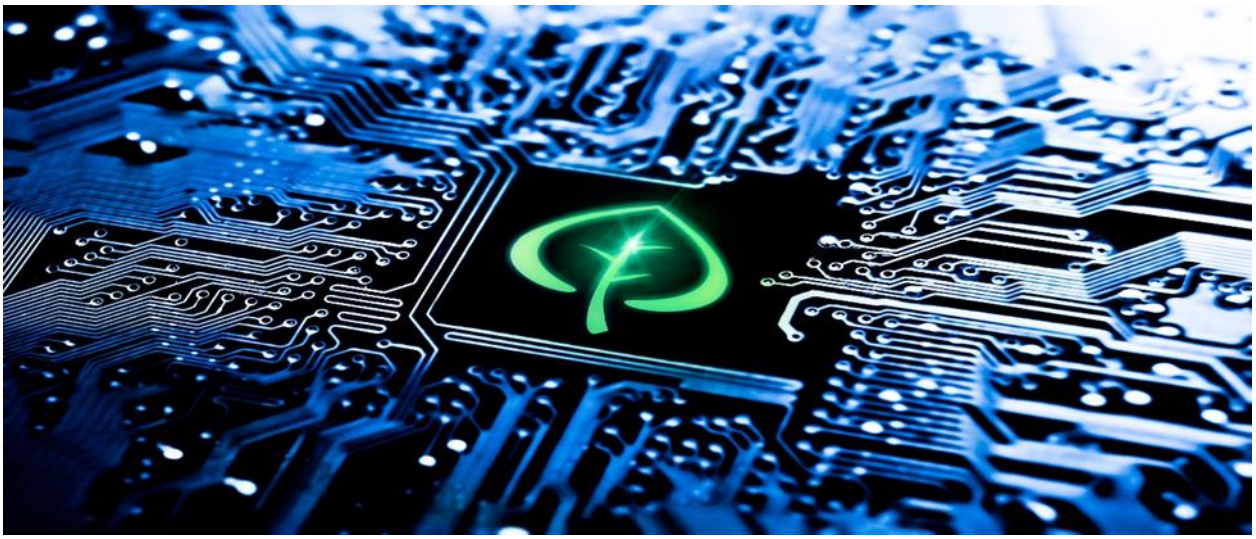

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The shaded areas of the map indicate ESCAP members and associate members.[1]

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Table of Contents

Abstract

The on-going pandemic of COVID-19 has shown the great extent with which we rely upon the digital services to sustain our normal existence.

The same services during the time of need can transform into a source of innovation and hope, and become powerful tools to manage hazard and exposure. While there is a little doubt that our recovery effort success with leaving no one behind will depend on the reliable, high quality, accessible and affordable digital services and the underlying ICTs.

This is why the cooperation strengthening regional e-resilience, whilch includes using ICTs as tools during crises and ICTs own resilience, is critically important and could not come at the better time.

By putting robust and scalable measurement as a first step, ESCAP secretarare is writing in hopes to expand the options available to the Member States. The toolkit should become useful in policy deliberations of the regional economic groups, as well as facilitate a greater regional cooperation and dialogue on practical steps to address e-resilience.

This paper aims to establish baseline methodology and a point for further discussions driven by the membership.

In particular, the paper desribes process of initial e-resilience data collection, techniques used to transform the data into a single dataset, operations with data, such as missing values treatment and normalization, and visualization of the data.

The dataset for the several pilot country are already available online for all members as the ESCAP web resource.

To show the potential of this tool, based on the dataset published in the form of an online visually appealing dashboard, we put together several pilot country profiles with specific policy recommendations.

Hopes are high for decisive actions in the upcoming decade – the last before the end of the current Sustainable Development Goals agenda and the first for the UN Framework Convention on Climate Change, as well as the ESCAP initiative on Asia-Pacific Information Superhighway (AP-IS) 2022-2026 Action Plan.

Data-driven and smart action is needed more than ever. Resilience of the digital requires strong policy response, and ESCAP is ready to assist Member States in reaching their objectives in line with the vision of prosperous, safe, resilient, and digital, Asia-Pacific.

Keywords: e-resilience, methodology, composite index, policy recommendations, country profile, monitoring dashboard.

I. INTRODUCTION

1.1. E-Resilience Background

As per the Asia Pacific Information Superhighway Action (AP-IS) 2016-2020 Master Plan, the UN ESCAP Secretariat was directed to assist member countries in developing their e-resilience, the third pillar of the AP-IS, which is understood as:

> *the ability of ICT systems to withstand, recover from and change in the face of an external disturbance.*

In order to understand the needs of the countries and keep better track of the progress achieved, the Secretariat decided to create an online dashboard which sources data from the existing indicators to visualize the progress of efforts aimed at strengthening the e-resilience in the ESCAP region. Creating a separate index with primary collection of data can be very costly. The CICTSTI of 2019 has guided the secretariat to develop the methodology.

Meanwhile, there are many existing organizations which are already collecting data on different aspects of e-resilience, including UN agencies and other international organizations, regional foras, business associations, academic institutions and other stakeholders.

Keeping this in mind, the e-resilience dashboard was envisaged as an attempt to leverage already existing knowledge and measurements, so that the available resources are used sparingly and at a best value possible.

In this working paper we discuss the ways to measure the e-resilience, provide methodological notes for creating an index, and prepare sample policy recommendations and pilot country profiles to showcase the potential usefulness of this toolkit.

1.2. Pillars of E-Resilience

In order to measure e-resilience, it is crucial to understand and structure the object of the measurement along more manageable subdimensions.

Such subdimensions need to provide a balanced, complete picture of e-resilience, while also being much more substantial, and more measureable.

As a result, e-resilience indicators are grouped and are viewed under the lenses of five pillars – ICT infrastructure, ICT policy, New Systems and Applications, Digital Data, and Hazard and Exposure.

Firstly, the **Infrastructure**, which is the foundation upon which everything else related to ICTs is built.

Policy, the second pillar, is the measure with which a society is able to form an enabling environment for e-resilience.

The third pillar, **New Systems and Apps**, is about adoption of emerging technologies, but also about innovations and new business models.

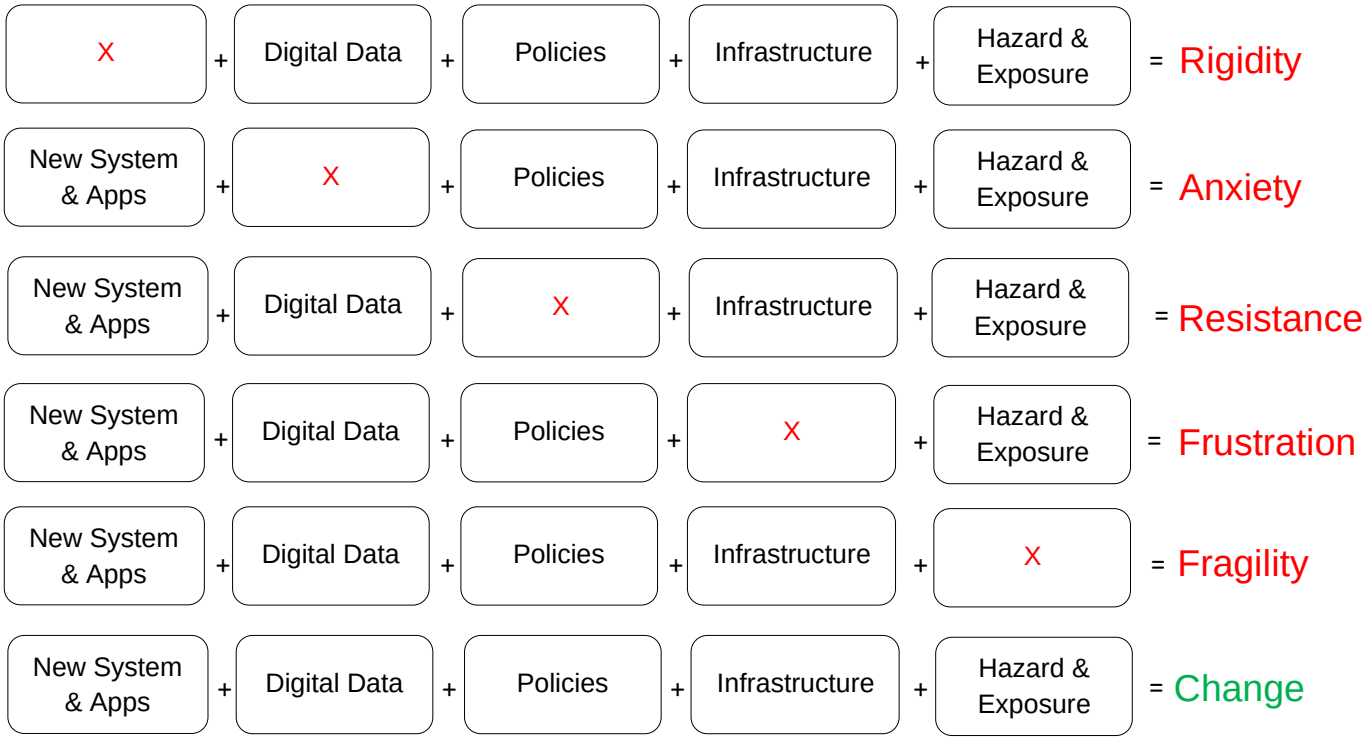
The fourth pillar of **Digital Data** is covering the ability of a society to absorb changes, the everyday use of digital services, the extent with which the society is ready to utilize digital tools in a case of a public health crisis

or other emergencies.

Lastly, the 5th pillar of **Hazard and Exposure** is a measure of attention given to disaster resilience in all of its forms, be it preparedness, response or recovery.

To understand deeper the interconnection between the pillars a following change framework reference model is proposed (figure 1). In absence of one element or pillar, the whole ecosystem is in tense of rigidity, anxiety, resistance, frustration or fragility. While the wholistic approach in presence of each interconnected blocks of pillars may drive the change of the whole ecosystem, and keep it more sustainable as a dynamic and evolutionalry model of progressive development, with powerful e-resilience.

Figure 1: Change framework reference model for e-resilience pillars



Source: Adapted from M. Lipitt (1987) "The Managing Complex Change Model" via E. Casali, IntenseMinimalism.com

1.3. Initial Data

The data was gathered from multiple of sources into 50 indicators spread across 5 pillars.

These indicators were published online in the form of a repository visualized by a PowerBI online dashboard, alongside with visual static maps connecting the data for visualization purposes.

The dashboard is presented in a table with indicators grouped under pillars and occupying the vertical axis. The country names were placed along the horizontal axis, with a possibility of viewing the data based on the economic grouping (e.g. LDCs, LLDCs etc.) or geography (ENEA, PICS, SEA etc.).

Each indicator was assigned a color coding representing the level of resilience, with green representing the best scores, and red represented the worst scores. There was also light green, yellow and orange coding representing middle scores in between.

Figure 2: Snapshot of Initial dashboard covering e-resilience scores for LDCs group

Pillar	Name	Afghanistan	Bangladesh	Bhutan	Kiribati	Myanmar	Nepal	Solomon Islands	Timor-Leste	Tuvalu	Vanuatu
ICT infrastructure as a physical foundation	4G mobile network coverage (0-100 % max)		58,00				15,50				
	Active mobile-broadband subscriptions per 100 inhabitants (0-100 % max)	18,82	41,24	101,64	1,46	92,69	47,52	17,50	31,61	0,00	65,07
	Computer software spending (0-100 % max)		0,18				1,40				
	Fixed (wired) broadband subscriptions per 100 inhabitants	0,04	6,34	1,43	0,76	0,24	2,82	0,23	0,05	3,96	1,61
	Fixed-broadband subscriptions, > 10 Mbit/s, % of total fixed-broadband subscriptions, (0-100 % max)		20,00								
	Handset pricec (%monthly GDP per capita) (0-100 max)		46,95				21,20				
	International Internet bendwidth per Internet user (kbit/s)		24 095,79				13 198,35				
	Internet access in schools (0-100 % max)		4,14								
	Mobile cellular subscriptions per 100 inhabitants (0-100 max)	59,12	100,24	93,26	50,79	113,84	120,00	73,83	115,81	70,36	85,91
	Mobile tariffs (%monthly GDP per capita) (0-100% max)		69,55				49,50				
	Percentage of Households with a computer (0-100 % max)	3,43	5,60	23,58			13,97				
	Percentage of Households with Internet access at home (0-100 % max)		6,75				17,70				
	Percentage of Individuals using the Internet (0-100 % max)	13,50	15,00	48,11	14,58	30,68	34,00	11,92	27,49	49,32	25,72
ICT policy in different sectors	Adult Literacy (0-100 % max)	43,02	73,91	66,56	93,00	75,55	67,91	76,60	68,07	98,00	87,51
	Cybersecurity (0-1 max)		0,52				0,26				
	DRR Implementation 0-10 (max, the worst)	6,30	3,00	4,50		7,10	5,40	6,60	6,30		5,40
	Ease of doing business (0-100 max)		26,20				58,30				

1.4. General Considerations

Out of the dialogue within SPECA Member Countries, with experts of Working Group on Innovation and Technology for Sustainable Development and through discussions with the ESCAP consultant and expert community, the idea of a e-resilience composite index has gained important substantive inputs of several considerations.

The need identified was to set the index as an evolving tool, which transforms accordingly to the needs of the Member States.

Measurement is intended for self-review, and is not suitable for country comparisons

This index should be driven by the inputs of the broad community, i.e. representatives of regulators, business community, civil society and academia, and should be updated and revised on a set given time periods.

The core idea is to create a basis, a starting point for future work involving partners with a clear methodology, simple measurement design, and scope built with a scale-up possibility.

II. METHODOLOGICAL NOTES

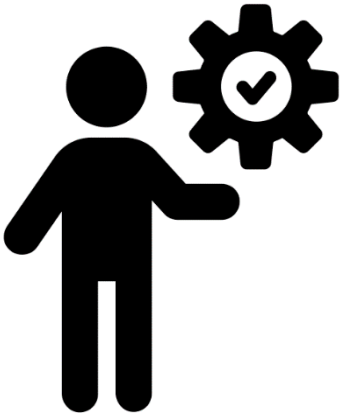
2.1. Issues and challenges

Overall, gathering the initial data from a variety of sources was leading to several issues.

Firstly, there was no data consistency, meaning that it was hard to understand what characteristics each source had, what data ranges and what methodologies were used in the collection of the data, and the extent to which indicators were compatible to each other and could co-exist in a single dataset.

Secondly, the measurement scale for each indicator was not the same. Some of the indicators had a range of scores, such as [0; 100], others were measured in absolute values (e.g. *Number of secure internet servers*), and the third category relied on the share of the variable compared to the population size (e.g. *Number of mobile broadband subscriptions per 100 inhabitants*). Moreover, some indicators' scales allowed negative values, such as. [-2,5;2,5] for *Regulatory quality*, and some had reverse scales, where lower scores represented better outcomes (e.g. *Hazard & Exposure*). It is obvious that the different scales were puzzling and did not allow to compare different indicators.

Perhaps most challenging, the data had a lot of missing values, especially for some specific countries. The missing data cannot be used for constructing a single digit general score per pillar, and it also makes dataset incomplete, meaning that many data operations in the research based on this data would be impossible.



Last but not least, the data was presented in a format which was making it difficult for end-user to bring out any useful information from the tool, rendering the entire exercise useless for factual purposes. As such, user had no clear picture, like visual graphs or single-digit scores, instead being presented with a patchwork of 50 different indicators with inconsistent scales and the nature of sources.

To deal with these challenges, a number of actions are proposed: 1) to review the data sources and unify the data; 2) to handle with missing values using rigorous but simple international statistics techniques; 3) to perform normalization of data and bring all the values to one 0 to 100 scale; 4) to weight the indicators and calculate a pillar score.

2.2. Review of the Data Sources

The first step was to examine the data sources and unify the data.

The main three sources for the initial database are:

1) International Telecommunication Union World Telecommunication Indicators Database (WTID);

2) World Economic Forum Network Readiness Index (NRI); and

3) UN DESA E-Government Development Index (EGDI).

The nature of the ITU WTID and EGDI is that the data is collected directly from the Member States statistical agencies' surveys and country studies. These sources are considered as a ***primary source***.

The WEF NRI, however, is a composite index itself, meaning that the data was pulled from a variety of different sources, which makes it an ***intermediary source***.

While constructing a composite indicator it is essential to utilize data as close to the source as possible, to minimize the distortion. As such, for our measurement we tried as much as possible to utilize the primary sources.

It is also important to identify the source for the future data normalization in order to find global minimum and maximum reference values.

One of the issues with the WEF NRI data was that the NRI does not provide the original data, and there is no sufficient metadata to understand what data and for what year has been incorporated into the index, and how it was normalized.

Some of the NRI calculations were also made in-house, and the methodology is too unclear to replicate the findings or scale them beyond the scope of NRI.

Moreover, different datasets may be utilizing different methodologies, data collection sources, margin of error etc.

Table 1: Original Sources for the Network Readiness Index

Indicator sources	Entity responsible for data collection	URL-link
World Development Indicators (WDI)	World Bank	http://wdi.worldbank.org/
Global Findex database	World Bank	https://globalfindex.worldbank.org/
Global Innovation Index (GII)	INSEAD/WIPO/Cornell University	https://www.globalinnovationindex.org/
ITU ICT Regulatory Tracker	International Telecommunication Union	https://www.itu.int/net4/itu-d/irt/
ITU World Telecommunications Indicators Database (WTID)	International Telecommunication Union	https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
ITU Global Cybersecurity Index (GCI)	International Telecommunication Union	https://www.itu.int/en/ITU-D/Cybersecurity/Pages/global-cybersecurity-index.aspx
Mobile Connectivity Index (MCI)	GSMA	https://www.mobileconnectivityindex.com/
WEF Executive Opinion Survey	World Economic Forum	https://www.weforum.org/reports/
WEF Global Competitiveness Index	World Economic Forum	https://www.weforum.org/reports/the-global-competitiveness-report-2020

UNCTAD Cyberlaw Tracker	UN Conference on Trade and Development (UNCTAD)	https://unctad.org/page/cyberlaw-tracker-country-detail
UNESCO UIS Stat Database	UN Educational, Scientific and Cultural Organization (UNESCO)	http://data.uis.unesco.org/
UNIDO Competitive Industrial Performance Index (CIP)	UN Industrial Development Organization (UNIDO)	https://stat.unido.org/cip/
IHS Markit ICT Database	IHS Inc.	Not available
Tarifica Mobile Tariffs Database	Tarifica	Not available

2.3. Handling Missing Values

After all the sources have been checked, the values for the indicators were updated with the latest 2020 data where possible. However, there arose an issue of ***missing data***.

Missing data, or missing values, occur when no data value is stored for the variable in an observation. Missing data are a common occurrence and can have a significant effect on the conclusions that can be drawn from the data.

As we are using a full *population*, and not a sample, for our measurement we aim to create a ***robust composite index,*** or in other words a dataset claiming to have a conventional ***"completeness" of cases***, which means that the missing values can have considerable influence on the outcomes of our endeavor and lead to substantial inaccuracies.

To reduce this negative influence, we utilize different techniques developed by international statistics study field, and try to come up to a complete dataset. While it is necessary to use these techniques, we must be ***mindful of assumptions***, and understand that the completeness of this dataset is only a convention.

As such, we impute the missing values based on the ***Missing-at-Random (MAR) assumption***, meaning that we assume that the values missing have nothing to do with the country's level of e-resilience, nor these values are missing because of any of other indicators in our measurement tool. For missing data we use ***cold-deck imputation***, which in our means replacing the values with the older available data for the same country.

For the remaining data we check that all indicators have no more than 1 case missing per pillar, and then we use ***case deletion (complete case analysis)***, which means that we omit the remaining missing record in the calculation of a pillar score (pillar score calculation "ignores" a missing case, instead of counting it as a zero). This technique allows a better measurement, and does not make zero-value assumption which can be incorrectly "punishing" the countries with missing values in an indicator.

This was enough for our pilot countries to have the conventionally complete set with no missing data.

In future, consideration should be given to other imputation techniques, such as *hot-deck imputation*, which means imputing missing values with "similar" country data.

One of the possible ways to find "similar" countries can be taking into account demographics and economy conditions to determine a number of countries with possibly similar conditions.

Then we fill the blank cells with the average of such "similar" countries. This, of course, is not the perfect solution, but it helps the dataset to stay relatively unharmed by the missing values, and serve its purpose.

More importantly, it is necessary to engage partners in the future to find and populate missing cells and have more complete dataset.

2.4. Data Normalization

The data collected from multitude of sources is often using different scales, which makes comparing this data a difficult. In this case it is necessary to perform an appropriate ***normalization*** procedure.

Global maximum and minimum values were identified for each indicator

The values were normalized to a 0-100 scale via ***Min-Max method.*** Min-Max normalises indicators to have an identical range [0, 100] by subtracting the minimum value and dividing by the range of the indicator values.

Min-Max method relies on identifying global reference maximum $Xmax$ and minimum values $Xmin$, and then using case value score Xi to identify a score relative to these reference values, which is also called a ***normalized value*** $Xi\ (nm)$.

Mathematically, formula to find the normalized indicator value $Xi\ (nm)$ is as follows**:**

$$Xi(nm) = \frac{(Xi - Xmin)}{(Xmax - Xmin)} * 100$$

Formula for a reverse Min-Max (indicators where higher values are worse):

$$Xi(nm) = \frac{(Xmax - Xi)}{(Xmax - Xmin)} * 100$$

Not all the indicators were normalized this way. Following good international practice, we respect the data properties and try to refrain from normalization where the scale is initially at 0-100 range, so that the the inherent information stays intact and continue be helpful for the reader, such as in the indicators calculating scores per 100 inhabitants.

Table 2: Example of Min-Max reference value identification

Economy	High-tech exports, % of total exports	
Hong Kong SAR	65,57	= $Xmax$
…	…	
…	…	
…	…	
…	…	
Country X	30	= Xi
…	…	
…	…	
…	…	
…	…	
…	…	
Mauritania	0	= $Xmin$

In future it might be beneficial to consider the influence of outliers to the normalization. As such, some of the reference values might be taken from the regional level instead of global (e.g. ESCAP regional data). A way to detect and deal with outliers might be to analyse skewness and kurtosis, and use *winsorisation* and/or *log transformation* technique.

2.5. Data Weighting and Pillar Score Calculation

Weighting performed with ***equal weights (EW)*** approach, meaing that the equal weights are assigned to each indicator to calculate the pillar score.

General formula for the calculation of the weighted pillar scores is as follows:

$$X = \frac{X_1 W_1 + X_2 W_2 + \ldots + X_n W_n}{W_1 + W_2 + \ldots + W_n},$$

where X is a pillar score, X_1 is a score for the first indicator within that pillar, the Wx is the ***weighing coefficient*** or ***weighting factor***.

In our current approach of equal weights we assume W to take be equal for all X, which means that the resulting value actually equal to the arithmetic mean.

Although the number of indicators is not the same in every pillar, this does not imbalance the index, as there is no single Index score.

In future it might be beneficial to have a discussion on different weights assigned to indicators.

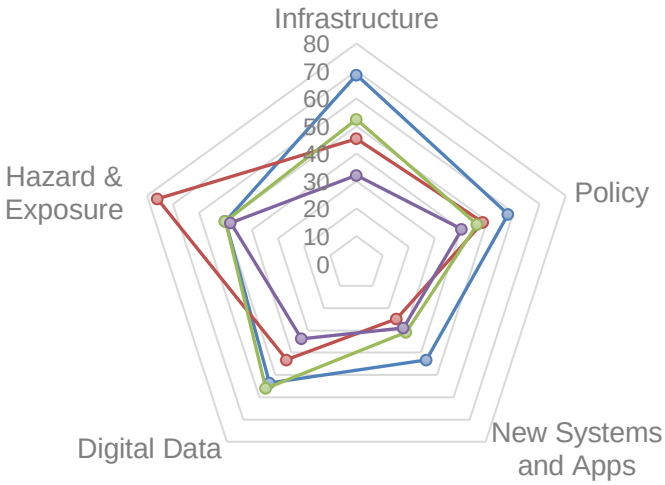
2.6. Data Visualization

The resulting score for each pillar is visualized via a radar chart (pentagon), which is a simple but powerful tool for the user to be able to understand the findings of the measurement, while also giving the depth and an incentive to investigate the data further.

This visualization form allows readers to have a data-driven and informed discussions on "what the numbers show".

Simple visualizations allow to draw the important policy lessons and recommendations, however, these can be further supported by a deeper dive into the data, and presented to user in a form of a story or profile about a specific country case (see Section III below).

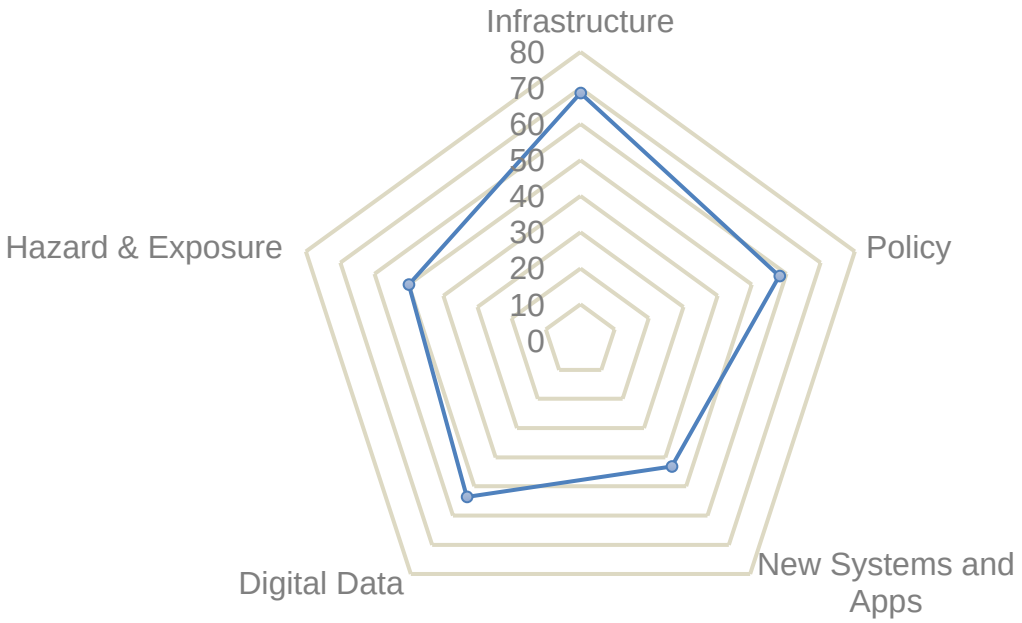
Figure 3: Sample visualization radar chart (pentagon) for 4 pilot countries



III. COUNTRY PROFILES AND POLICY RECOMMENDATIONS

3.1. Kazakhstan

Figure 4: Kazakhstan E-resilience Radar Chart (pentagon)



Overall, the e-resilience scores of 2020 for Kazakhstan show solid performance across all five pillars of e-resilience. Particular forte is infrastructure and policy, where Kazakhstan has very impressive scores in terms of internet use and affordability of broadband. However, there is a potential scope in the domestic computer software development, tailored to local conditions and needs. Kazakhstan may benefit from strengthening the cooperation within the pillar of New Systems and Apps, particularly by incentivizing investments in domestic research and development.

Kazakhstan shows very good scores on ***infrastructure***, with 5 internet users for every 6 individuals residing in the country.

Almost the same share of Kazakhs actively enjoys the mobile broadband, which is not surprising, given that Kazakhstan is one of the global leaders in terms of affordability of mobile tariffs.

To further this success, Kazakhstan might want to consider giving more attention to the domestic computer software development, tailored to the local conditions and needs, which can be a serious bottleneck for taking advantage of the developed ICT infrastructure, both during the times of building preparedness, and during crisis recovery.

In terms of ***ICT policy***, Kazakhstan gives great attention to the ease of doing business, and general education support, but, perhaps, most prominently – cybersecurity policies, which enables it to have very good scores under this pillar.

At the same time, there is room for improvement, for example, in providing incentives for the network operators and webmasters to protect the data, and deploy modern encryption technologies, as currently

the number of servers utilizing trusted SSL/TLS certificates is not very high.

Stronger encryption can provide, inter alia, security of financial transactions, which is paramount not only at a face value, reducing uncertainty in the times during and after crisis, but also can serve as a way to build up public trust to use digital services and achieve better e-resilience. Additional consideration might also be given to supporting national R&D efforts in this area.

Regarding the ***new systems and applications***, this is an area that requires attention the most. While there are strong sides, such as the number of apps developed relative to the population size, and the general government support for investment in emerging technologies, the internet presence of both consumers shopping online, and companies utilizing websites, remains quite low.

Future policy directions might include studies on the limitations and the needs of businesses and people in the online presence.

Another issue is the relatively low share of high and medium-tech industries in export structure, which is a complex problem, pointing at general need to seek opportunities and niches for domestic companies to achieve a level of regional and global competitiveness, and, in the end, greater sustainability. Achieving this can help national ICT ecosystems to withstand and recover from crises, and to develop a capacity to adapt to the evolving needs.

In the pillar of ***digital data***, Kazakhstan have developed popular and powerful e-government systems, and enjoys a very high level of proliferation of ICT skills among its population. These two aspects are crucial during crises, as was made evident by the ongoing COVID-19 pandemic, where the presence of ICT skills or availability of government services online decides whether the society could continue the usual way of life with minimal discomfort, or face serious disruptions, confusion and economical downtime.

For Kazakhstan, to make another step towards greater e-resilience, it might be important to utilize the opportunities by using open data to make government more accountable, and give citizens new ways to participate in their communities, and also to incentivize the creation of locally relevant content online, especially for the rural communities and remote areas.

Additional consideration should also be given to the healthy inflow of ICT professionals working in the industry to contribute to these efforts.

On ***hazard & exposure,*** Kazakhstan shows mediocre scores, highlighting the need to give more support to the general efforts in regards to the disaster risk reduction, including by participating in the regional and global initiatives, including the Sendai Framework for Disaster Risk Reduction.

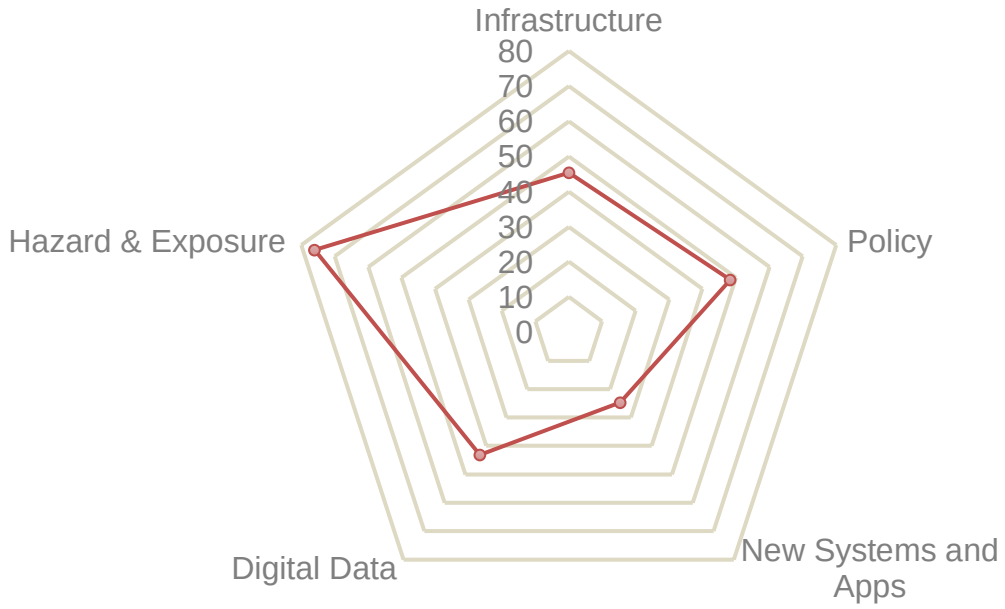
Leveraging Kazakhstan overall strong ICT systems performance for the purposes of managing preparedness, withstanding the blow, and building back better from disasters is crucial for Kazakhstan success in the field of e-resilience.

In terms of our reference change framework model, there is a risk of overall **rigidity**, and inability for flexible changes according to the rapidly evolving needs.

In terms of practical regional cooperation, to achieve meaningful **change**, Kazakhstan could share with the region good practice about deploying infrastructure, and learn about innovative ways to facilitate the new and emerging technologies, and make sure that all of the conducive conditions are there to promote innovation.

3.2. Kyrgyzstan

Figure 5: Kyrgyzstan E-resilience Radar Chart (pentagon)



Overall, the data scores per pilar on e-resilience of 2020 for Kyrgyzstan has shown very good performance against Hazard & Exposure, showcasing the strong political will and broad consensus for steps towards a more resilient society.

There is also an indication of good progress in terms of Policy pillar of e-resilience. Kyrgyzstan may benefit from expanding cooperation in adoption of new and emerging technologies, taking measures for lowering the costs for internet access, as well as in developing robust system national cybersecurity policies following the international and regional best practice.

On the ***infrastructure*** side, there are more than 100 mobile cellular subscriptions per 100 inhabitants of Kyrgyzstan, and there is 4G mobile network coverage on more than 85% of the territory of the country. Kyrgyzstan infrastructure might benefit from expanded cooperation in the field of fixed broadband subscriptions and improving numbers for the households with computers at home.

Additional scope of cooperation also exists in lowering the costs of mobile and fixed broadband relative to household incomes.

For the **new systems and apps** one in four Kyrgyz companies have a website, and a significant number of apps is developed in the country compared to the population size.

There are particular areas of further regional cooperation in strengthening the trust of consumers to shop online, and promoting the adoption of new and emerging technologies.

In the field of ***ICT Policy***, in the recent years Kyrgyz government gave great attention to the ease of doing business, and to developing modern ICT regulation, which are are essential in the times of a sudden crisis, as evidenced in the ongoing COVID-19 pandemic.

Kyrgyz authorities might explore further areas of cooperation on the regional and

international levels, and make use of lessons learned in terms of developing strong national cybersecurity frameworks and ensuring the flexibility of national laws and regulations, allowing innovative uses of ICTs to contain threats and build back better.

In the ***digital data realm*** Kyrgyzstan has relatively progressive e-government systems, but more importantly there is a very impressive availability of the locally relevant content online.

Areas where Kyrgyzstan can achieve greater scores are ICT skills, both for supporting higher education of ICT professionals, as well as ensuring the penetration of basic ICT skills among its population.

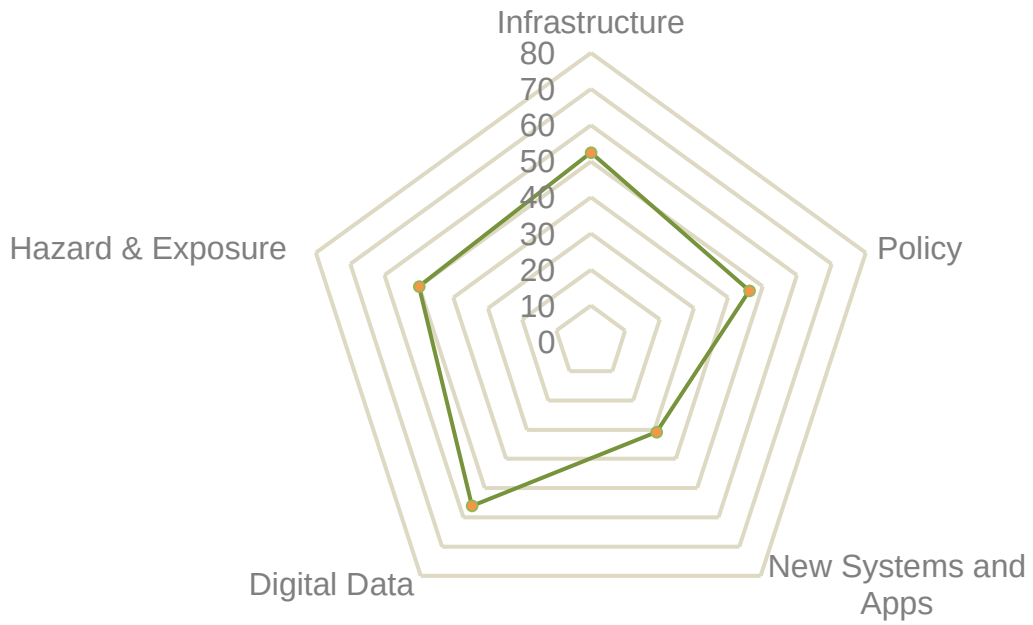
Kyrgyzstan does a good job on managing ***hazard & exposure***, which showcases the national focus to ensure social resiliency during crisis. It is crucial to continue the efforts in the direction of strengthening ICT systems capacity to withstand the blows, and to utilize modern technologies to recover and build back better.

Kyrgyzstan also is prone to overall **rigidity** risks, but most notably there is a limited ability to absorb changes and mitigate the impact with the every day use of digital sevices, which creates significant threats and **anxiety** over possible emergincies, like public health crises, disasters etc.

Kyrgyzstan can be a model and a case study of excellent government commitment to control hazard & exposure, which can be disseminated for use not only in the region, but also beyond in other developing countries. At the same time, for substantial **change** to take place, Kyrgyzstan could look at how other Central Asian countries promote the use of digital services take data-driven approaches, with good reference, for example, in government measures in Mongolia.

3.3. Mongolia

Figure 6: Mongolia E-resilience Radar Chart (pentagon)



Overall, the data per pillar on e-resilience of 2020 for Mongolia has middle-of-the-pack scores across all pillars.

Remarkably, Mongolia has an excellent inclusion practice and is a suitable as a case study for review and adoption in other countries of the region, in terms of a balanced gender profiles of Internet usage, and significantly higher than average rural use of digital payment systems.

Mongolia may benefit from expanding cooperation towards greater availability of e-government services and to continue to provide incentive es for operators to expand the coverage of 4G networks across the country.

Regarding **ICT infrastructure**, more than 65% of the Mongolian population aged 15 and above are using the Internet, while more than half of the broadband subscriptions have very high (more than 10 Mbit/sec) data rate, telling that the existing infrastructure has very good quality.

The additional scope of cooperation exists between regional governments stakeholders, national operators, and the civil society to further improve the coverage of 4G networks across the country,

With the ***new systems and apps***, Mongolia has a developed medium- and high-tech industry, and a good number of companies make use of online presence via websites.

Mongolia may wish to explore the best practices to strengthen the trust of consumers to shop online, and the ways to support investment in emerging tech.

On the ***policy*** component, there is a relatively developed and modern ICT regulation framework in place, coupled with an e-commerce legislation, helping to offset restrictions, such as lockdowns, during the crises.

To further improve scores under this pillar, Mongolia may wish to review the best practices in developing national cybersecurity policies, and engage with regional partners to support R&D activities.

As was outlined above, on **the digital data** there are very balanced gender profiles of

Internet use, and active use of digital payments by the inhabitants of the rural regions. Almost half of Mongolian population are the active users of Internet banking, which can be crucial to minimize contacts in public places, and still be able to support livelihoods.

There is a very good potential to explore and further develop e-government services, taking note of the lessons learned from, and also leapfrogging some issues.

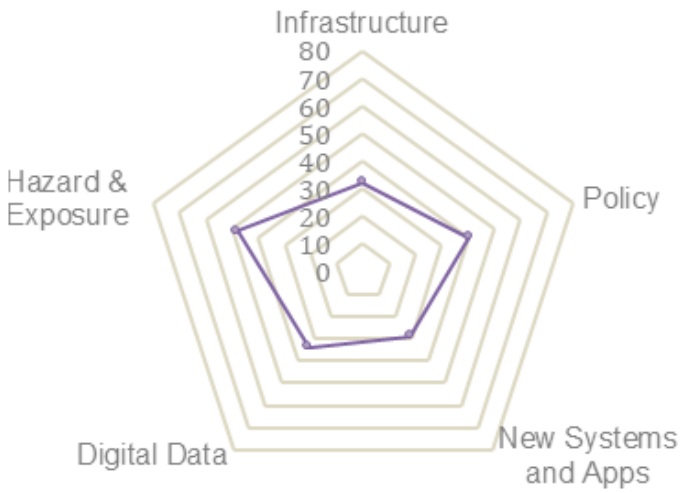
Finally, on managing **hazard & exposure** Mongolia shows mediocre scores, highlighting the need to give more attention to the disaster risk reduction, e.g. participate in the regional and global initiatives, including the activities under the Sendai Framework for Disaster Risk Reduction.

Mongolia could tackle the possible **rigidness** in making sure that the new and emerging technologies take root and proliferate by the means of greater regional cooperation and creating related channels of exchange of good practices.

Remarkably, Mongolia has an excellent inclusion practice and is a suitable as a case study for review and adoption in other countries of the region, in terms of a balanced gender profiles of Internet usage, and significantly higher than average rural use of digital payment systems.

3.4. Tajikistan

Figure 7: Tajikistan E-resilience Radar Chart (pentagon)



Overall, the data per pillar on e-resilience of 2020 for Tajikistan shows relatively good scores against Hazard & Exposure. Moreover, Tajikistan government took an active approach to support new and emerging tech adoption.

At the same time, Tajikistan may benefit the most from regional cooperation in terms of ICT regulation and cybersecurity policies, and e-government services, while also reviewing the relevant best practice cases that can help lowering the costs of mobile tariffs relative to household incomes.

There is a great potential in Tajikistan ***ICT infrastructure***, with more than 100 mobile cellular subscriptions per 100 inhabitants, and, 80% of the country covered by 4G networks. It remains vital for Tajikistan to find good and applicable solutions to reduce the mobile tariffs, which remain very high relative to household incomes, and incentivize the consumers to utilize broadband for economic benefit, as a crucial component of strengthening national e-resilience.

In regards to ***new systems and apps***, the government gives a lot of attention to promoting emerging tech, and, at least partially as a consequence, both emerging tech adoption scores and investments into emerging tech scores are remarkably high. Tajikistan might consider leveraging regional partnerships to ensure that the technology adoption and the associated benefits are distributed fairly in the society, so that during the extreme times nobody is left behind.

Regarding **ICT Policy**, the public trust is there for the policies implemented. There is a scope for cooperation related to modern ICT regulatory practices, and ensuring legal framework adaptability.

On the **digital data**, there is a remarkably high level of ICT skills penetration in the population, and rural population are active users of e-payments. Tajikistan can benefit from best practice to develop e-government.

Tajikistan shows middle-of-the-pack ***Hazard & Exposure*** scores, highlighting the need to give more attention to the disaster risk reduction and related cooperation.

Tajikistan can benefit the most from the expanded regional networks of partnerships, as there are significant rigidity, anxiety and frustration risks. Tajikistan could take a closer look at the regional infrastructure development initiatives, and overall policy frameworks, for example, those utilized in Kazakhstan to develop national infrastructure.

IV. FUTURE STEPS AND WAY FORWARD

The present paper is an attempt to lay down a foundation, a simple but sound methodology, behind the measurements of e-resilience. This work is aimed to spark the discussion by the Member States to strengthen and sharpen this measurement tool to develop their capacities in accordance with the nationally determined public policy objectives and needs.

In future we recommend to create a membership-led process of continuous review of this tool, and to engage in this process a wide range of stakeholders, and essentially scope the tool to the broader audience in the ESCAP region.

The review process could involve specialists with different backgrounds, including policy-makers, ICT experts, statisticians, and other potential users of this toolkit.

Some specific issues this process could address are which indicators could be added, and which could be sunsetted, what sources are relevant, and what missing values treatment is appropriate, how the indicators should be weighted in the pillar scores, how to better visualize the data and better align with the end-users needs and expectations, and other considerations.

Such process can also be used to disseminate the findings across the region and among different stakeholder groups, and to have a greater impact in support of the data-driven decision making.

This work could also involve agenda of greater cooperation in terms of data collection, and a possible assistance to the countries in this regard.

The timing to step up the efforts is good, the resources are present, and, if anything, the broad consensus is there that we in a desperate need for meaningful, smart and impactful actions grounded in hard data base in support of the e-resilent Asia-Pacific.

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