Digital Economy and Society Index (DESI) 2020

Methodological note

Table of Contents

1 Introduction 3

2 Structure of the DESI 4

2.1 Connectivity dimension 5

2.2 Human capital dimension 6

2.3 Use of internet services dimension 7

2.4 Integration of digital technology dimension 8

2.5 Digital public services dimension 9

2.6 Data sources 10

2.7 Data flags 10

3 Methodological considerations 11

3.1 Indicator requirements 11

3.2 Data updates and corrections 11

3.3 Normalisation 11

3.4 Imputation of missing observations 13

3.5 Weights 14

3.6 Method of aggregation 15

Annex 1 Methodology for the Broadband price index indicator 16

1 Introduction

The Digital Economy and Society Index (DESI) measures EU countries' progress towards a digital economy and society. As such, the index brings together a set of relevant indicators on Europe's current digital policy mix.

With the DESI, four main types of analysis are possible:

- A general performance assessment: to obtain a general characterisation of the performance of individual Member States by observing their overall index score and the scores of the main dimensions of the index.
- Zooming-in: to pinpoint the areas where Member State performance could be improved by analysing the scores of the index's sub-dimensions and individual indicators.
- Follow-up: to assess whether there is progress over time.
- Comparative analysis: to cluster Member States according to their index scores, comparing countries in similar stages of digital development in order to flag up the need for improvement in relevant policy areas.

The DESI was developed according to the guidelines and recommendations in the OECD's 'Handbook on constructing composite indicators: methodology and user guide'[1]. The data included in the index were mostly collected from the relevant authorities of the Member States by the European Commission (Directorate-General for Communications Networks, Content and Technology as well as Eurostat) and from ad hoc studies launched by the Commission.

[1] http://www.oecd.org/els/soc/handbookonconstructingcompositeindicatorsmethodologyanduserguide.htm

2 Structure of the DESI

The DESI has a three-level structure as depicted in the three columns in Table 1.

Dimension	Sub-dimension	Indicator
1 Connectivity	1a Fixed broadband take-up	1a1 Overall fixed broadband take-up
		1a2 At least 100 Mbps fixed broadband take-up
	1b Fixed broadband coverage	1b1 Fast broadband (NGA) coverage
		1b2 Fixed Very High Capacity Network (VHCN) coverage
	1c Mobile broadband	1c1 4G coverage
		1c2 Mobile broadband take-up
		1c3 5G readiness
	1d Broadband price index	1d1 Broadband price index
2 Human capital	2a Internet user skills	2a1 At least basic digital skills
		2a2 Above basic digital skills
		2a3 At least basic software skills
	2b Advanced skills and development	2b1 ICT specialists
		2b2 Female ICT specialists
		2b3 ICT graduates
3 Use of internet services	3a Internet use	3a1 People who never used the internet
		3a2 Internet users
	3b Activities online	3b1 News
		3b2 Music, videos and games
		3b3 Video on demand
		3b4 Video calls
		3b5 Social networks
		3b6 Doing an online course
	3c Transactions	3c1 Banking
		3c2 Shopping
		3c3 Selling online
4 Integration of digital technology	4a Business digitisation	4a1 Electronic information sharing
		4a2 Social media
		4a3 Big data
		4a4 Cloud
	4b e-Commerce	4b1 SMEs selling online
		4b2 e-Commerce turnover
		4b3 Selling online cross-border
5 Digital public services	5a e-Government	5a1 e-Government users
		5a2 Pre-filled forms
		5a3 Online service completion
		5a4 Digital public services for businesses
		5a5 Open data

Table 1. DESI structure

At the dimension level, the DESI addresses the five principal policy areas of concern for a digital economy and society. These are not isolated areas that contribute separately to digital development but in fact interconnected areas. As such, developments in the digital economy cannot be achieved through isolated improvements in particular areas but through concerted improvement in all areas. For methodological reasons and for reasons of data availability, DESI 2020 presents structural changes compared to DESI 2019. The following sections present the list of indicators in DESI 2020.

2.1 Connectivity dimension

Indicator	Description	Breakdown	Unit	Source
1a1 Overall fixed broadband take-up	% of households subscribing to fixed broadband	All households	% of households	Eurostat - Community survey on ICT usage in Households and by Individuals, link to data
1a2 At least 100 Mbps fixed broadband take-up	% of households subscribing to fixed broadband of at least 100 Mbps, calculated as overall fixed broadband take-up (source: Eurostat) multiplied with the percentage of fixed broadband lines of at least 100 Mbps (source: COCOM)	All fixed broadband subscriptions	% of households	European Commission, through the Communications Committee (COCOM) and Eurostat - Community survey on ICT usage in Households and by Individuals, link to data
1b1 Fast broadband (NGA) coverage	% of households covered by fixed broadband of at least 30 Mbps download. The technologies considered are FTTH, FTTB, Cable Docsis 3.0 and VDSL	All households	% of households	Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic, link to data
1b2 Fixed Very High Capacity Network (VHCN) coverage	% of households covered by any fixed VHCN. The technologies considered are FTTH and FTTB for 2015-2018 and FTTH, FTTB and Cable Docsis 3.1 for 2019	All households	% households	Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic, link to data
1c1 4G coverage	% of populated areas with coverage by 4G - measured as the average coverage of telecom operators in each country	All households	% of households	Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic, link to data
1c2 Mobile broadband take-up	Number of mobile data subscriptions per 100 people	All subscriptions	Subscribers per 100 people	European Commission services, through the Communications Committee (COCOM), link to data
1c3 5G readiness	The amount of spectrum assigned and ready for 5G use by the end of 2020 within the so-called 5G pioneer bands. These bands are 700 MHz (703-733 MHz and 758-788 MHz), 3.6 GHz (3400-3800 MHz) and 26 GHz (1000 MHz within 24250-27500 MHz). All three spectrum bands have an equal weight	5G pioneer bands	% of harmonised spectrum	European Commission services, through the Communications Committee (COCOM), link to data
1d1 Broadband price index	The broadband price index measures the prices of representative baskets of fixed, mobile and converged broadband offers	All fixed, mobile and converged broadband offers	Score (0-100)	Broadband retail prices study, annual studies for the European Commission realised by Empirica, link to data

Table 2. Connectivity dimension

2.2 Human capital dimension

Indicator	Description	Breakdown	Unit	Source
2a1 At least basic digital skills	Individuals with 'basic' or 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months).	All individuals (aged 16-74)	% of individuals	Eurostat - Community survey on ICT usage in Households and by Individuals, link to data
2a2 Above basic digital skills	Individuals with 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months).	All individuals (aged 16-74)	% of individuals	Eurostat Community survey on ICT usage in Households and by Individuals, link to data
2a3 At least basic software skills	Individuals who, in addition to having used basic software features such as word processing, have used advanced spreadsheet functions, created a presentation or document integrating text, pictures and tables or charts, or written code in a programming language.	All individuals (aged 16-74)	% of individuals	Eurostat - Community survey on ICT usage in Households and by Individuals, link to data
2b1 ICT specialists	Employed ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers.	Individuals in employment aged 15-74	% of individuals in employment aged 15-74	Eurostat - Labour force survey, link to data
2b2 Female ICT specialists	Employed ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers.	Females in employment aged 15-74	% of females in employment aged 15-74	Eurostat - Labour force survey, link to isoc_sks_itsps, Link to lfsa_egan
2b3 ICT graduates	Individuals with a degree in ICT	Graduates	% of graduates	Eurostat (table educ_uoegrad03, using selection ISCED11=ED5-8), link to data

Table 3. Human capital dimension

2.3 Use of internet services dimension

Indicator	Description	Breakdown	Unit	Source
3a1 People who never used the internet	Individuals who never used the internet	All individuals (aged 16-74)	% of individuals	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUX), link to data
3a2 Internet users	Individuals who used the internet at least once a week	All individuals (aged 16-74)	% of individuals	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUSE), link to data
3b1 News	Individuals who used the internet to read online news sites, newspapers or news magazines	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUNW1), link to data
3b2 Music, videos and games	Individuals who used the internet to play or download games, images, films or music	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals, link to data
3b3 Video on demand	Individuals who used the internet to use video on demand services	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals, link to data
3b4 Video calls	Individuals who used the internet to make telephone or video calls (e.g. Skype)	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUPH1) , link to data
3b5 Social networks	Individuals who used the internet to participate in social networks (create user profile, post messages or other contributions)	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUSNET) , link to data
3b6 Doing an online course	Individuals who used the internet to do an online course (on any subject)	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUOLC) , link to data
3c1 Banking	Individuals who used the internet to use online banking	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUBK), link to data
3c2 Shopping	Individuals who ordered goods or services online	All individuals (aged 16-74)	% of internet users (last year)	Eurostat - Community survey on ICT usage in Households and by Individuals (I_BLT12) , link to data
3c3 Selling online	Individuals who sold goods or services online	All individuals (aged 16-74)	% of individuals who used internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUSELL), link to data

Table 4. Use of internet dimension

2.4 Integration of digital technology dimension

Indicator	Description	Breakdown	Unit	Source
4a1 Electronic information sharing	Businesses who have in use an ERP (enterprise resource planning) software package to share information between different functional areas (e.g. accounting, planning, production, marketing)	All enterprises (no financial sector, 10+ employees)	% of enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_ERP1), link to data
4a2 Social media	Businesses using two or more of the following social media: social networks, enterprise's blog or microblog, multimedia content sharing websites, wiki-based knowledge sharing tools. Using social media means that the enterprise has a user profile, an account or a user license depending on the requirements and the type of the social media.	All enterprises (no financial sector, 10+ employees)	% of enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_SM1_GE2), link to data
4a3 Big data	Enterprises analysing big data from any data source	All enterprises (no financial sector, 10+ employees)	% of enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_BD), link to data
4a4 Cloud	Businesses purchasing at least one of the following cloud computing services: hosting of the enterprise's database, accounting software applications, CRM software, computing power	All enterprises (no financial sector, 10+ employees)	% of enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises, link to data
4b1 SMEs selling online	SMEs selling online (at least 1% of turnover)	SMEs (no financial sector, 10-249 employees)	% of SMEs	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_ESELL), link to data
4b2 e-Commerce turnover	SMEs total turnover from e-commerce	SMEs (no financial sector, 10-249 employees)	% of turnover	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_ETURN), link to data
4b3 Selling online cross-border	SMEs that carried out electronic sales to other EU countries	SMEs (no financial sector, 10-249 employees)	% of SMEs	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_AESEU), link to data

Table 5. Integration of technology dimension

2.5 Digital public services dimension

Indicator	Description	Breakdown	Unit	Source
5a1 e-Government users	Individuals who sent filled forms to public authorities over the internet in the previous 12 months	All individuals (aged 16-74)	% of internet users who, during the previous year, needed to send filled forms to the public administration.	Eurostat - Community survey on ICT usage in Households and by Individuals (IGOV12RT), link to data
5a2 Pre-filled forms	Amount of data that is pre-filled in public service online forms	Services assessed in the e-government benchmark	Score (0 to 100)	e-government benchmark, link to data
5a3 Online service completion	The share of administrative steps that can be done online for major life events (birth of a child, new residence, etc.)	Services assessed in the e-government benchmark	Score (0 to 100)	e-government benchmark, link to data
5a4 Digital public services for businesses	The indicator broadly reflects the share of public services needed for starting a business and conducting regular business operations that are available online for domestic as well as foreign users. Services provided through a portal receive a higher score, services which provide only information (but have to be completed offline) receive a more limited score.	Services assessed in the e-government benchmark	Score (0 to 100)	e-government benchmark, link to data
5a5 Open data	This composite indicator measures to what extent countries have an open data policy in place (including the transposition of the revised PSI Directive), the estimated political, social and economic impact of open data and the characteristics (functionalities, data availability and usage) of the national data portal.	Aggregate score	% of maximum score	European data portal, link to data

Table 6. Digital public services dimension

2.6 Data sources

Most of the data in the DESI have been collected directly by national authorities. Table 7 presents the data sources and the role of national authorities in data collection and validation.

Data source	Data collection process
Eurostat	Data collected and verified by the national statistical offices or by Eurostat
Communications Committee (COCOM)	Data collected and verified by the national regulatory authorities (by data experts appointed by the members of the Communications Committee in every Member State)
Broadband coverage studies	Data collected by IHS and verified by the national regulatory authorities (by data experts appointed by the members of the Communications Committee in every Member State)
Retail broadband prices studies	Data collected by Empirica and verified by the national regulatory authorities (by data experts appointed by the members of the Communications Committee in every Member State)
e-government benchmark	Data collected by Capgemini and verified by relevant ministries in every Member State
European data portal	Data collected by Capgemini from representatives appointed by the relevant ministries in every Member State.

Table 7. Data sources and the role of national authorities

2.7 Data flags

A limited number of data points include explanatory notes (data flags), which can be consulted directly on the website of Eurostat at https://ec.europa.eu/eurostat/web/digital-economy-and-society.

3 Methodological considerations

3.1 Indicator requirements

Indicators used in the DESI comply with the following requirements:

- *Must be collected on a regular basis*. In order to fulfil the monitoring function, the indicators used in the index must be collected ideally on a yearly basis (or at least with a pre-defined regularity).
- *Must be relevant for a policy area of interest*. All indicators in the index must be accepted as relevant metrics in their specific policy areas.
- *Must not be redundant*. The index should not contain indicators that are redundant, either statistically or in terms of interpretation.

3.2 Data updates and corrections

Updates and corrections are part of the lifecycle and nature of statistical data. It is typical that the values for one indicator suffer small amendments and only stabilise completely months or even years after the indicator was originally computed. This is the case with a significant number of indicators used in the construction of the DESI.

At each publication, historical data are also reviewed to accommodate such changes. It is to be noted that the current report takes account of changes notified to the European Commission before 1 February 2020, except for the indicators 5G readiness, Broadband price index, 4G coverage, Fast broadband coverage (NGA) and Very High Capacity Network (VHCN) coverage, where data collection and validation were completed in April 2020. Any modification made after this date will be included in the next report, which is expected in 2021.

3.3 Normalisation

In order to aggregate indicators expressed in different units into the sub-dimensions and dimensions of the DESI, those indicators were normalised. In DESI, normalisation was done using the *min-max* method, which consists in a linear projection of each indicator onto a scale between 0 and 1. For indicators with positive direction (i.e., where higher is better), the 0 value in the normalised scale was anchored to the minimum value in the indicator original scale, and the value 1 in the normalised scale was anchored to the maximum value in the indicator's scale.

To allow for inter-temporal comparisons of index scores, the minima and maxima for the normalisation of each indicator were fixed and will be used for normalisation in the future versions of the DESI. Table 8 presents the values that were chosen as the minimum and maximum of each indicator for normalisation purposes.

Due to the choice of normalisation minima and maxima that are fixed over time, the values of one or another indicator may surpass the indicator's normalisation maximum or fall below its minimum in the future. The score for such values will become higher than 1 or lower than 0 respectively. While this is not a major methodological concern, the choice of minima and maxima was performed carefully, taking into account the likely evolution of each indicator and the balance between indicators, in an attempt to minimise the occurrence of such events.

Indicator	Minima	Maxima
1a1 Overall fixed broadband take-up	50%	100%
1a2 At least 100 Mbps fixed broadband take-up	0%	100%
1b1 Fast broadband (NGA) coverage	0%	100%
1b2 Fixed Very High Capacity Network (VHCN) coverage	0%	100%
1c1 4G coverage	0%	100%
1c2 Mobile broadband take-up	25	200
1c3 5G readiness	0%	100%
1d1 Broadband price index	0	100
2a1 At least basic digital skills	0%	100%
2a2 Above basic digital skills	0%	66%
2a3 At least basic software skills	0%	100%
2b1 ICT specialists	0%	7%
2b2 Female ICT specialists	0%	4%
2b3 ICT graduates	0%	10%
3a1 People who never used the internet	0%	45%
3a2 Internet users	40%	100%
3b1 News	33%	100%
3b2 Music, videos and games	50%	100%
3b3 Video on demand	0%	75%
3b4 Video calls	20%	100%
3b5 Social networks	40%	100%
3b6 Doing an online course	0%	30%
3c1 Banking	0%	100%
3c2 Shopping	0%	100%
3c3 Selling online	0%	60%
4a1 Electronic information sharing	0%	60%
4a2 Social media	0%	50%
4a3 Big data	0%	33%
4a4 Cloud	0%	50%
4b1 SMEs selling online	0%	33%
4b2 e-Commerce turnover	0%	33%
4b3 Selling online cross-border	0%	25%
5a1 e-Government users	0%	100%
5a2 Pre-filled forms	0	100
5a3 Online service completion	40	100
5a4 Digital public services for businesses	20	100
5a5 Open data	0%	100%

Table 8. Minima and maxima used in indicator normalisation

3.4 Imputation of missing observations

Some indicators presented missing observations for some countries. Values for those observations were estimated using different methodologies, such as:

- using available figures from the previous year,
- using available figures from the following year,
- using proxy indicators to identify trends to complete time series.

In DESI 2020, less than 0.1% of all observations were imputed.

3.5 Weights

Some dimensions, sub-dimensions and individual indicators are more relevant than others, which is why they were given higher weight in the computation of the final index score for each country.

Table 9 presents the overall weights attributed to the main DESI dimensions, which reflect the EU's digital policy priorities.

Dimension	Weight
1 Connectivity	25%
2 Human capital	25%
3 Use of internet services	15%
4 Integration of digital technology	20%
5 Digital public services	15%

Table 9. Weights attributed to the DESI dimensions

Connectivity and human capital can be considered the most relevant dimensions because they represent the infrastructure of the digital economy and society. Hence, they were given higher weights. Integration of digital technology captures the use of ICT by the business sector, which, according to growth accounting theories is one of the most important drivers of growth. It was given a high weight, but not as high as the previous two dimensions. Finally, use of internet (by citizens) and digital public services are enabled by the infrastructure and their contribution is strengthened by the quality of such infrastructure. For this reason, they were weighed less.

Weights were also assigned at the sub-dimension and individual indicator level. Weights used at the sub-dimension level are summarised in table 10[2].

Sub-dimension		Weight
1 Connectivity		
	1a Fixed broadband take-up	25%
	1b Fixed broadband coverage	25%
	1c Mobile broadband	35%
	1d Broadband price index	15%
2 Human capital		
	2a Internet user skills	50%
	2b Advanced skills and development	50%
3 Use of internet		
	3a Internet use	25%
	3b Activities online	50%
	3c Transactions	25%
4 Integration of digital technology		
	4a Business digitisation	60%

[2] Since the weight assignment for sub-dimensions is local to the dimension that they are part of, the sum of weights of the sub-dimensions within each dimension should add up to 100%.

4b e-Commerce	40%
5 Digital public services	
5a e-Government	100%

Table 10. Weights attributed to the DESI sub-dimensions

For reasons of simplicity, most individual indicators within each sub-dimension were considered of equal importance and therefore weighted equally within the respective sub-dimension. However, indicators measuring advanced digital technologies (5G readiness, VHCN coverage, cloud and big data) have double weights.

3.6 Method of aggregation

In DESI, the aggregation of indicators into sub-dimensions, of sub-dimensions into dimensions, and of dimensions into the overall index was performed from the bottom up using simple weighted arithmetic averages following the structure of the index (Table 1).

As an example, the top-level DESI score for country C was calculated using the formula:

$$DESI(C) = Connectivity(C) * 0.25 + Human\_capital(C) * 0.25 + Use\_of\_Internet\ (C) * 0.15 + Integration\_of\_Digital\_Technology(C) * 0.2 + Digital\_Public\_Services(C) * 0.15$$

Where $Connectivity(C)$ is the score obtained by country C in the Connectivity dimension, and so on for the remaining dimensions in the formula.

Annex 1 Methodology for the Broadband price index indicator

Scope

The Broadband price index includes all the baskets identified in the Broadband retail prices study by Empirica. It covers 34 baskets altogether:

- 13 with fixed services only,
- 12 with mobile service only and
- 9 with converged fixed and mobile services.

Treatment of outliers

For the data series of each basket, the skewness and kurtosis tests are performed. When the absolute value of skewness is larger than 2 and kurtosis is larger than 3.5, the outliers are treated. In the whole pricing database, 3 data points of Cyprus were treated by lowering the figures (which were the highest) to the value of the second highest.

Normalisation

The min-max approached is used to normalise data for each basket separately. Minimum and maximum values are computed as follows:

- Minimum: Actual minimum value in the basket multiplied by 0.75.
- Maximum: Actual maximum value in the basket multiplied by 1.25.

All prices are normalised to a score between 0 and 100, where 100 is the best performance.

Aggregation and missing data

The Broadband price index score is calculated as the arithmetic average of the normalised scores for all baskets in each member state. When data is not available (as no such offers exist that meet the criteria of a given basket), missing data is not estimated, so the index score is calculated based on the available baskets.