DESI 2019

Digital Economy and Society Index

Methodological note

Table of Contents

1 Introduction

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

The index allows four main types of analysis:

- 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 index dimensions.
- 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 so as to flag the need for improvement in relevant policy areas.

The DESI was developed following 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 by the European Commission services (DG CNECT, Eurostat) and by ad-hoc studies launched by the Commission services.

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

2 Structure of the DESI

The DESI has a three-layer structure as depicted in table 1. It is composed of 5 principal dimensions, each divided in a set of sub-dimensions, which are in turn composed by individual indicators.

Dimension	Sub-dimension	Indicator
1 Connectivity	1a Fixed broadband	1a1 Fixed broadband coverage
		1a2 Fixed broadband take-up
	1b Mobile broadband	1b1 4G coverage
		1b2 Mobile broadband take-up
		1b3 5G readiness
	1c Fast broadband	1c1 Fast broadband (NGA) coverage
		1c2 Fast broadband take-up
	1d Ultrafast broadband	1d1 Ultrafast broadband coverage
		1d2 Ultrafast broadband take-up
	1e Broadband price index	1e1 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 Professional social networks
		3b7 Doing an online course
		3b8 Online consultations and voting
	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
	5b e-Health	5b1 e-Health services
		5b2 Medical data exchange
		5b3 e-Prescription

Table 1. DESI Structure

At high 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 are in fact interconnected. 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 and data availability reasons, DESI 2019 presents structural changes when compared to DESI 2018. Such changes are described in section 2.6.

The following sections present the list of indicators in DESI 2019.

2.1 Connectivity dimension

Indicator	Description	Breakdown	Unit	Source
1a1 Fixed broadband coverage	% of households covered by broadband: xDSL, cable (basic and NGA), FTTP or WiMax networks	All households	% households	Broadband coverage in Europe, studies for the EC by IHS and Valdani, Vicari & Associati (2013-2015, SMART 2013/0054) and by IHS and Point Topic (2016 onwards, SMART 2016/0045)
1a2 Fixed broadband take-up	% of households subscribing to broadband: xDSL, cable (basic and NGA), FTTP or WiMax networks	All households	% households	Eurostat - Community survey on ICT usage in Households and by People
1b1 4G coverage	% of populated areas coverage by 4G - measured as the average coverage of telecom operators in each country	All households	% households	Broadband coverage in Europe, studies for the EC by IHS and Valdani, Vicari & Associati (2013-2015, SMART 2013/0054) and by IHS and Point Topic (2016 onwards, SMART 2016/0045)
1b2 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)
1b3 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)
1c1 Fast broadband (NGA) coverage	% of households covered by broadband of at least 30 Mbps download. Considered technologies are FTTH, FTTB, Cable Docsis 3.0 and VDSL	All households	% households	Broadband coverage in Europe, studies for the EC by IHS and Valdani, Vicari & Associati (2013-2015, SMART 2013/0054) and by IHS and Point Topic (2016 onwards, SMART 2016/0045)
1c2 Fast broadband take-up	% of households subscribing to broadband of at least 30 Mbps	All fixed broadband subscriptions	% of households	European Commission services, through the Communications Committee (COCOM) and Eurostat Eurostat - Community survey on ICT usage in Households and by People
1d1 Ultrafast broadband coverage	% of households covered by broadband of at least 100 Mbps download. Considered technologies are FTTH, FTTB and Cable Docsis 3.0	All households	% households	Broadband coverage in Europe, studies for the EC by IHS and Valdani, Vicari & Associati (2013-2015, SMART 2013/0054) and by IHS and Point Topic (2016 onwards, SMART 2016/0045)
1d2 Ultrafast broadband take-up	% of households subscribing to broadband of at least 100 Mbps	All fixed broadband subscriptions	% of households	European Commission services, through the Communications Committee (COCOM) and Eurostat Eurostat - Community survey on ICT usage in Households and by People
1e1 Broadband price index	The Broadband Price Index measures the prices of twelve representative broadband baskets as the percentage of household income. The baskets include three speed categories (12-30 Mbps, 30-100 Mbps and at least 100 Mbps) and four types of products (standalone internet, internet + TV, internet + fixed telephony and internet + TV + fixed telephony).	All fixed broadband offers	Score (0-100)	Access cost: Broadband Internet Access Cost (BIAC), annual studies for the EC realised by Van Dijk (2013-2015) and by Empirica (2016 onwards). Income: Real adjusted gross disposable income of households per capita (Eurostat: tec00113)

Table 2. Connectivity dimension

2.2 Human Capital Dimension

Indicator	Description	Breakdown	Unit	Source
2a1 At least basic digital skills	People 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 People (aged 16-74)	% People	Eurostat - Community survey on ICT usage in Households and by Individuals
2a2 Above basic digital skills	People 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 People (aged 16-74)	% People	Eurostat - Community survey on ICT usage in Households and by Individuals
2a3 At least basic software skills	People 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 People (aged 16-74)	% People	Eurostat - Community survey on ICT usage in Households and by Individuals
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.	People in employment aged 15-74	% People in employment aged 15-74	Eurostat - Labour force survey
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	% Females in employment aged 15-74	Eurostat - Labour force survey
2b3 ICT graduates	People with a degree in ICT	Graduates	% of Graduates	Eurostat (table educ_uoegrad04, using selection ISCED11=ED5-8)

Table 3. Human capital dimension

2.3 Use of Internet Dimension

Indicator	Description	Breakdown	Unit	Source
3a1 People who never used the internet	People who never used the Internet	All People (aged 16-74)	% People	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUX)
3a2 Internet users	People who use the Internet at least once a week	All People (aged 16-74)	% People	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUSE)
3b1 News	People who used the internet to read online news sites, newspapers or news magazines	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUNW1)
3b2 Music, videos and games	People who used the internet to play or download games, images, films or music	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals
3b3 Video on demand	People who used the internet to use Video on Demand services	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals
3b4 Video calls	People who used the internet to make telephone or video calls (eg Skpe)	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUPH1)
3b5 Social networks	People who used the internet to participate in social networks (create user profile, post messages or other contributions)	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUSNET)
3b6 Professional social networks	People who have used Internet for participating in social or professional networks	All People (aged 16-74)	% People who used Internet in the previous 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUNET)
3b7 Doing an online course	People who have used the Internet for doing an online course (on any subject)	All People (aged 16-74)	% People who used Internet in the previous 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUOLC)
3b8 Online consultations and voting	People who took part in on-line consultations or voting to define civic or political issues (e.g. urban planning, signing a petition)	All People (aged 16-74)	% People who used Internet in the previous 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUVOTE)
3c1 Banking	People who used the Internet to use online banking	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUBK)
3c2 Shopping	People who ordered goods or services online	All People (aged 16-74)	% internet users (last year)	Eurostat - Community survey on ICT usage in Households and by Individuals (I_BLT12)
3c3 Selling online	People who sold goods or services online	All People (aged 16-74)	% People who used Internet in the last 3 months	Eurostat - Community survey on ICT usage in Households and by Individuals (I_IUSELL)

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)	% enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_ERP1)
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 have 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)	% enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_SM1_GE2)
4a3 Big data	Enterprises analysing big data from any data source	All enterprises (no financial sector, 10+ employees)	% enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_BD)
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)	% enterprises	Eurostat - Community survey on ICT usage and eCommerce in Enterprises
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)
4b2 e-Commerce turnover	SMEs total turnover from e-commerce	SMEs (no financial sector, 10-249 employees)	% turnover	Eurostat - Community survey on ICT usage and eCommerce in Enterprises (E_ETURN)
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)

Table 5. Integration of technology dimension

2.5 Digital Public Services Dimension

Indicator	Description	Breakdown	Unit	Source
5a1 e-Government users	People who sent filled forms to public authorities, over the internet, previous 12 months	All People (aged 16-74)	% 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)
5a2 Pre-filled forms	Amount of data that is pre-filled in public services' online forms	Services assessed in the eGovernment Benchmark	Score (0 to 100)	eGovernment Benchmark
5a3 Online service completion	The share of administrative steps related to major life events (birth of a child, new residence, etc) that can be done online	Services assessed in the eGovernment Benchmark	Score (0 to 100)	eGovernment Benchmark
5a4 Digital public services for businesses	The indicator broadly reflects the share of public services needed for starting a business and for conducting regular business operations that are available online for domestics as well as for foreign users. Services provided through a portal receive an higher score, services which provide only information (but have to be completed offline) receive a more limited score.	Services assessed in the eGovernment Benchmark	Score (0 to 100)	eGovernment Benchmark
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
5b1 e-Health services	% of people who used health and care services provided online without having to go to the hospital or doctors surgery (for example, by getting a prescription or a consultation online)	All people	% of people	Eurobarometer 460: Attitudes towards the impact of digitisation and automation on daily life
5b2 Medical data exchange	General practitioners exchanging medical data with hospitals and doctors	All general practitioners	% of general practitioners	Benchmarking Deployment of eHealth among General Practitioners
5b3 e-Prescription	General practitioners using electronic prescriptions	All general practitioners	% of general practitioners	Benchmarking Deployment of eHealth among General Practitioners

Table 6. Digital public services dimension

2.6   Changes compared to DESI 2018

The current publication of the DESI includes improvement in comparison to the version published by the European Commission in 2018. The below table presents the new indicators:

Dimension	Sub-dimension	Indicator
1 Connectivity	1b Mobile broadband	1b3 5G readiness
2 Human capital	2a Internet user skills	2a2 Above basic digital skills
2 Human capital	2a Internet user skills	2a3 At least basic software skills
2 Human capital	2b Advanced skills and development	2b2 Female ICT specialists
2 Human capital	2b Advanced skills and development	2b3 ICT graduates
3 Use of internet services	3a Internet use	3a1 People who never used the internet
3 Use of internet services	3b Activities online	3b6 Professional social networks
3 Use of internet services	3b Activities online	3b7 Doing an online course
3 Use of internet services	3b Activities online	3b8 Online consultations and voting
3 Use of internet services	3c Transactions	3c3 Selling online
4 Integration of digital technology	4a Business digitisation	4a3 Big data
5 Digital public services	5b e-Health	5b2 Medical data exchange
5 Digital public services	5b e-Health	5b3 e-Prescription

Table 7. New indicators

In addition, a limited number of historical data points were revised for other indicators, too. As a result of the above changes, the rankings for the previous years have slightly changed.

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 <u>ideally</u> 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 15 February 2019, except for the indictor 5G readiness (9 April 2019). Any modification made after this date will be included in the next report, which is expected in 2020.

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 on 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, respectively, higher than 1 or lower than 0. While this fact does not present 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, so as to try to minimise the occurrence of such events.

Indicator	Minima	Maxima
1a1 Fixed broadband coverage	75%	100%
1a2 Fixed broadband take-up	50%	100%
1b1 4G coverage	0%	100%
1b2 Mobile broadband take-up	25	150
1b3 5G readiness	0%	100%
1c1 Fast broadband (NGA) coverage	0%	100%
1c2 Fast broadband take-up	0%	100%
1d1 Ultrafast broadband coverage	0%	100%
1d2 Ultrafast broadband take-up	0%	100%
1e1 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 Professional social networks	0%	40%
3b7 Doing an online course	0%	30%
3b8 Online consultations and voting	0%	40%
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%
5b1 e-Health services	0%	100%
5b2 Medical data exchange	0%	100%
5b3 e-Prescription	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 by:

- using available figures from the previous year,

- using available figures from more the following year,

- using proxy indicators to identify trends to complete time series.

In DESI 2019, 0.03 % of all observations were imputed. As for the whole data set (DESI 2014-2019) imputations concern 20 % of data points.

3.5   Weights

Some dimensions, sub-dimensions and individual indicators are more relevant than others, and for such a reason 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	18.5%
1b Mobile broadband	35%
1c Fast broadband	18.5%
1d Ultrafast broadband	18.5%
1e Broadband price Index	9.5%
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%
4b e-Commerce	40%
5 Digital public services	
5a e-Government	80%
5b e-Health	20%

Table 10. Weights attributed to the DESI sub-dimensions

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

For simplicity, all individual indicators within each sub-dimension were considered of equal importance and therefore weighted equally within the respective sub-dimension.

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.