The State of Data Innovation in the EU

CENTER FOR DATA INNOVATION

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Nick Wallace

Daniel Castro

ABOUT THE CENTER FOR DATA INNOVATION

From creating a modern, evidence-based health-care system to building sustainable, energy-efficient cities, data is increasingly a critical component in many initiatives to make the world a better place. In the coming years, the collection, analysis, and use of massive amounts of data will have the potential to generate enormous social and economic benefits, but successfully capitalizing on these opportunities will require public policies designed to allow data-driven innovation to flourish.

The Center for Data Innovation is the leading think tank studying the intersection of data, technology, and public policy. Based in Washington, DC, the Center formulates and promotes pragmatic public policies designed to maximize the benefits of data-driven innovation in the public and private sectors. It educates policymakers and the public about the opportunities and challenges associated with data, as well as technology trends such as predictive analytics, open data, cloud computing, and the Internet of Things. The Center is a nonprofit, nonpartisan research institute affiliated with the Information Technology and Innovation Foundation.

TABLE OF CONTENTS

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October 2017

Data innovation—the innovative use of data to create social and economic benefits—is making a significant mark in Europe.[1] In economic terms, data innovation contributed about €300 billion to Europe's economy in 2016 (or approximately 2 percent of GDP), and its value will likely more than double by 2020.[2] Across society, data innovation is creating more responsive governments, better health care, and safer cities. But EU nations differ in the degree to which they are harnessing the benefits of data. This report uses a variety of indicators to rank EU member states and discusses why some countries are ahead and what others can do to catch up.

INTRODUCTION

Data innovation is happening today because the rapid growth in the ability to collect, store, analyze, and share large quantities of information at low cost drives new forms of economic activity, scientific discovery, and social innovation. For example, in health care, greater use of medical data can help doctors to diagnose problems much earlier, and manage long-term conditions better.[3] In schools, teachers and administrators can use data to personalize educational software to meet the needs of individual pupils.[4] And in business, an array of data-driven tools can help companies streamline their business processes and become more responsive to their customers. In the financial sector, for example, companies use sophisticated analytics and large datasets to prevent fraud as well as to improve and expand their lending services.[5]

Member states that more effectively embraced data innovation will find it easier to respond to social and economic challenges in the years ahead. This means member states that may lag behind other European countries today could lead the EU's competitive edge in the future if they support and invest in the underpinnings of the data economy.

To identify the areas where member states are doing well or need to improve, this report examines a range of indicators across three categories:

- **Data**: The availability of useable data and the effectiveness of government policies in promoting the supply and reuse of data. This includes the size of the national data economy, data sharing in health care, the extent and impact of open-data policies, and the robustness of freedom-of-information laws.
- **Technology**: The availability and use of key digital infrastructure and systems, such as the Internet of Things, e-government, and high-speed broadband.
- **People and Firms**: The use of data-driven technologies in the workplace, the prevalence of digital skills, and the role of education and civil society in developing such skills.

The report concludes with recommendations for policymakers on how to improve their country's performance in data innovation. To summarize, governments need to prioritize three goals:

1. **Maximize the supply of reusable data.** Governments should both avoid laws and regulations that stifle the supply and flow of data, such as overly burdensome data-protection rules and data-localization policies in different member states, and increase the supply of data, such as via open data and freedom-of-information policies.[6]
2. **Improve infrastructure that supports data innovation.** Governments should encourage the development of key technological platforms that enable data innovation, such as broadband, digital public services, smart meters, and smart cities.
3. **Develop data-science and data-literacy skills in workers.** Governments should encourage the development of data-related skills through the education system and through professional training programs.

METHODOLOGY

This report uses 29 different measurements to assess the state of data innovation in the 28 EU nations. In order to make the different measurements comparable, we standardized them into z-scores, which measure a value's distance from the mean as a multiple of the standard deviation. We capped these standardized values at ±4.0 (though none fell outside this range) and then scaled them to a score between 0 and 100, with 0 corresponding to the lowest z-score attained and 100 to the highest attained. The indicator scores are derived from the weighted averages of the measurement scores, and the category scores are weighted averages of the indicator scores. The overall score is the average of the three equally-weighted category scores. All scores and weights are in the appendix.

On some measurements, data was not available for all member states. There were missing values for all open data measurements (Cyprus, Lithuania, Luxembourg, Malta, Romania, and Slovenia), protections against libel chill-costs (Croatia), and e-business—use of big data (Austria, Ireland, and Latvia). Where values were missing, we excluded the measurement from the weighted average of the indicator for that country. In the case of open data, we excluded the entire indicator from the weighted average of the category scores for those countries. This has the effect of increasing the weight of the other measurements and indicators in those averages.

The indicators we used for this report are in part a reflection of the data that was available. Member states would benefit from better metrics on the data economy. For example, had we been able to find the data, we would have liked to include statistics on smart manufacturing, in addition to the other business indicators we did use. Similarly, statistics on the use of the Internet of Things and artificial intelligence in business and in public services (particularly health care) would also provide excellent indications of the extent of data innovation in a country. Data on precision agriculture, where the Internet of Things and data analytics improve food production, would have indicated performance in an important area of data innovation in rural society, providing an interesting counterweight to urban and cosmopolitan indicators such as smart cities and data-science groups in capital cities. The number of data scientists employed would also have been a very useful indicator

(we used the number of ICT specialists). Some measures were only available in a few countries, and therefore we could not use these as a basis for comparison.

Likewise, some of the indicators we included could have been stronger. For example, accurate data on the prevalence of smart meters in every member state would have been preferable to the indicator available—intentions to roll out smart meters in line with EU targets—but this dataset was the best that was available for almost all member states. Similarly, the number of data-science degree programs on offer has a bias towards the English language. Although non-English speaking countries nevertheless outperform countries where English is the official language, this still means the results are skewed by a nation's capacity for learning foreign languages, and not a perfect measurement of its pursuit of data science as an academic discipline. Though the weight of each indicator (see appendix) is primarily based on its importance, for indicators where we saw limitations such as these, we reduced the weight of the score.

Figure 1: Overview of Indicators

Section 1: Data	Description	Source
Data Economy		
Data Market Size	The value of data market demand as a percentage of member states' GDP.	Open Evidence/IDC
Data Companies	The total revenues of data companies as a percentage of GDP	Open Evidence/IDC
Open Data		
Implementation	The extent to which government datasets are available and adhere to open data principles.	Open Data Barometer
Impact	The strength of legal protections against malicious accusations of defamation.	Open Data Barometer
Data Sharing in Health care	The percentage of GPs sharing data electronically with other health-care practitioners.	European Commission Digital Scoreboard
Freedom of Information		
Right to Information	Legal guarantees of citizens' rights to access information held by government.	Access Info/Center for Law and Democracy
Corruption	The extent to which member states are free from corruption.	Transparency International
Protections Against Libel Chill		
Legal Safeguards	The strength of legal protections against malicious accusations of defamation.	International Press Institute/primary research
Costs	The approximate cost of going to court in each member state.	European Commission/Bemolin Brulard Barthelemy
Special Plaintiffs	The extent to which member states' defamation laws treat all would-be plaintiffs as equals.	International Press Institute/primary research

Section 2: Technology	Description	Source
Internet of Things		
Smart Meters	Member states' intentions regarding EU targets for the rollout of smart meters.	European Commission
Smart Ticketing	Integrated and smart ticketing systems in capital cities' transport networks.	Various sources/primary research
Smart Cities	The approximate number of smart cities in as a percentage of total cities.	European Commission/RAND Corporation
E-Government	Percentage of respondents who have used an online government service during the previous 12 months.	European Commission Digital Scoreboard
Business Broadband		
Connections over 30 Mbps	The percentage of businesses with broadband Internet connections faster than 30 Mbps.	European Commission Digital Scoreboard
Connections	The percentage of businesses with access to broadband Internet.	European Commission Digital Scoreboard
Household Broadband		
Access	The percentage of businesses with access to broadband Internet.	European Commission Digital Scoreboard
Speed	The average speed of Internet connections in each member state.	European Commission Digital Scoreboard

Section 3: People and Firms	Description	Source
E-Business		
Big Data	The percentage of businesses analyzing and using big data from any source.	Eurostat
Cloud Computing	The percentage of businesses making use of cloud computing.	Eurostat
RFID	The percentage of businesses using RFID technology to log physical objects.	Eurostat
ERP	The percentage of businesses using ERP software to automate business processes.	Eurostat
CRM	The percentage of businesses using CRM software to manage customer interactions.	Eurostat
Workforce		
ICT Specialists	ICT specialists as a percentage of the employed labor force.	Eurostat
ICT Skills	The percentage of the population with above basic ICT skills	Eurostat
R&D Personnel	The number of R&D personnel per employed in each member state, per 1,000 people.	Eurostat
Education and Civil Society		
Data-Science Groups	The number of data science Meetup groups in each member state's capital city per 10,000 inhabitants.	Meetup
Science and Technology Graduates	The number of people with science and technology degrees per 1,000 population.	Eurostat
Data-Science Degrees	The number of advertised of data science postgraduate programs for international students, per 10,000 students in tertiary education.	MastersPortal.EU

OVERALL RANKINGS

EU member states differ significantly on the extent to which they have transformed their economies and society with data. Some of these differences reflect underlying economic conditions, but some reflect differences in policy.

The top five countries in data innovation are Denmark, Finland, the Netherlands, Sweden, and the UK. Member states with higher per-capita income generally have higher scores than nations with lower incomes: there is a moderate positive linear correlation of 0.49 between member states' per capita incomes and their scores on this index.

But income is not a guarantee of strong performance in data innovation. The top five nations all enjoy higher incomes, but other high-income nations, such as Germany and France, rank 14th and 11th respectively, and Luxembourg, the richest nation in Europe, ranks just 10th. In contrast, Estonia, where GDP per capita is below the EU average, ranks sixth. This variation shows how effective strong national leadership and the right policy can be.

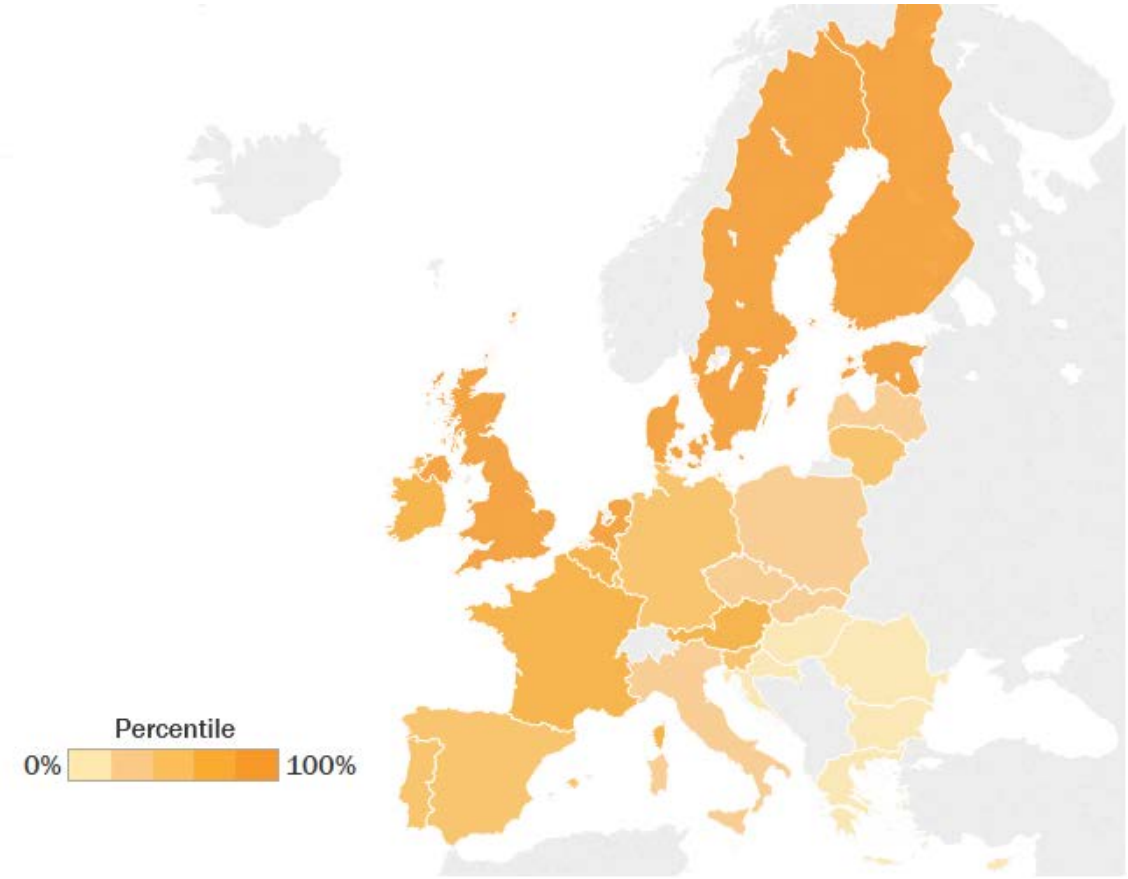
The lowest-ranking five countries are Greece, Croatia, Hungary, Bulgaria, and Cyprus. Each has a GDP per capita below the EU average, but the most striking characteristic of the lower-ranking countries is corruption: there is a strong inverse correlation of 0.88 between corruption levels and the final score, even though the former is worth just 1 percent of the latter (see appendix for weights). The bottom five exhibit some of the highest levels of corruption in the EU (see table 12).

Corruption can steer policy off course and undermine the effectiveness of government, and this finding reinforces the importance of accountability and strong institutions to effective policymaking. Open data and freedom-of-information laws alone cannot solve endemic corruption or institutional weakness, but they are useful tools in promoting the transparency necessary to combat such problems, and thus are vital to data innovation.

Table 1: Overall Rankings

Rank	Country	Score	Rank	Country	Score
1	Denmark	71.14	15	Lithuania	43.69
2	Finland	69.36	16	Portugal	39.06
3	Netherlands	65.82	17	Slovenia	37.42
4	Sweden	64.95	18	Latvia	37.22
5	United Kingdom	63.47	19	Slovakia	35.20
6	Estonia	61.11	20	Poland	32.68
7	Austria	53.07	21	Italy	31.29
8	Ireland	49.62	22	Czech Republic	30.80
9	Malta	48.66	23	Romania	30.60
10	Belgium	47.91	24	Greece	28.68
11	France	46.96	25	Croatia	28.10
12	Spain	45.48	26	Hungary	27.46
13	Germany	44.94	27	Bulgaria	26.95
14	Luxembourg	44.47	28	Cyprus	26.88

Map 1: Overall Rankings



SECTION I: ENSURING DATA IS AVAILABLE FOR USE

Greater availability of data drives economic efficiency, supports social and scientific research, and improves transparency in public institutions. Governments can lead the way by publishing open data, passing robust freedom-of-information laws, reforming censorious libel laws, and encouraging data-driven businesses through sensible regulation. Policymakers can also use data to improve vital public services, such as health care and education.

This category measures the extent to which member states make different types of data available. It is made up of five indicators: the data economy, open data, data sharing in health care, freedom of information, and protection against the threat of libel chill.

The top five countries in this category are Estonia, the UK, Denmark, Sweden, and Finland. Estonia's position in first place is largely the result of its very high data economy score. The UK, meanwhile, performs well on most indicators in this category, especially on open data and freedom of information. Estonia and the UK lead by a very large margin: the gap between the UK's score and that of third-place Denmark is 14.87 points (with a maximum attainable score of 100).

The Nordic countries were strong performers across most of the indicators in the data category, with Finland exhibiting the strongest resistance to libel chill. Denmark ranked only ninth for freedom of information, but performed very well on open data (fourth place) and other data indicators.

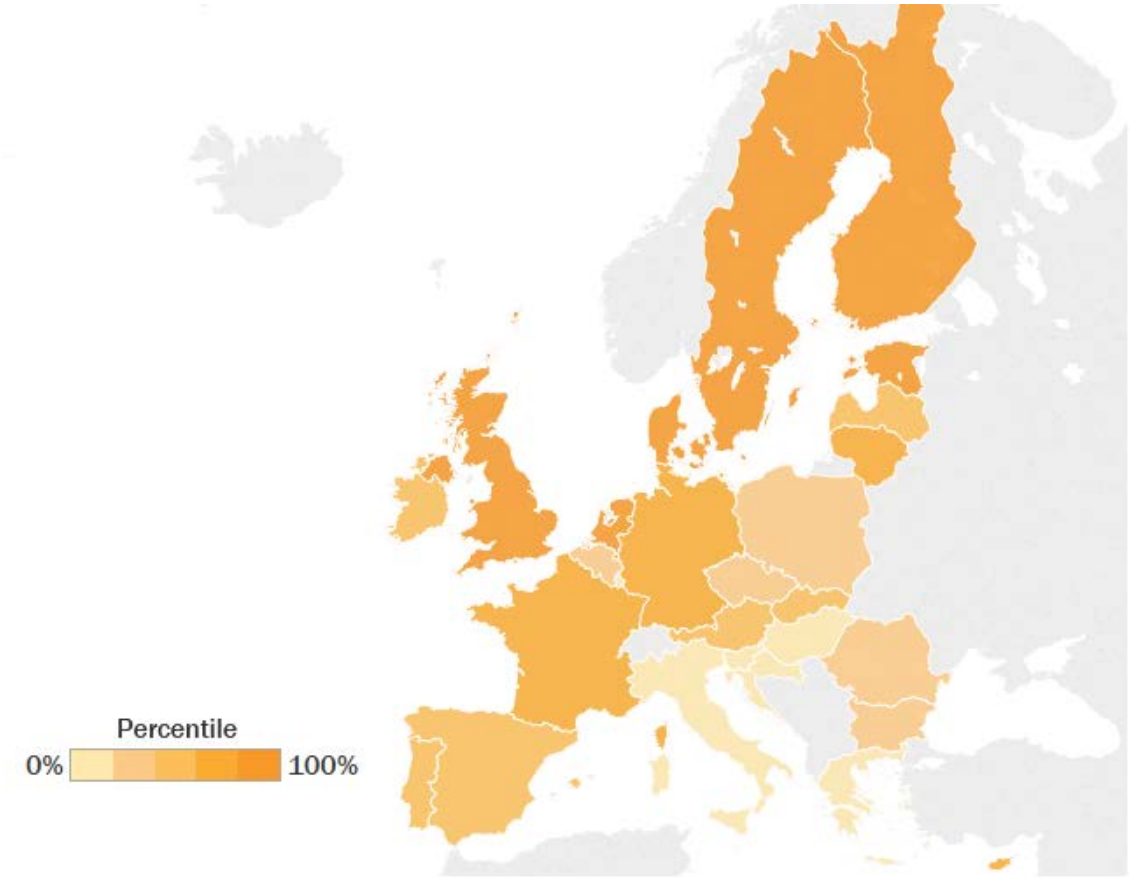
The five lowest ranking countries in this category are Slovenia, Hungary, Croatia, Greece, and Luxembourg. Hungary and Croatia are also in the bottom five for open data, while Croatia is in the bottom five for data sharing in health care. Greece is in the bottom five on two data indicators: freedom of information and protection from libel chill, and performed well below average on all others. Luxembourg ranks 28th for data economy and 27th for freedom of information.

Unlike the other two categories and the overall score, there is no correlation between GDP per capita and the data score (the coefficient is —0.05). Lithuania achieves eighth place, ahead of Germany and France, while Latvia, in 13th place, is ahead of Ireland and Austria. Cyprus, which ranks 28th for technology and 27th for people and firms, achieves 7th place for data. The correlation between data and the other two category scores is 0.42 and 0.41, weaker than the 0.53 coefficient between technology and people and firms.

Table 2: Data

Rank	Country	Score	Rank	Country	Score
1	Estonia	73.38	15	Austria	36.34
2	United Kingdom	67.56	16	Slovakia	33.00
3	Denmark	52.69	17	Portugal	32.99
4	Sweden	52.09	18	Bulgaria	32.91
5	Finland	50.36	19	Poland	30.96
6	Netherlands	47.51	20	Czech Republic	30.41
7	Cyprus	44.63	21	Romania	29.69
8	Lithuania	44.05	22	Belgium	27.50
9	Germany	41.60	23	Italy	26.46
10	France	41.52	24	Slovenia	24.09
11	Malta	39.02	25	Hungary	24.04
12	Spain	38.76	26	Croatia	21.18
13	Latvia	38.46	27	Greece	18.21
14	Ireland	36.65	28	Luxembourg	14.61

Map 2: Data



DATA ECONOMY

The relative value of data market demand and the revenues of data companies.

Why is this important? In the data economy, data is a valuable, tradeable asset that fuels new kinds of products and services, and this indicator reflects the size of the market for the trade in data in each member state. The size of data markets reflects the extent to which data is available for companies across multiple industries to share and use to integrate into their own products and services, create new value, and increase productivity.

The rankings: The top five countries on this indicator are the Estonia, Cyprus, the UK, Malta, and Denmark. The bottom five are Croatia, the Czech Republic, Greece, Slovenia, and Luxembourg.

Estonia ranks first on both measurements in this indicator. Cyprus achieves third place with a high score on both measurements, making this the only indicator in this study where the country does particularly well at all. The UK ranks third for market size (behind Estonia and Cyprus) and second for data companies' revenues (behind Estonia).

Methodology: The indicator is worth 40 percent of the data category. It comprises two metrics from the European Data Market Report, a study by Open Evidence and IDC for the European Commission on the European data economy. The two measurements are the value of data market demand and the total revenues of companies supplying digital data as a product (2016 figures for both). We expressed both values as a percentage of 2016 GDP. We weighted both measurements equally.

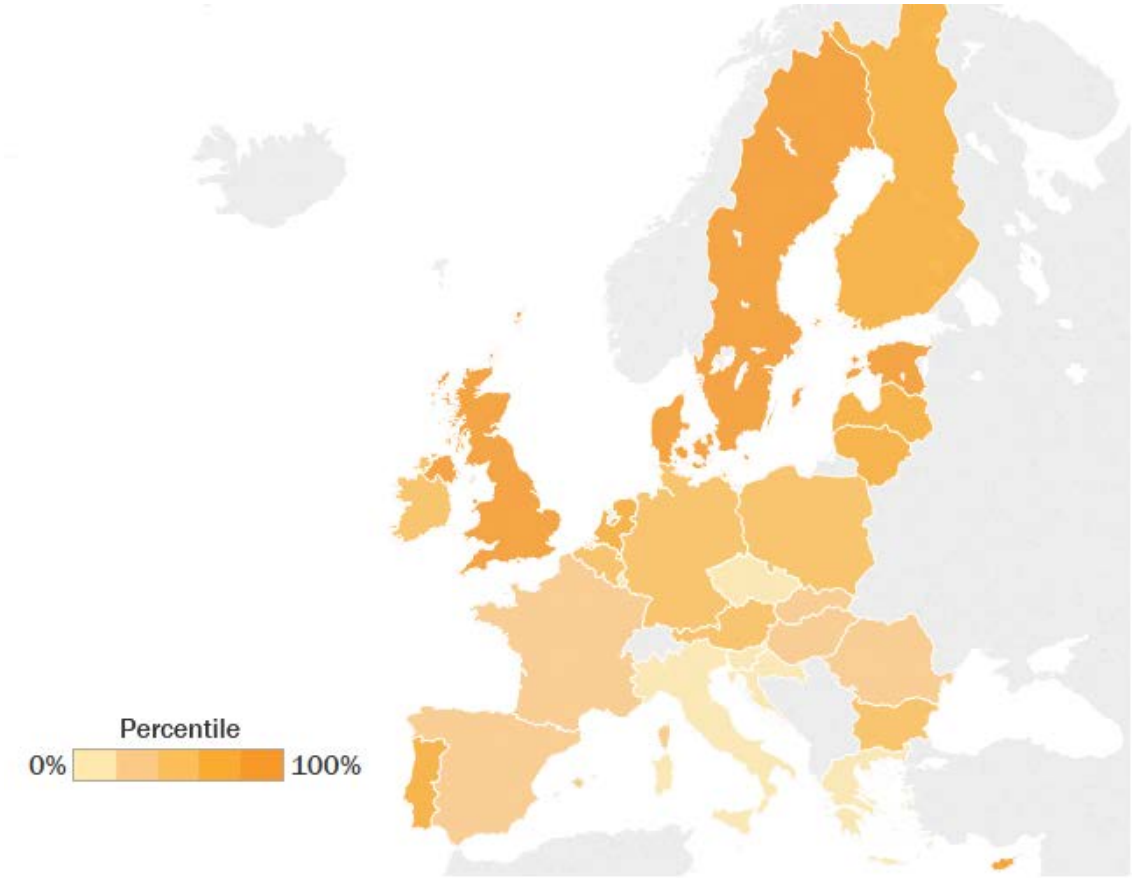
The data market is "the marketplace where digital data is exchanged as products or services as a result of the elaboration of raw data" and its value is "the aggregate value of the demand of digital data." This definition excludes estimates of "other direct, indirect, and induced impacts on the economy." Data companies are "data suppliers' organizations, whose main activity is the production and delivery of digital data-related products, services, and technologies."[7]

Source: *European Data Market Final Report: Study Dataset* (Open Evidence/IDC, May 2, 2017) http://www.datalandscape.eu/european-data-market-monitoring-tool.

Table 3: Data Economy

Rank	Country	Score	Rank	Country	Score
1	Estonia	100.00	15	Austria	25.92
2	Cyprus	55.68	16	Belgium	23.53
3	United Kingdom	53.56	17	Ireland	23.16
4	Malta	44.69	18	France	21.63
5	Denmark	44.48	19	Slovakia	19.29
6	Sweden	43.57	20	Hungary	18.42
7	Portugal	40.31	21	Romania	17.00
8	Netherlands	40.08	22	Spain	16.28
9	Latvia	38.08	23	Italy	13.21
10	Lithuania	38.00	24	Croatia	12.39
11	Finland	34.33	25	Czech Republic	11.48
12	Bulgaria	33.62	26	Greece	9.89
13	Germany	31.30	27	Slovenia	5.08
14	Poland	30.41	28	Luxembourg	4.98

Map 3: Data Economy



DATA ECONOMY: DATA MARKET SIZE

The value of a member state's data market demand as a percentage of its GDP.

Why is this important? The value of market demand for data-driven products and services indicates the importance of data to the national economy and of the viability of business models built around making data available for reuse.

The rankings: The top five countries are Estonia, Cyprus, the UK, Malta, and Bulgaria. The bottom five are Spain, Slovenia, Italy, Greece, and Luxembourg. Though the top five include some very small economies, there is no correlation between GDP and demand as a percentage of GDP (the coefficient is just -0.11). Thus, the scores of Cyprus, Malta, and Bulgaria are not statistical accidents, but genuine indications of market demand for data-driven products and services in those countries.

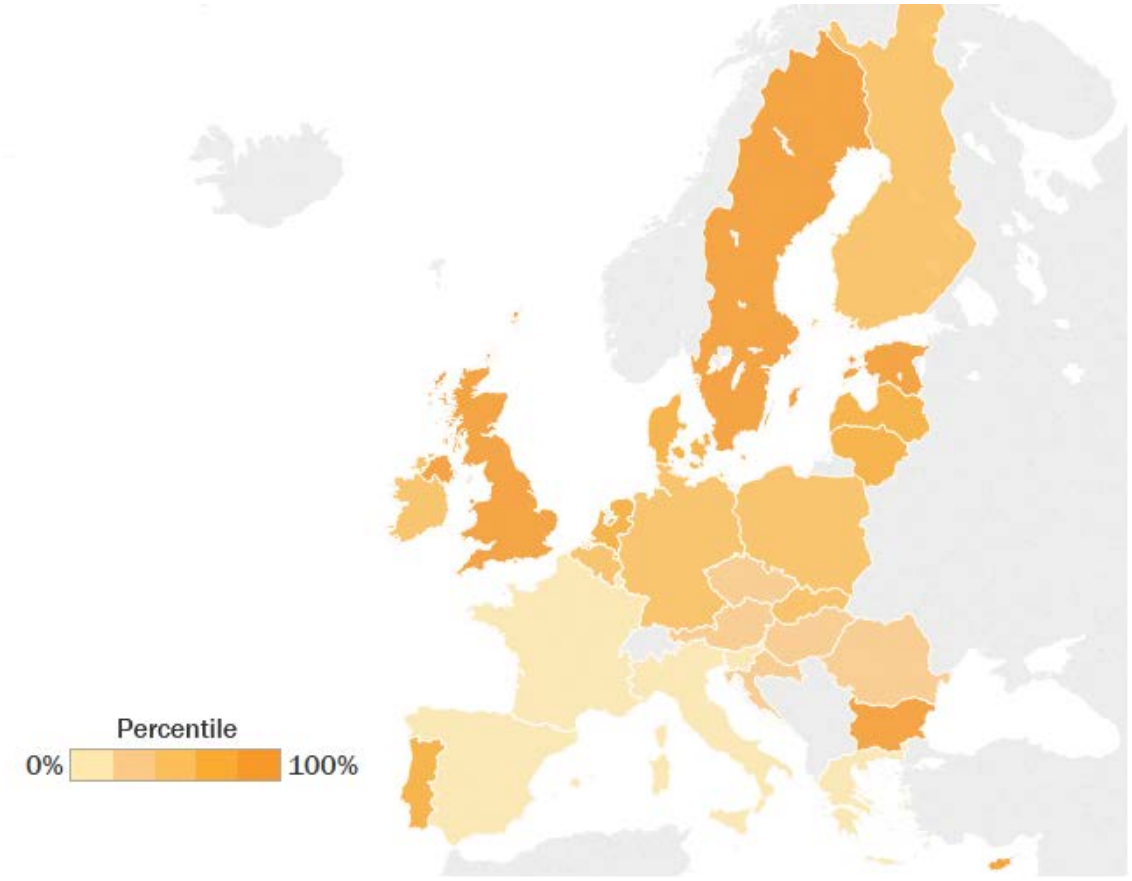
Methodology: The European Data Market Report gives 2016 data market demand in euros, which we express here as a percentage of each country's GDP in 2016. The data market is "the marketplace where digital data is exchanged as products or services as a result of the elaboration of raw data" and its value is "the aggregate value of the demand of digital data."[8] This definition excludes exports and estimates of "other direct, indirect, and induced impacts on the economy."[9]

Source: *European Data Market Final Report: Study Dataset* (Open Evidence/IDC, May 2, 2017) http://www.datalandscape.eu/european-data-market-monitoring-tool.

Table 4: Data Economy—Data Market Size

Rank	Country	Percentage of GDP	Rank	Country	Percentage of GDP
1	Estonia	0.94%	15	Slovakia	0.40%
2	Cyprus	0.67%	16	Ireland	0.38%
3	United Kingdom	0.56%	17	Belgium	0.37%
4	Malta	0.54%	18	Austria	0.36%
5	Bulgaria	0.53%	19	Croatia	0.36%
6	Sweden	0.50%	20	Hungary	0.35%
7	Netherlands	0.48%	21	Czech Republic	0.35%
8	Latvia	0.47%	22	Romania	0.34%
9	Lithuania	0.47%	23	France	0.33%
10	Portugal	0.46%	24	Spain	0.29%
11	Denmark	0.46%	25	Slovenia	0.28%
12	Finland	0.45%	26	Italy	0.28%
13	Germany	0.41%	27	Greece	0.24%
14	Poland	0.40%	28	Luxembourg	0.21%

Map 4: Data Economy—Data Market Size



DATA ECONOMY: DATA COMPANIES

The revenues of data companies as a percentage of national GDP.

Why is this important? The revenues of data companies are an indicator of data-driven economic activity in a country, including exports, and therefore the extent to which companies are finding viable business models in making data available for reuse by others. Whereas the data market size indicates the domestic demand for data-driven innovation, the revenues of data companies indicate the extent to which domestic businesses are supplying data-driven products and services domestically and abroad.

The rankings: The top five countries are Estonia, Denmark, the UK, Cyprus, and Sweden. The bottom five are Slovakia, Luxembourg, Croatia, the Czech Republic, and Slovenia. The average total revenue of data companies in each member state was 0.43 percent of GDP.

Estonia leads by a large margin: Estonian data companies' revenues were equivalent to 0.94 percent of national GDP, compared to 0.62 percent in the UK. Before controlling for GDP, the UK and Germany are ahead of the rest of the EU by a huge margin: British data companies took €14.6 billion in revenues and German data companies €13.4 billion; the next-highest after Germany was France with just €7.9 billion. After controlling for GDP, the UK is still able to achieve second on this measurement, despite its large overall GDP, but Germany ranks 12th, with 0.43 percent. French data companies generated the third-highest total revenue in the EU after the UK and Germany, but after controlling for GDP, the country ranks just 15th.

In Slovenia, data companies generated just €57 million, or 0.14 percent of GDP. Croatian data companies contributed a little more—€83 million, corresponding to 0.18 percent of GDP. Czech data firms generated much more revenue—€313 million—but in the significantly larger Czech economy, this accounts for a smaller proportion of GDP than in Croatia, slightly less than 0.18 percent.

Methodology: We took the total revenues of data companies in 2016 as reported in the European Data Market Report and recalculated these figures as a percentage of 2016 GDP, as reported by Eurostat. The report defines data companies as "data suppliers' organizations, whose main activity is the production and delivery of digital data-related products, services, and technologies."[10]

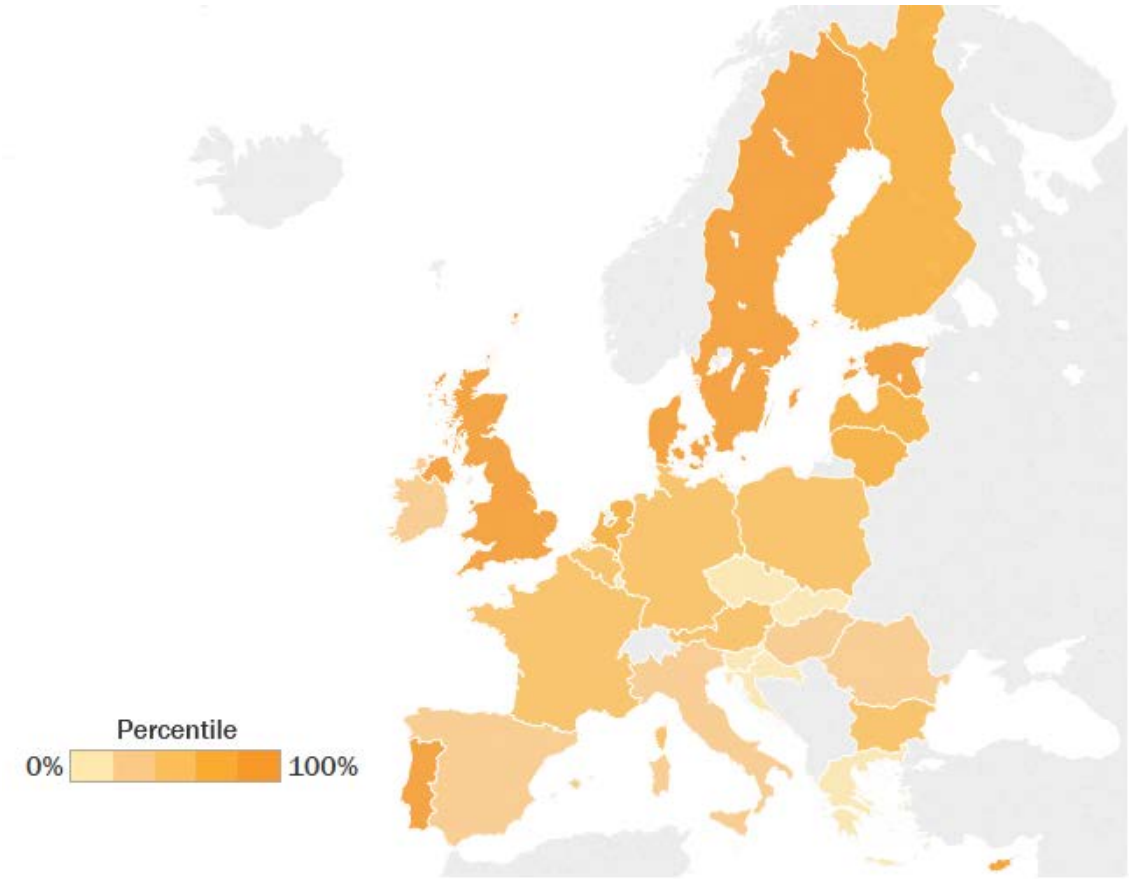
Source: Revenue information: *European Data Market Final Report: Study Dataset* (Open Evidence/IDC, May 2, 2017) http://www.datalandscape.eu/european-data-market-monitoring-tool.

2016 GDP: "Purchasing power parities (PPPs), price level indices and real expenditures for ESA 2010 aggregates" *Eurostat* [prc_ppp_ind], last updated June 29, 2017.

Table 5: Data Economy—Data Companies

Rank	Country	Percentage of GDP	Rank	Country	Percentage of GDP
1	Estonia	0.94%	15	France	0.36%
2	United Kingdom	0.62%	16	Belgium	0.35%
3	Denmark	0.58%	17	Bulgaria	0.34%
4	Cyprus	0.53%	18	Ireland	0.33%
5	Sweden	0.53%	19	Spain	0.31%
6	Portugal	0.51%	20	Italy	0.28%
7	Malta	0.50%	21	Hungary	0.28%
8	Netherlands	0.49%	22	Romania	0.27%
9	Lithuania	0.47%	23	Greece	0.26%
10	Latvia	0.47%	24	Slovakia	0.25%
11	Finland	0.43%	25	Luxembourg	0.22%
12	Germany	0.43%	26	Croatia	0.18%
13	Poland	0.42%	27	Czech Republic	0.18%
14	Austria	0.39%	28	Slovenia	0.14%

Map 5: Data Economy—Data Companies



OPEN DATA

The extent and success of member states' open data policies.

Why is this important? In addition to improving transparency and accountability in government, open data provides a large repository of freely reusable, machine-readable data that can fuel economic activity.[11] McKinsey Global Institute, the research arm of the McKinsey consultancy, estimates that open data has the potential to contribute $900 billion (€760 trillion) per year to the global economy.[12]

The rankings: The top five countries are the UK, France, Spain, Denmark, and Germany. The UK's score is well ahead of the other top-ranking countries. The UK government publishes more than 42,000 free, machine-readable datasets, and those datasets are extensively reused by third parties, including for commercial purposes, contributing to very high scores for the UK on both implementation and impact (see methodology sections for these two measurements for an explanation of what they show). France was an early adopter of open data, and the first country to appoint a national chief data officer to direct policy and strategy.[13] France ranks lower due to its much more limited supply of available datasets, though France and the UK are close in terms of impact. Spain, Denmark, and Germany show similar availability of datasets to France, but the impact of that data is less significant than in France or the UK.

The five lowest-ranking countries are Estonia, Hungary, Latvia, Poland, and Croatia. All five countries scored below average for both implementation and impact, but their impact scores were especially low. Given that government has to implement open data well before that data can have much of an impact, this stands to reason, but countries such as Spain and Austria were able to rank higher on impact nations that outperformed them on implementation. This shows that third-party users in business and civil society can still take the initiative when the national government is not doing quite as well as those in other countries, provided they have at least something to work with.

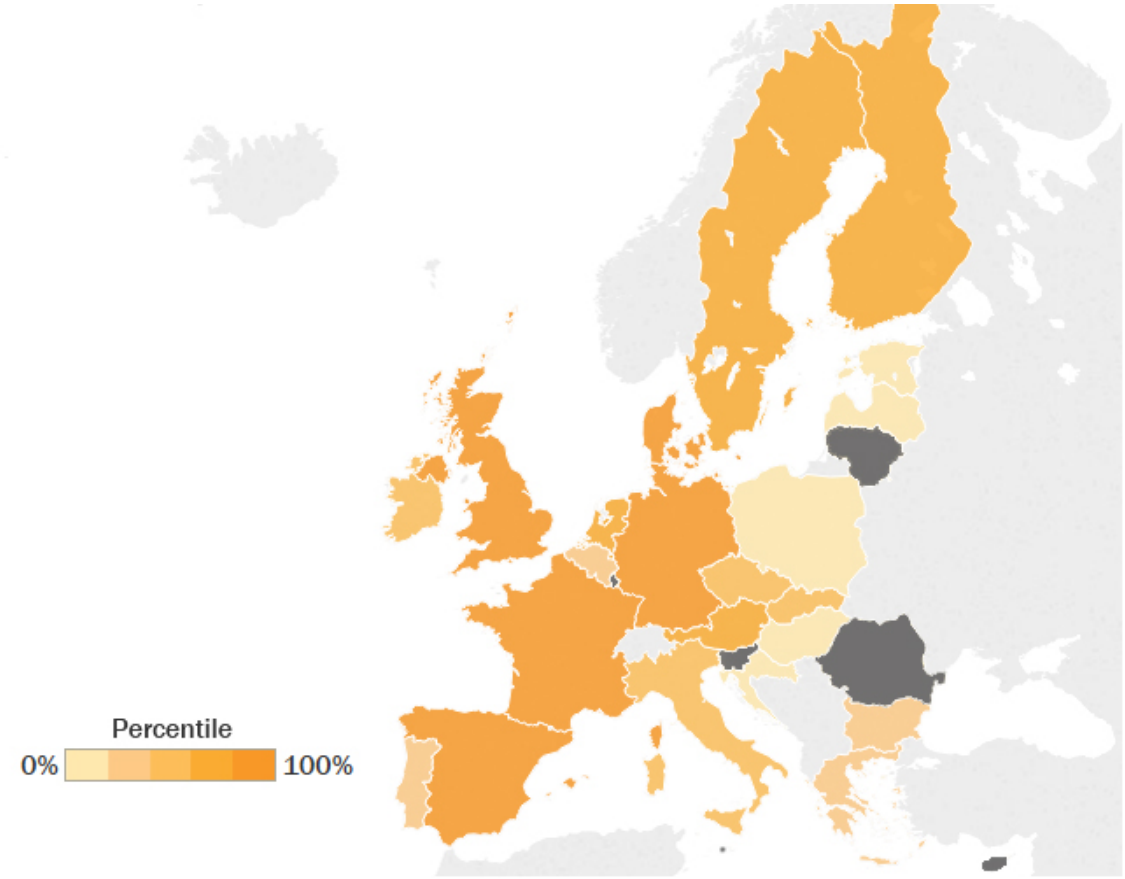
Methodology: The open data indicator is worth 20 percent of the open data category. It combines two metrics from the World Wide Web Foundation's Open Data Barometer, a dataset that measures a wide variety of open data performance indicators worldwide. The two equally-weighted measurements are implementation and impact, each is explained in its own methodology section below. Scores were not available for Cyprus, Lithuania, Luxembourg, Slovenia, or Romania. See main methodology section for an explanation of omissions and their effect on scores.

Source: *Open Data Barometer 2016 (Fourth Edition),* (World Wide Web Foundation, 2016), http://opendatabarometer.org.

Table 6: Open Data
(Data not available for Cyprus, Lithuania, Luxembourg, Slovenia and Romania)

Rank	Country	Score	Rank	Country	Score
1	United Kingdom	100.00	12	Slovakia	30.59
2	France	77.73	13	Ireland	26.81
3	Spain	69.18	14	Portugal	23.64
4	Denmark	68.69	15	Belgium	19.85
5	Germany	67.37	15	Greece	19.85
6	Austria	62.54	17	Bulgaria	19.67
7	Netherlands	62.49	18	Estonia	19.13
8	Sweden	55.26	19	Hungary	14.71
9	Finland	46.02	20	Latvia	12.50
10	Italy	37.44	21	Poland	12.23
11	Czech Republic	32.31	22	Croatia	4.26

Map 6: Open Data
(Data not available for Cyprus, Lithuania, Luxembourg, Slovenia and Romania)



OPEN DATA: IMPLEMENTATION

The extent to which government datasets are available and adhere to open data principles.

Why is this important? Implementation matters because a de jure open-data policy means little until it is put into practice. This score gauges the openness of government data—what datasets are available and how well they adhere to open data principles, such as machine-readability and open licensing.

The rankings: The top five countries are the UK, Denmark, France, Sweden, and Germany. The UK is well ahead of the others with a lead of 29 points out of 100, larger than any other gap between consecutively-ranked countries in this measurement, while the variation between the other four is extremely small: Denmark and France are tied, and less than one point separates them from Sweden, and Sweden from Germany.

No country achieved the maximum score for implementation. The UK's main shortcoming is that the majority of the datasets surveyed did not provide data identifiers for key elements—but all other member states perform poorly on this measure too, and many fail to provide this for any datasets at all. Denmark and France are well behind due to a wider variety of failings. Barely more than half of the French datasets surveyed were openly licensed and kept up-to-date. Denmark, though satisfying all standards (except identifiers) for most of its datasets, had some that were only "open" in the sense that they were available to see, but were not machine-readable, free, or reusable: including the company register, land ownership data, government-spending information, and public contracts (the latter two were not even online).

The bottom five countries are Belgium, Greece, Hungary, Croatia, and Poland. Belgium and Greece are tied, with Hungary five points behind them, and Croatia and Poland are tied in last place, a further five points behind Hungary. Only about half of Croatia's surveyed datasets were available online, none were machine-readable, only four were free of charge, and only one was openly licensed. None of the Polish datasets were openly licensed, and only a few were machine-readable or free of charge—though most were at least available online.

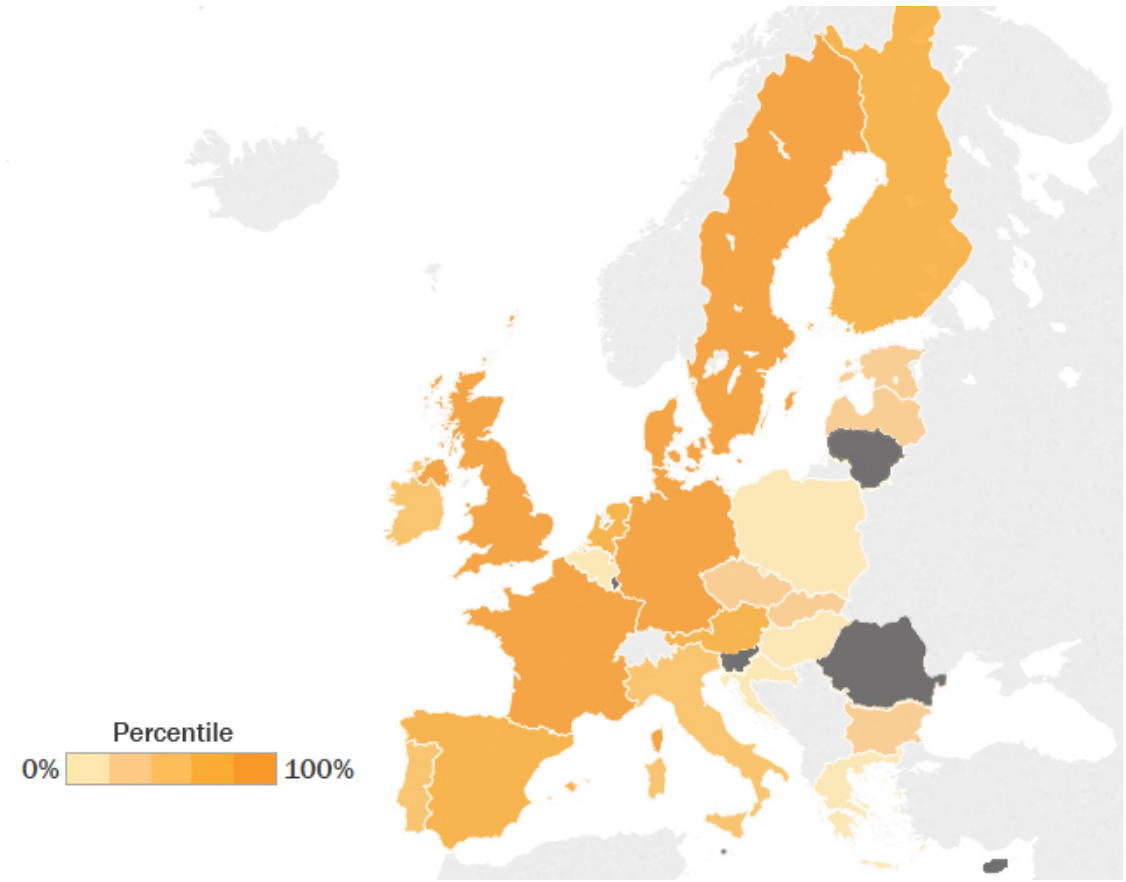
Methodology: The implementation score reflects the number and variety of datasets that government has made available as open data, and the extent to which they adhere to open data principles. The Open Data Barometer awards points based on whether 15 particular datasets exist (such as map data, land ownership data, and census data), and whether they are available online, machine-readable, available in bulk, free of charge, openly licensed, regularly kept up-to-date, and whether data identifiers were available for key elements.[14] Scores were not available for Cyprus, Lithuania, Luxembourg, Slovenia or Romania.

Source: *Open Data Barometer 2016 (Fourth Edition),* (World Wide Web Foundation, 2016), http://opendatabarometer.org.

Table 7: Open Data—Implementation
(Data not available for Cyprus, Lithuania, Luxembourg, Slovenia and Romania)

Rank	Country	Score	Rank	Country	Score
1	United Kingdom	100	12	Portugal	47
2	Denmark	71	13	Bulgaria	45
2	France	71	13	Estonia	45
4	Sweden	70	15	Czech Republic	44
5	Germany	69	16	Latvia	43
6	Netherlands	64	16	Slovakia	43
7	Finland	60	18	Belgium	38
8	Spain	58	18	Greece	38
9	Austria	56	20	Hungary	31
10	Ireland	51	21	Croatia	24
10	Italy	51	21	Poland	24

Map 7: Open Data—Implementation
(Data not available for Cyprus, Lithuania, Luxembourg, Slovenia and Romania)



OPEN DATA: IMPACT

The extent of reuse by third parties of open data published by the government.

Why is this important? This measurement matters because it measures the extent to which third parties reuse open data made available by government. Open data drives economic growth by providing the raw material for data-driven businesses models and improves government services by encouraging the transfer of best practices throughout government, and by exposing evidence of waste and corruption.[15]

The rankings: The top five countries are the United Kingdom, France, Spain, Austria, and Denmark, and the bottom five are Portugal and Bulgaria (tied), Estonia, Croatia, and Latvia.

Impact scores correlate with implementation scores—the coefficient is 0.80—but some countries managed to outperform others on impact despite weaker scores for implementation. Austria and Spain achieved only average implementation scores that were only a little higher than those of Estonia and Bulgaria. The findings suggest that simply publishing open data is insufficient: governments should encourage and promote beneficial reuses of their data, such as by funding open data research or hosting "hackathons." They should also ensure the data they publish is of good quality because third parties will struggle to make use of data that is not logically structured, accurate, and up-to-date.[16]

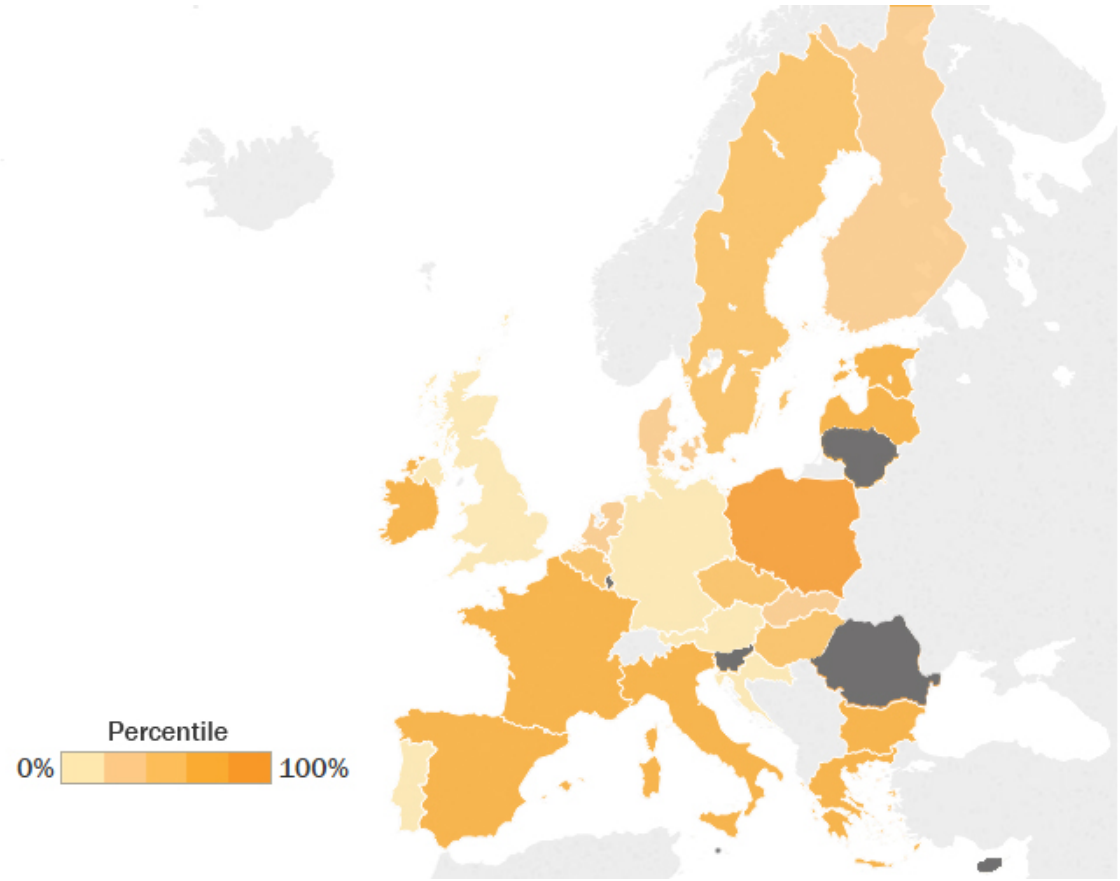
Methodology: The Open Data Barometer uses the number of reports of open data uses in the mainstream media and in academic literature as a proxy for open data's impact, and sorts impacts into three components: political, economic, and social.[17] Scores were not available for Cyprus, Lithuania, Luxembourg, Slovenia or Romania.

Source: *Open Data Barometer 2016 (Fourth Edition),* (World Wide Web Foundation, 2016), http://opendatabarometer.org.

Table 8: Open Data—Impact
(Data not available for Cyprus, Lithuania, Luxembourg, Slovenia and Romania)

Rank	Country	Score	Rank	Country	Score
1	United Kingdom	94	12	Slovakia	34
2	France	88	13	Poland	23
2	Spain	88	14	Belgium	20
4	Austria	78	14	Greece	20
5	Denmark	71	16	Hungary	19
5	Germany	71	17	Ireland	17
7	Netherlands	68	18	Portugal	16
8	Sweden	47	19	Bulgaria	11
9	Finland	42	20	Estonia	10
10	Italy	37	21	Croatia	8
11	Czech Republic	36	22	Latvia	0

Map 8: Open Data—Impact
(Data not available for Cyprus, Lithuania, Luxembourg, Slovenia and Romania)



DATA SHARING IN HEALTH CARE

The percentage of general practitioners sharing data electronically with other health-care practitioners.

Why is this important? If patient data is shared electronically, it can support innovation in health care that improves outcomes for patients and cuts costs. For example, quick access to electronic health records (EHRs) allows doctors to avoid unnecessary duplication of medical tests that have already been carried out. Clinical decision-support systems can use data in EHRs to avoid clinical errors, such as alerting medical staff to a drug the patient has shown a bad reaction to in the past.[18] Furthermore, EHRs create a rich information base for medical research.[19]

The rankings: The top five countries are Denmark, the Netherlands, Estonia, Finland, and Spain. Denmark leads by a very wide margin; 91.82 percent of GPs in Denmark were sharing data electronically, compared to 76.19 percent in the Netherlands, 72.00 percent in Estonia, 66.81 percent in Finland, and 63.60 percent in Spain. The corresponding figures for the lowest ranking countries—Poland, Croatia, Bulgaria, Slovakia, and Slovenia—were 5.40 percent in Slovenia, 7.45 percent in Slovakia, 8.67 percent in Bulgaria, 10.80 percent in Croatia and 10.95 percent in Poland.

As with other variables, the top five are noticeably wealthier than the bottom five, but the correlation between GDP per capita and the rate of electronic data sharing is only 0.25. However, all of the bottom nine in ranking are post-communist countries (there are only 11 in the EU, excluding reunified Germany, which in any case also performed well below average). This suggests that a history of under-resourced public services impacts e-health performance today, although as with several other indicators in this report, Estonia overcomes such challenges, achieving third place.

There is a correlation of 0.66 between this variable and the use of e-government services (see table 28). Four of the top five (Denmark, the Netherlands, Estonia and Finland) also perform very well on e-government, and three of the bottom five (Poland, Croatia, and Bulgaria) perform particularly badly on that indicator. Spain scored about average on e-government, while Slovakia and Slovenia scored just below average. This suggests a possible link between data-sharing in health care and the wider digitization of public services.

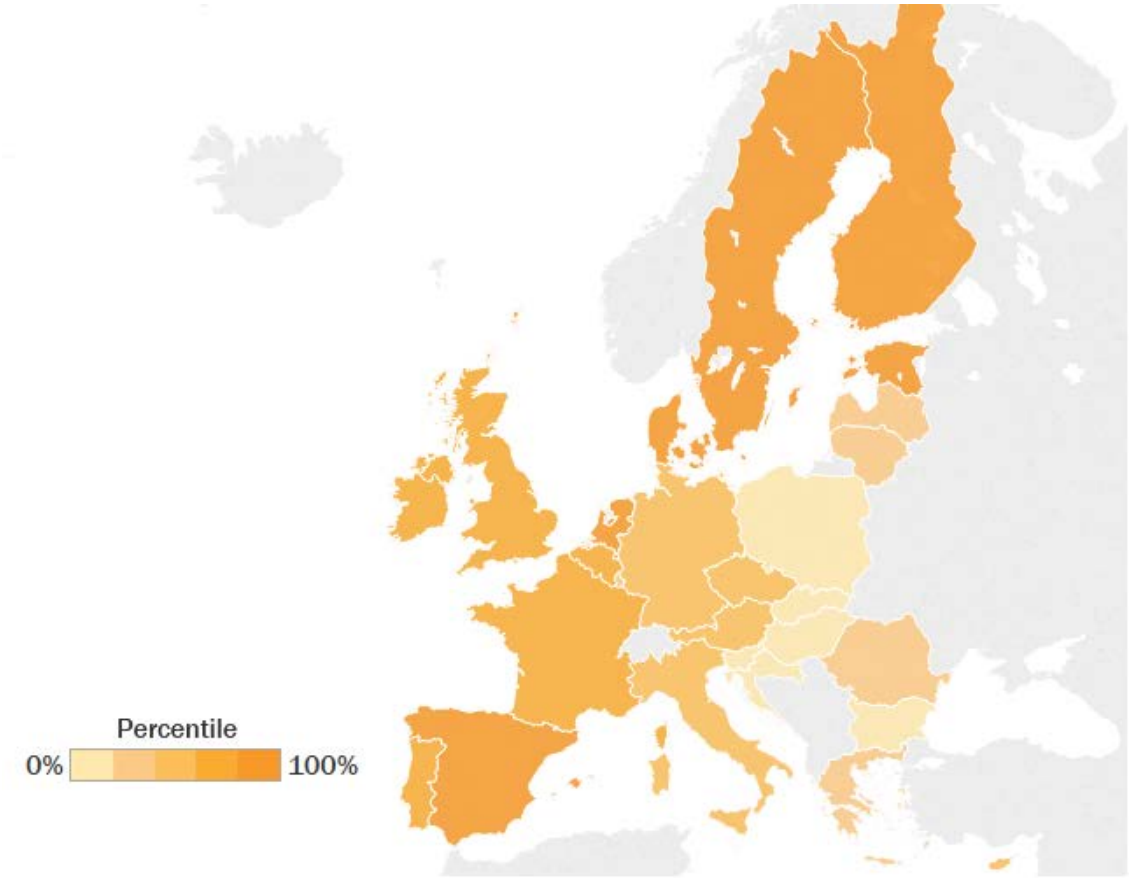
Methodology: The data sharing in health care indicator is based on the percentage of general practitioners (GPs) sharing data electronically with other health-care providers and professionals. It is worth 20 percent of the data category.

Source: *Digital scoreboard* (European Commission, 2013), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 9: Data Sharing in Health Care

Rank	Country	Percentage	Rank	Country	Percentage
1	Denmark	91.82%	15	Germany	23.85%
2	Netherlands	76.19%	16	Czech Republic	23.35%
3	Estonia	72.00%	17	Malta	18.00%
4	Finland	66.81%	18	Luxembourg	17.81%
5	Spain	63.60%	19	Greece	16.88%
6	Sweden	55.96%	20	Romania	15.92%
7	United Kingdom	52.76%	21	Latvia	12.99%
8	Portugal	42.87%	22	Lithuania	12.25%
9	Belgium	39.42%	23	Hungary	11.96%
10	France	39.42%	24	Poland	10.95%
11	Ireland	37.02%	25	Croatia	10.80%
12	Italy	31.24%	26	Bulgaria	8.67%
13	Austria	28.80%	27	Slovakia	7.45%
14	Cyprus	24.00%	28	Slovenia	5.40%

Map 9: Data Sharing in Health Care



FREEDOM OF INFORMATION

The extent to which citizens can demand and receive specific information from government

Why is this important? This indicator measures how easily citizens can demand that government release data into the public domain. Freedom-of-information laws are important to data innovation because they require public administrations to make public potentially valuable information. This indicator considers the law as an indication of rights in principle, and corruption as an indication of how effectively the law rules within bureaucracies.

The rankings: The top five countries are Finland, Slovenia, the United Kingdom, Sweden, and Croatia. All five have high right-to-information (RTI) scores, indicating robust freedom-of-information laws. Finland, Sweden, and the UK also had high Corruption Perceptions Index (CPI) scores, indicating low levels of corruption, and suggesting stronger rule of law in public institutions.

Slovenia exhibits the highest RTI score in the EU, but its CPI score was below the EU average. Neighboring Croatia has the EU's second-highest RTI score, but is in 22nd place for CPI. A third former Yugoslav state, Serbia—which is not currently a member of the EU, but is a candidate for membership—has the highest RTI rating in Europe, and the second-highest in the world (after Mexico), but has a lower CPI score than any EU member state. In fact, all the other countries of the former Yugoslavia—Bosnia and Herzegovina, Montenegro, Macedonia, and Kosovo—also exhibit very high RTI scores, but low CPI scores. The same is true of Romania, Bulgaria, and Albania, leaving Greece as only country in the Balkans to score below the EU average for both RTI and CPI.

Sweden—which has the oldest freedom-of-information law in the world, the Freedom of the Press Act 1766—had a lower RTI score than Croatia, Ireland (sixth place for freedom of information) and Estonia (eighth), but achieved a higher rank than all three due to lower corruption, which is also why Estonia ranked behind Ireland, despite its RTI score being higher. Finland, in first place, had the third-highest RTI score, after Slovenia and Croatia, and the second-highest CPI score after Denmark, which ranked ninth due to its mediocre RTI score.

The bottom five countries are Slovakia, Austria, Greece, Luxembourg, and Cyprus. Neither Cyprus nor Luxembourg has functioning freedom-of-information laws. Cyprus ranked last due to low scores on both RTI and CPI. Luxembourg's CPI score, however, was high: it tied for fifth for CPI alongside Germany and the United Kingdom, but Luxembourg ranked below countries with far higher levels of corruption due to its total lack of freedom-of-information law.

Methodology: This indicator is worth ten percent of the data category, and comprises two weighted measurements. One is the right-to-information (RTI) rating provided by Access Info and the Center for Law and Democracy, worth 70 percent of the score for this indicator. The other is Transparency International's corruption perceptions index (CPI), weighted 30 percent. The RTI score is a measurement of good law, while the CPI score is a proxy for the rule of law.

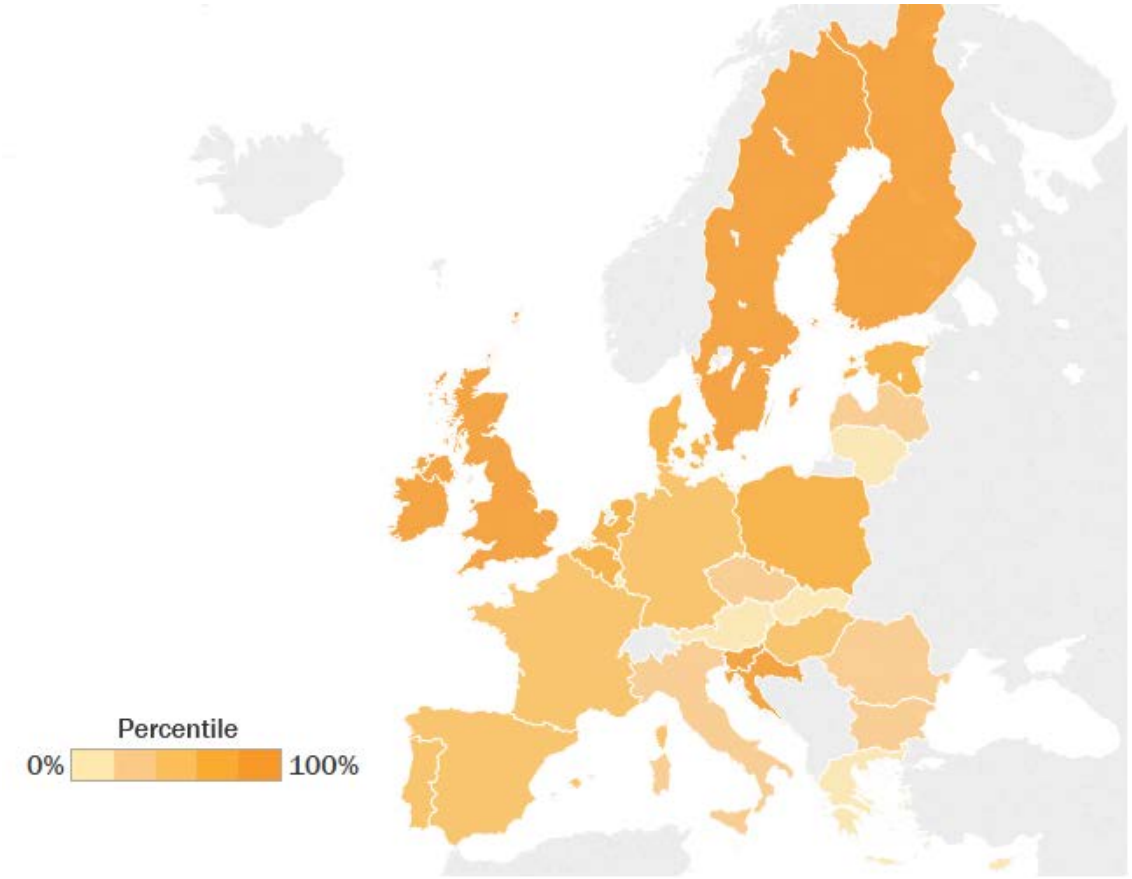
Source: *Global Right to Information Rating* (Access Info/Center for Law and Democracy), http://www.rti-rating.org/country-data/, accessed September 25, 2017.

Corruption Perceptions Index 2016 (Transparency International, January 25, 2017), https://www.transparency.org/news/feature/corruption_perceptions_index_2016.

Table 10: Freedom of Information

Rank	Country	Score	Rank	Country	Score
1	Finland	86.36	15	Hungary	51.50
2	Slovenia	82.24	16	Malta	50.90
3	United Kingdom	78.75	17	Spain	50.02
4	Sweden	78.70	18	Italy	49.80
5	Croatia	73.27	19	Bulgaria	49.38
6	Ireland	71.14	20	Romania	49.32
7	Netherlands	70.21	21	Latvia	48.87
8	Estonia	69.85	22	Czech Republic	47.64
9	Denmark	64.73	23	Lithuania	45.75
10	Poland	55.73	24	Slovakia	43.02
11	Belgium	54.06	25	Austria	38.72
12	Germany	53.79	26	Greece	37.11
13	Portugal	52.47	27	Luxembourg	24.49
14	France	51.87	28	Cyprus	4.29

Map 10: Freedom of Information



FREEDOM OF INFORMATION: RIGHT TO INFORMATION

Legal guarantees of citizens' rights to access information held by government.

Why is this important? The right-to-information (RTI) score assesses the extent to which the law guarantees citizens the rights to obtain information from government. This is important because freedom of information cannot function without such legal guarantees and rights.

The rankings: The top five countries are Slovenia, Croatia, Finland, the UK, and Estonia. Finland's freedom-of-information laws exhibit all of the following qualities: its constitution protects the right of citizens to access information; there is specific legislation to operationalize that right, and the rights conferred by that law are very broad and highly inclusive; there are no fees for freedom-of-information requests or for explanations of refusals, and the maximum waiting period is below the EU's standard of 15 days (14 days in Finland's case); there are no unusual or excessively vague exceptions to the law; and there is independent oversight. For the most part, the same can be said of Slovenia and Croatia, but it is notable that Slovenia, despite its higher RTI score, charges for freedom-of-information requests and has a maximum waiting period of 20 days (Croatia's is 15, on par with EU standards).

The bottom five are Belgium, Germany, Austria, and—tied—Cyprus and Luxembourg. Cyprus and Luxembourg have no functioning freedom-of-information laws, so Access Info and the Center for Law and Democracy excluded them from the RTI rankings altogether. For the purposes of this study, we have allocated RTI scores of zero. In theory, the constitution of Cyprus does confer a right to access information, but this right is not operationalized in legislation.

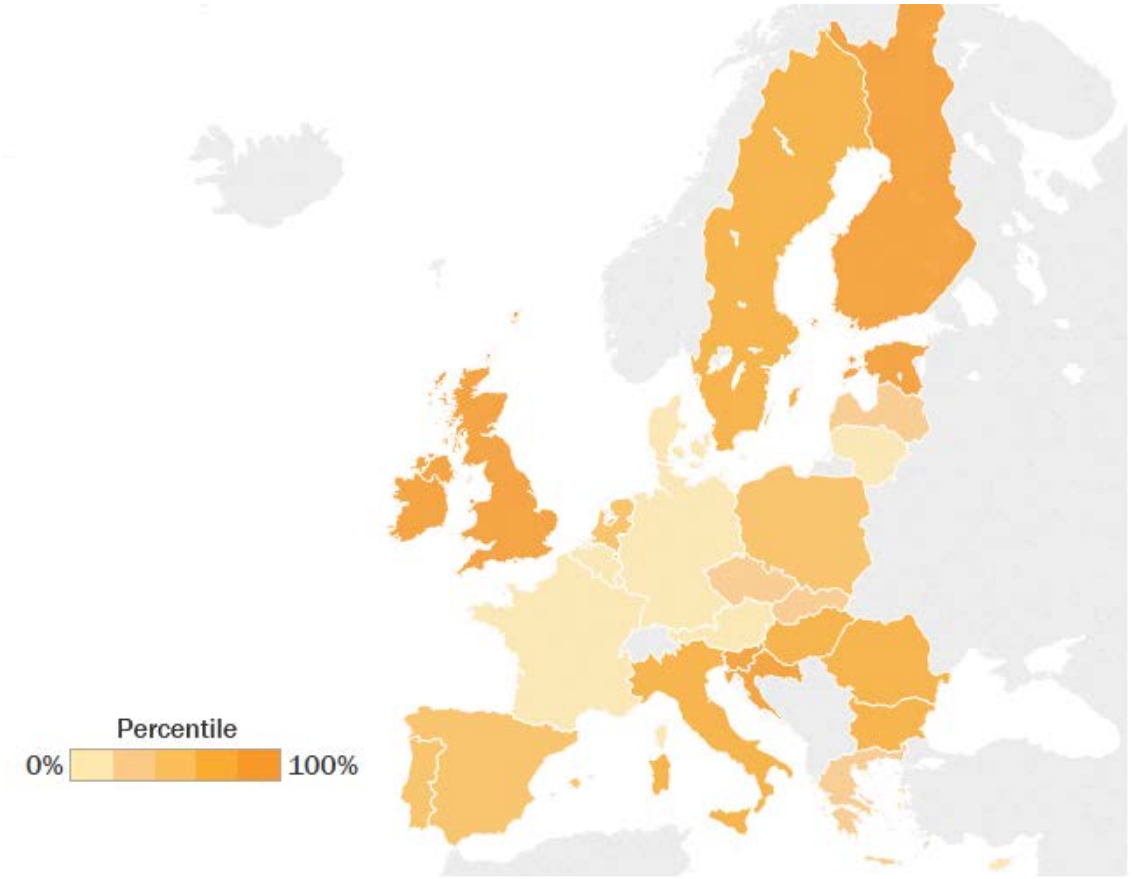
Methodology: The RTI score is a broad assessment of what protections for freedom of information exist in the law.

Source: *Global Right to Information Rating* (Access Info/Center for Law and Democracy), http://www.rti-rating.org/country-data/, accessed September 25, 2017.

Table 11: Freedom of Information—Right to Information

Rank	Country	Score	Rank	Country	Score
1	Slovenia	129	15	Portugal	73
2	Croatia	126	15	Spain	73
3	Finland	105	17	Czech Republic	72
4	United Kingdom	100	17	Latvia	72
5	Estonia	96	19	Slovakia	68
6	Ireland	95	20	Greece	65
7	Sweden	92	21	Denmark	64
8	Bulgaria	91	21	France	64
9	Hungary	87	21	Lithuania	64
10	Italy	85	24	Belgium	59
11	Romania	83	25	Germany	54
12	Netherlands	82	26	Austria	33
13	Poland	79	27	Cyprus	0
14	Malta	78	27	Luxembourg	0

Map 11: Freedom of Information—Right to Information



FREEDOM OF INFORMATION: CORRUPTION

The extent to which member states are free from corruption.

Why is this important? Indicators of high corruption suggest weak institutions and inadequate rule of law within government and its bureaucracy. This is important because even if freedom-of-information laws appear robust on paper, high levels of corruption in the state can render them a matter of theory rather than practice.

The rankings: The top five countries—that is, the least perceptibly corrupt—are Denmark, Finland, Sweden, the Netherlands, and Germany. The bottom five—those where perceptions of corruption are highest—are Hungary, Romania, Italy, Greece, and Bulgaria.

Though this is one of the lowest-weighted measurements in the study, corruption correlates very strongly with the overall scores, with a positive coefficient of 0.88. Data—particularly that released through open data and freedom of information—can help to expose some types of corruption by exposing evidence of it.[20] In addition to the direct savings and economic benefits that result from reduced corruption, data openness and transparency also help to reduce the cost of investigating corruption in the first place, by making it easier for investigators to find and analyze relevant information.[21] However, corruption is a complex problem and open data is only one tool among many. It is not the solution. The correlation between the corruption scores and the open data scores is modest, with a coefficient of 0.6.

Key mechanisms for preventing corruption are as likely to be indicators of attempts to tackle endemic corruption as indicators of good practice and clean government. Similarly, the absence of such mechanisms could just as easily suggest complacency in a clean state as in a corrupt one. For example, a Transparency International report on the enforcement of the OECD convention on combatting foreign bribery reports that Bulgaria showed "little or no enforcement," but so did Denmark. Similarly, Greece and Hungary showed only "limited enforcement," but the same is true of the Netherlands and Sweden. Both Finland and Italy showed "moderate enforcement." Only two EU countries—Germany and the UK—showed "active enforcement." Romania, Lithuania, and Croatia are not signatories to the convention.[22] Transparency International also reports that Bulgaria and Greece have "none or very limited" legal protections for whistleblowers, but the same is true of high-ranking Finland. Conversely, Romania has very strong protections for whistleblowers—but in early 2017, government attempts to weaken anti-corruption laws sparked the largest protests in Romanian history.[23]

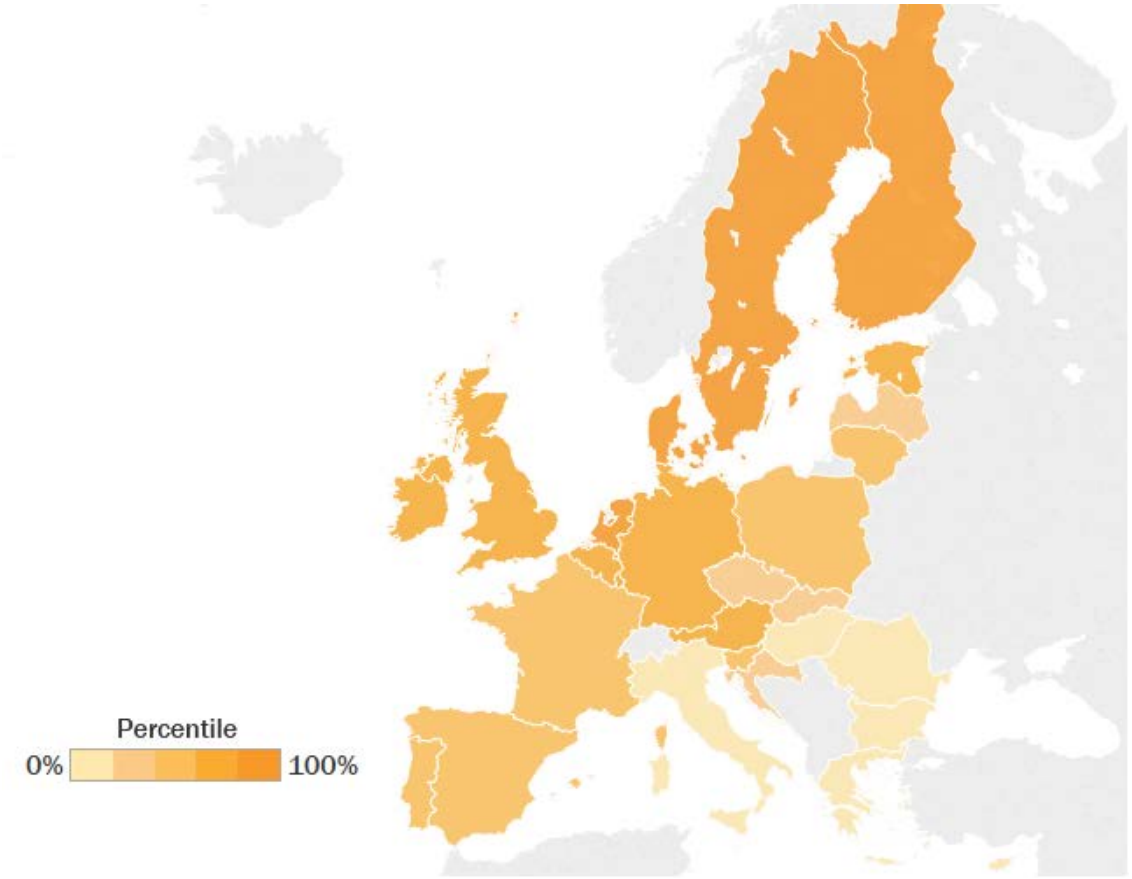
Methodology: The CPI score awards lower scores to countries perceived to be more corrupt, and higher scores to those perceived to be less corrupt. "Perceptions" are a more-reliable measure of corruption than proven cases, because corruption generally happens in secret, and is more likely to be uncovered and proven in less corrupt societies than in very corrupt ones.

Source: *Corruption Perceptions Index 2016* (Transparency International, January 25, 2017), https://www.transparency.org/news/feature/corruption_perceptions_index_2016.

Table 12: Freedom of Information—Corruption

Rank	Country	Score	Rank	Country	Score
1	Denmark	90	15	Slovenia	61
2	Finland	89	16	Lithuania	59
3	Sweden	88	17	Spain	58
4	Netherlands	83	18	Latvia	57
5	Germany	81	19	Czech Republic	55
5	Luxembourg	81	19	Malta	55
5	United Kingdom	81	21	Slovakia	51
8	Belgium	77	22	Croatia	49
9	Austria	75	23	Cyprus	48
10	Ireland	73	23	Hungary	48
11	Estonia	70	23	Romania	48
12	France	69	26	Italy	47
13	Poland	62	27	Greece	44
13	Portugal	62	28	Bulgaria	41

Map 12: Freedom of Information—Corruption



PROTECTIONS AGAINST LIBEL CHILL

How well member states' legal systems prevent defamation law from chilling freedom of speech.

Why is this important? Libel chill is where fear of defamation law deters people from publishing honest opinions or information. It impacts the availability of data in two ways. First, useful datasets may accompany scientific works that authors or publishers withhold.[24] Second, libel chill deters people from expressing themselves online in a way that might otherwise generate valuable data. For example, if restaurants threaten legal action against people who leave disparaging reviews online, then this will skew aggregate review data in the restaurant's favor.[25] Safeguards against libel chill does not provide a license to defame: businesses that are subject to malicious and false accusations in online reviews still have adequate legal recourse.

The rankings: The top five countries are Finland, the Czech Republic, Slovakia, Latvia, and Estonia, and the bottom five are Greece, the Netherlands, Germany, Malta, and Portugal. Overall, the risk of libel chill is very high in all but the few top-ranking countries. As the strongest-weighted measurement, legal safeguards naturally had the greatest impact on the rankings, and details of these safeguards are in the following section. However, the other measurements had an important influence in several countries. For example, Slovakia ranked higher than Latvia despite equal legal protections and higher court fees, because Slovakia has no laws against insulting particular "special plaintiffs" (see methodology).

Methodology: This indicator is worth ten percent of the data category, and comprises three measurements:

- Legal safeguards (weighted 50 percent): Statutory protections for free speech in defamation cases. This considers how likely a defendant is to win when telling the truth. We gave a score based on a series of questions about defamation law (listed in the following section).
- Costs (weighted 30 percent): The cost of fighting a case can cause libel chill for those who cannot afford it, whatever the chances of a successful defense. Unfortunately, detailed information on lawyers' fees and defamation cases were unavailable for all EU member states, so we used court fees in divorce cases as a rough proxy.
- Special plaintiffs (weighted 20 percent): This measures the extent to which certain individuals or institutions have special privileges in defamation law, thereby intensifying the threat of libel chill with regard to written statements concerning them. The fewer special plaintiffs, the higher the score. (See special plaintiffs section for a full list).

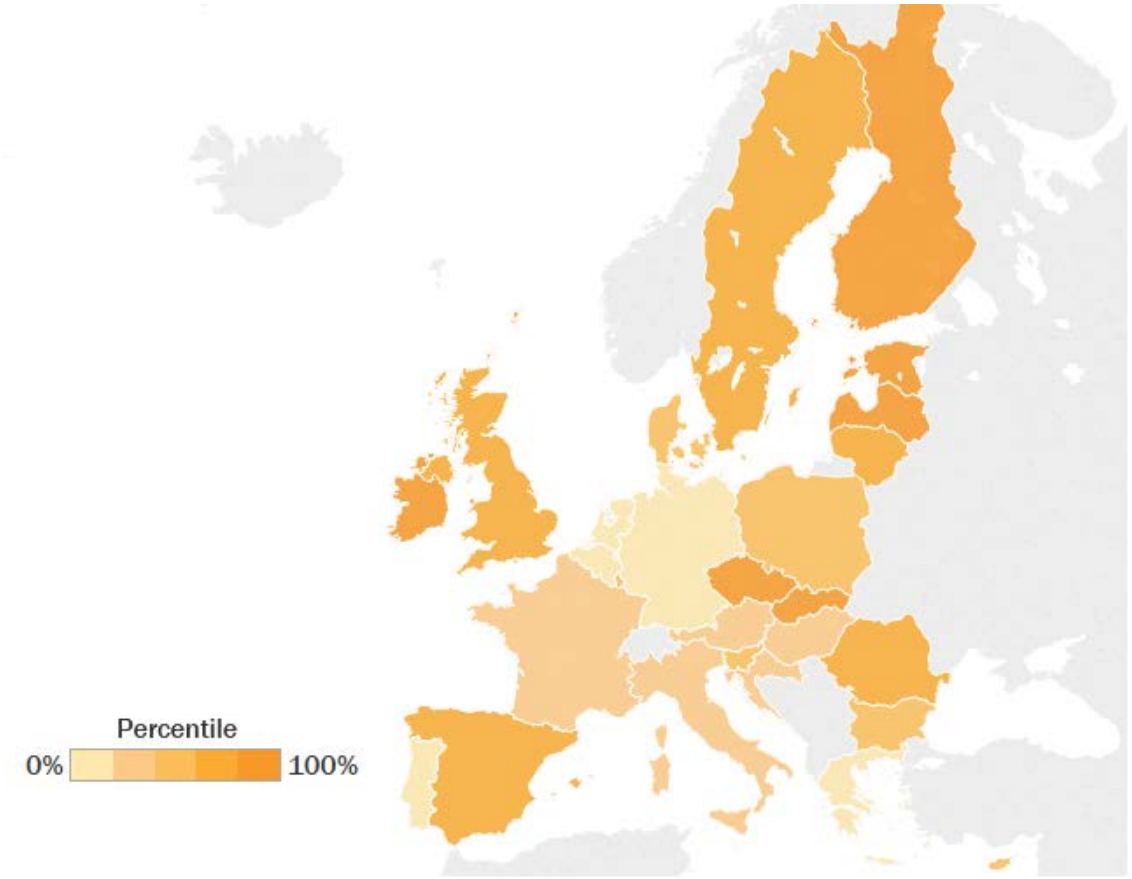
Source: Information on legal safeguards and special plaintiffs: *Media Laws Database: Defamation Laws in Europe 2016-2017,* (International Press Institute), http://legaldb.freemedia.at/defamation-laws-in-europe/, accessed September 25, 2017, and member state legislation.

Costs: *Study on the Transparency of Costs of Civil Judicial Proceedings in the European Union*, page 59 (Demolin Brulard Barthelemy for the European Commission, 2007), https://e-justice.europa.eu/content_costs_of_proceedings-37-en.do.

Table 13: Protections Against Libel Chill

Rank	Country	Score	Rank	Country	Score
1	Finland	87.18	15	Austria	41.73
2	Czech Republic	85.08	16	Denmark	41.50
3	Slovakia	82.67	17	Cyprus	40.79
4	Latvia	81.50	18	Bulgaria	40.05
5	Estonia	78.91	19	France	38.27
6	Ireland	75.79	20	Croatia	38.10
7	Lithuania	66.56	21	Hungary	37.76
8	Romania	60.83	22	Italy	34.10
9	Spain	56.60	23	Belgium	32.14
10	Sweden	53.23	24	Greece	29.28
11	United Kingdom	47.50	25	Netherlands	24.58
12	Poland	45.83	26	Germany	19.07
13	Luxembourg	43.24	27	Malta	4.47
14	Slovenia	41.93	28	Portugal	2.92

Map 13: Protections Against Libel Chill



PROTECTIONS AGAINST LIBEL CHILL: LEGAL SAFEGUARDS

The strength of legal protections against malicious accusations of defamation.

Why is this important? Without robust legal safeguards, defamation law can become a tool to suppress information, opinion, and associated data.

The rankings: The top five countries—those with the strongest safeguards—are Finland, the Czech Republic, Latvia, Slovakia, and Estonia. Finland lost points on only one matter: defamation is a crime in Finland (as it is in all EU countries other than Cyprus, Estonia, Romania, the United Kingdom and—with the exception of criminal blasphemy—Ireland). However, Finland does not allow private lawsuits to be pursued alongside criminal cases. Furthermore, the truth is always an absolute defense in Finnish libel cases, and the burden of proof is on the prosecution, not the defense (the prosecution does not have to prove a negative, but it cannot win simply by challenging the defense to prove something). Insults do not count as defamation—only lies do. Under these conditions, it would be extremely difficult to suppress information or opinion in Finland using the threat of a libel suit. Legal safeguards in the Czech Republic, Slovakia, and Latvia are similar to those of Finland, but private prosecutions are possible independently of criminal ones. In Estonia, however, the burden of proof is on the defendant. The bottom five countries are Greece, Hungary, Malta, the Netherlands, and Portugal. In all five, and in several higher-ranking countries, neither the truth, nor the public interest, nor honest opinion, are absolute defenses against charges of defamation

Methodology: We scored countries out of 18 points based on the following questions:

- Is defamation a criminal offense?
    - If yes, are civil cases possible independently of criminal ones?
- Is the truth a statutory defense?
    - If yes, is the burden of proof on the defendant?
- Is the public interest a statutory defense?
- Do insults count as defamation?
- Is fair comment or honest opinion a statutory defense?
    - If yes, does the defendant have to prove it was an opinion and not an assertion of fact?

We gave two points for each "good" answer (such as if defamation is not a criminal offense) and zero for each "bad" answer (such as if the burden of proof is on the defendant). We gave one point for ambiguities or mitigating factors (for example, in Slovakia, need to prove they had reason to believe what they said, but they do not have to prove it was true).

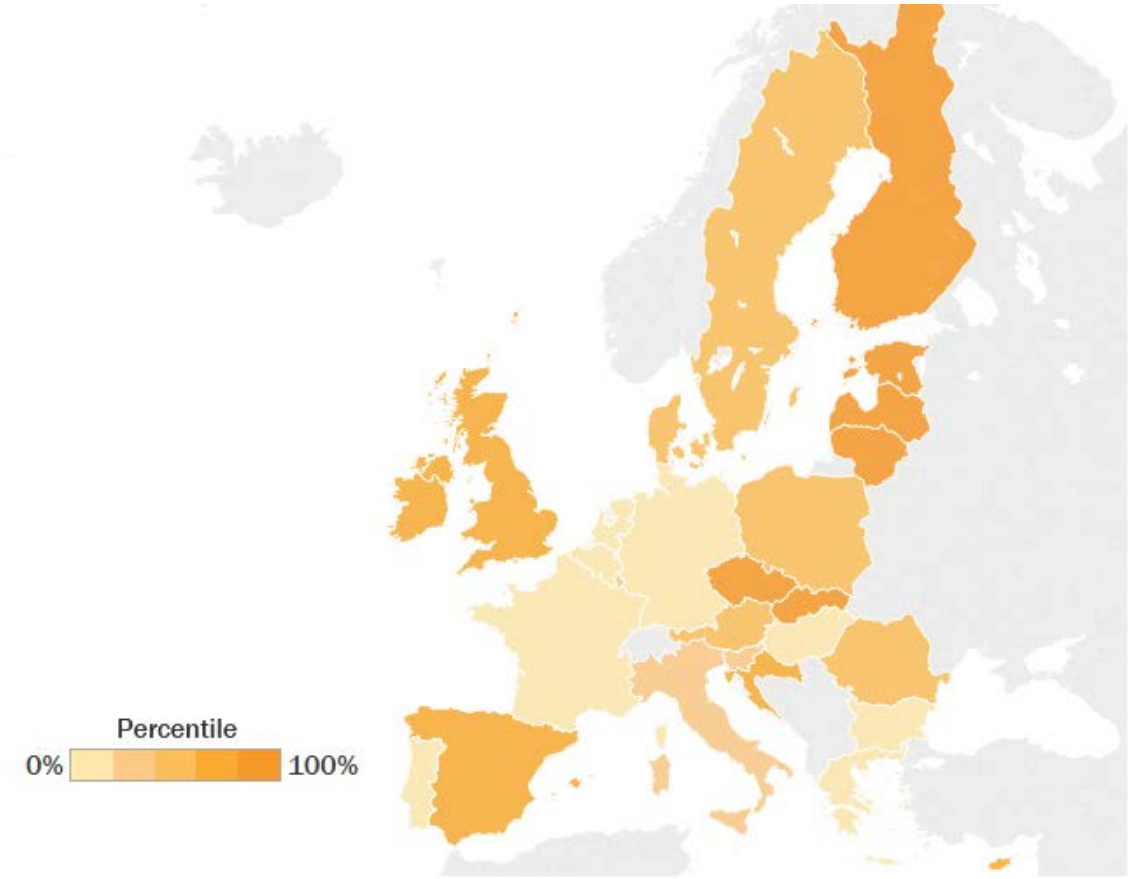
Source: *Media Laws Database: Defamation Laws in Europe 2016-2017,* (International Press Institute), http://legaldb.freemedia.at/defamation-laws-in-europe/, accessed September 25, 2017.

Member state legislation.

Table 14: Protections Against Libel Chill—Legal Safeguards

Rank	Country	Score	Rank	Country	Score
1	Finland	14	12	Romania	5
2	Czech Republic	12	12	Sweden	5
2	Latvia	12	17	Luxembourg	4
2	Slovakia	12	17	Slovenia	4
5	Estonia	11	19	Italy	3
6	Lithuania	10	20	Belgium	2
7	Cyprus	9	20	Bulgaria	2
7	Ireland	9	20	France	2
7	United Kingdom	9	20	Germany	2
10	Croatia	6	20	Greece	2
10	Spain	6	20	Hungary	2
12	Austria	5	20	Malta	2
12	Denmark	5	20	Netherlands	2
12	Poland	5	20	Portugal	2

Map 14: Protections Against Libel Chill—Legal Safeguards



PROTECTIONS AGAINST LIBEL CHILL: COSTS

The approximate cost of going to court in each member state.

Why is this important? High legal costs intensify the threat of libel chill even if legal safeguards are relatively strong, because the sheer cost of going to court can be enough to deter people from speech that may provoke a lawsuit, and to pressure defendants to settle and issue a retraction, even if they are otherwise confident of winning the case.

The rankings: The top countries are Poland and Romania, tied for-first, followed by Ireland, France, and Italy: in all five countries, court fees were virtually zero. As such, fees are merely a rough proxy; this does not mean one can defend oneself against a libel suit at no expense. For example, lawyers are often very expensive to hire. However, these findings are an indicator that costs are lower in these countries than in others.

The bottom five countries are Germany, Cyprus, Portugal, Malta, and the UK, with indicative court fees ranging from €250 in Germany to €500 in the UK—but once again, the actual the costs are likely to be far higher than this. Nevertheless, the UK is notorious for its expensive courts and lawyers, raising the risk of libel chill in that country.[26] Criticism of English libel laws—including from the United Nations—led to legal reforms in 2013 that did away with criminal defamation, required proof of harm from plaintiffs, and somewhat strengthened statutory defenses.[27] But the new laws did not address legal costs, and innocent defendants still have much to prove if the case gets to court.

Methodology: This measurement uses data on the cost of divorce cases as a proxy for the cost of going to court, controlled for national GDP per capita in 2007, the year for which cost data was available. There are two important caveats. First, the original source presents the data visually, not in raw figures, and some amounts appear to be token (for example, €1 instead of €0) and readers should interpret these as approximations, not fixed costs. Second, the actual cost of libel cases is likely to be far higher than these proxies, not least because the bulk of the cost comes not from court fees, but from lawyers' fees.

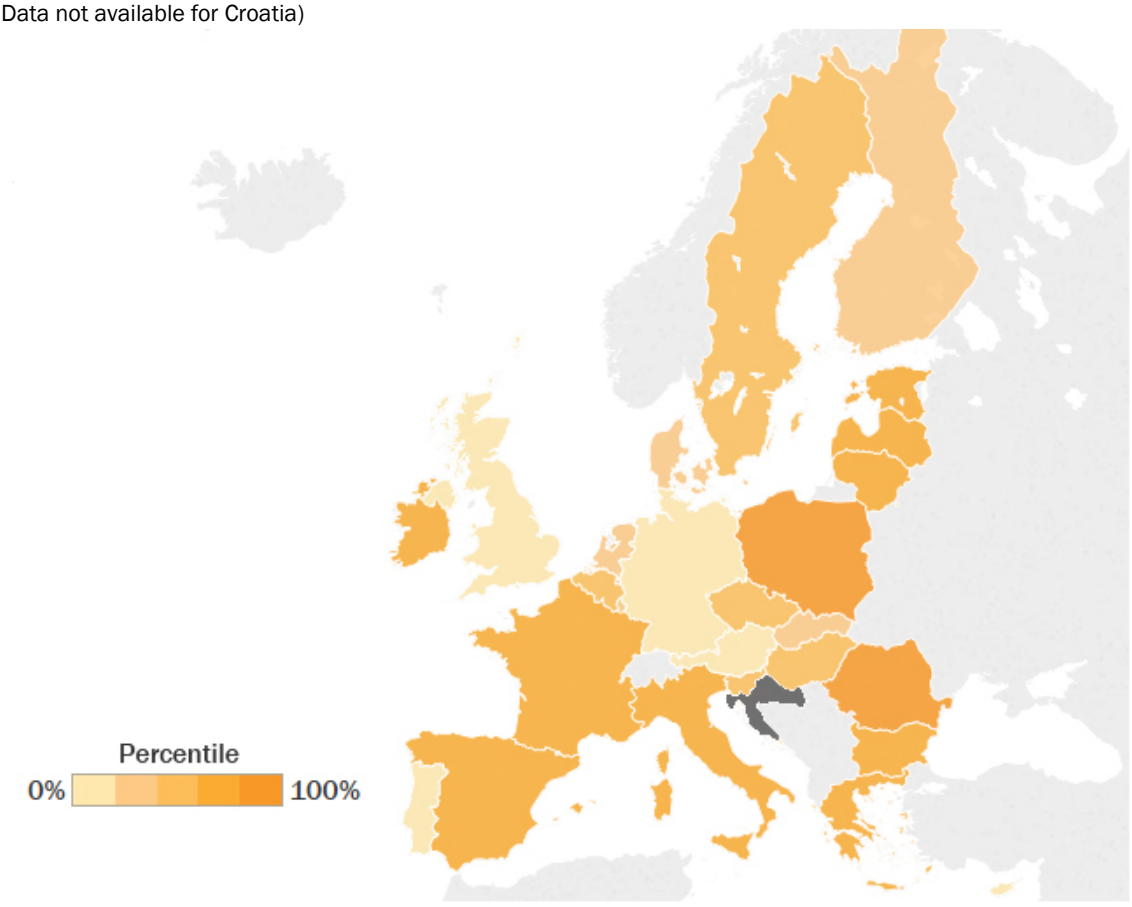
Cost data was not available for Croatia.

Source: *Study on the Transparency of Costs of Civil Judicial Proceedings in the European Union*, page 59 (produced by Demolin Brulard Barthelmy for the European Commission, 2007), https://e-justice.europa.eu/content_costs_of_proceedings-37-en.do.

Table 15: Protections Against Libel Chill—Costs
(Data not available for Croatia)

Rank	Country	Percentage of GDP per Capita	Rank	Country	Percentage of GDP per Capita
1	Poland	0.00%	15	Bulgaria	0.19%
1	Romania	0.00%	16	Latvia	0.20%
3	Ireland	0.00%	17	Denmark	0.25%
4	France	0.00%	18	Hungary	0.32%
5	Italy	0.00%	19	Finland	0.35%
6	Spain	0.00%	20	Netherlands	0.50%
7	Lithuania	0.01%	21	Slovakia	0.52%
8	Greece	0.04%	22	Austria	0.62%
9	Luxembourg	0.10%	23	Germany	0.82%
10	Estonia	0.11%	24	Cyprus	1.44%
11	Sweden	0.15%	25	Portugal	1.56%
12	Belgium	0.16%	26	Malta	1.66%
13	Slovenia	0.18%	27	United Kingdom	1.72%
14	Czech Republic	0.19%			

Map 15: Protections Against Libel Chill—Costs
(Data not available for Croatia)



PROTECTIONS AGAINST LIBEL CHILL: SPECIAL PLAINTIFFS

The extent to which member states' defamation laws treat all would-be plaintiffs as equals.

Why is this important? Provisions for special plaintiffs exacerbate the libel chill effect created by poor safeguards and high costs, because they direct criticism away from particular individuals, groups, or ideas.

The rankings: The top five—those with the fewest special plaintiffs—are Slovakia, Romania and the UK, tied for second, and the Czech Republic and Ireland, tied for fourth. Slovakia scored the maximum possible score, because there are no special plaintiffs in the Slovak Republic. The UK was just one point behind, because although the Westminster Parliament abolished the blasphemy law in 2008, blasphemy remains a crime in Northern Ireland. Similarly, Romania dropped just one point because although its criminal code contains no specific laws against insulting the state or its symbols, the Romanian constitution does ostensibly prohibit this (Romania and the UK are equal on the special plaintiffs measurement). Ireland lost two full points, because like in Northern Ireland, blasphemy is illegal throughout the republic.

The bottom five countries—those with the most special plaintiffs—are Poland, Germany, Greece, Italy, and Portugal. Portugal, Italy, and Greece have laws against insulting every special plaintiff we checked for: public officials, the head of state, the state and its symbols, foreign states and their symbols, officials, and heads of state, the dead, as well as gods and religions. Polish law permits insulting the dead, but none of the others. In 2017, Germany repealed its laws against insulting foreign heads of state, but insults against the rest remain illegal.

Methodology: Countries were scored out of 12 based on whether or not they had laws against defaming the following: public officials; the head of state; the state or state symbols; foreign states, foreign state symbols, foreign heads of state or foreign diplomatic officials; dead people; or gods or religions.

We gave a score of two points for the absence of each such law and zero for the presence of it. We gave one point where there are important ambiguities or mitigating factors in the law. For example, Article 30(7) of Romania's constitution says defamation of the state or the nation shall be prohibited by law, but there are no specific measures against such defamation in the Romanian penal code.

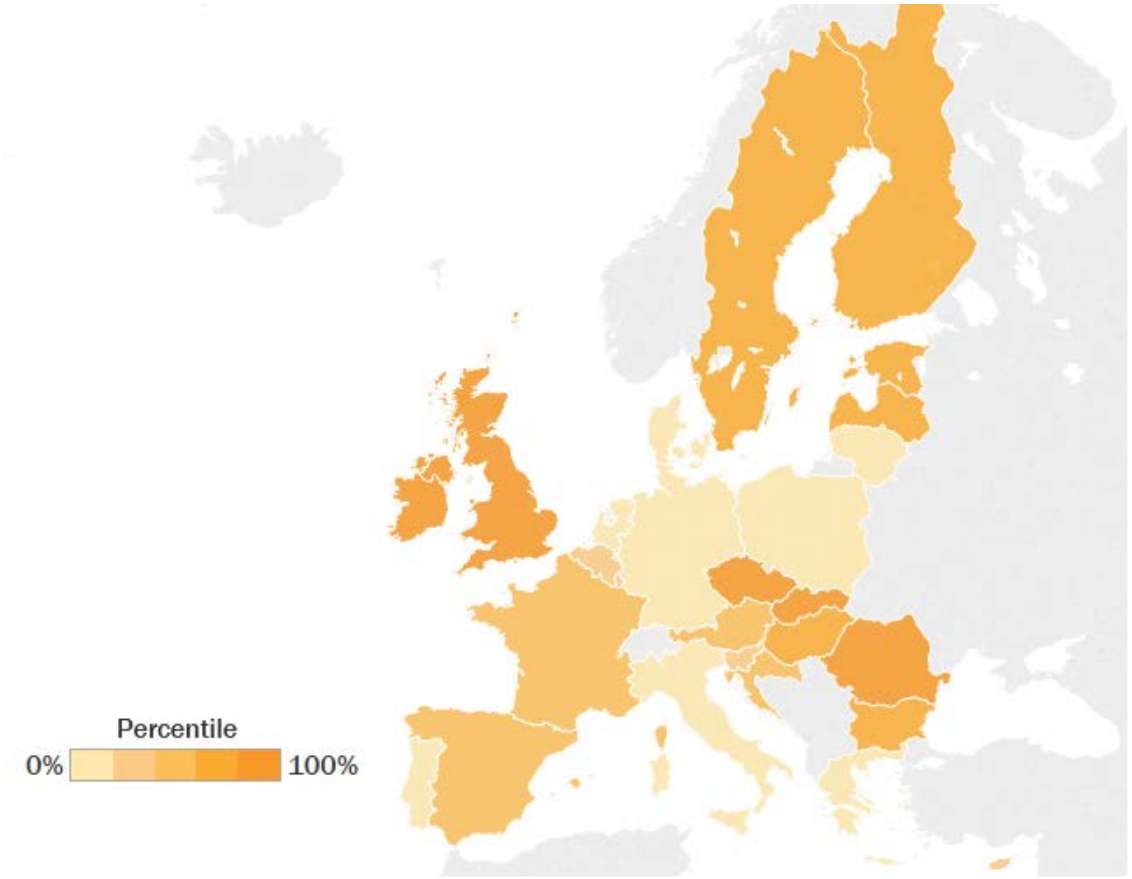
Source: *Media Laws Database: Defamation Laws in Europe 2016-2017,* (International Press Institute), http://legaldb.freemedia.at/defamation-laws-in-europe/, accessed September 25, 2017.

Member state legislation.

Table 16: Protections Against Libel Chill—Special Plaintiffs

Rank	Country	Score	Rank	Country	Score
1	Slovakia	12	15	France	5
2	Romania	11	16	Cyprus	4
2	United Kingdom	11	16	Luxembourg	4
4	Czech Republic	10	16	Slovenia	4
4	Ireland	10	19	Belgium	3
6	Bulgaria	8	20	Denmark	2
6	Estonia	8	20	Germany	2
6	Finland	8	20	Lithuania	2
6	Hungary	8	20	Malta	2
6	Latvia	8	20	Netherlands	2
6	Sweden	8	20	Poland	2
12	Austria	6	26	Greece	0
12	Croatia	6	26	Italy	0
12	Spain	6	26	Portugal	0

Map 16: Protections Against Libel Chill—Special Plaintiffs



SECTION II: ENABLING KEY TECHNOLOGY PLATFORMS

The technology category looks at the adoption of key technologies that support the data economy by enabling large-scale data collection, analysis, and dissemination. The technology category contains four indicators: the Internet of Things, e-government, broadband in businesses, and broadband in households.

The top five countries are Denmark, Sweden, Finland, the Netherlands, and Luxembourg. Denmark ranked first for both broadband in businesses, e-government, and Internet of Things, and third for broadband in households. Sweden ranks first for household broadband, second for Internet of Things and business broadband, and third for e-government. Finland ranks second for e-government and household broadband, fifth for Internet of Things, and eighth for business broadband.

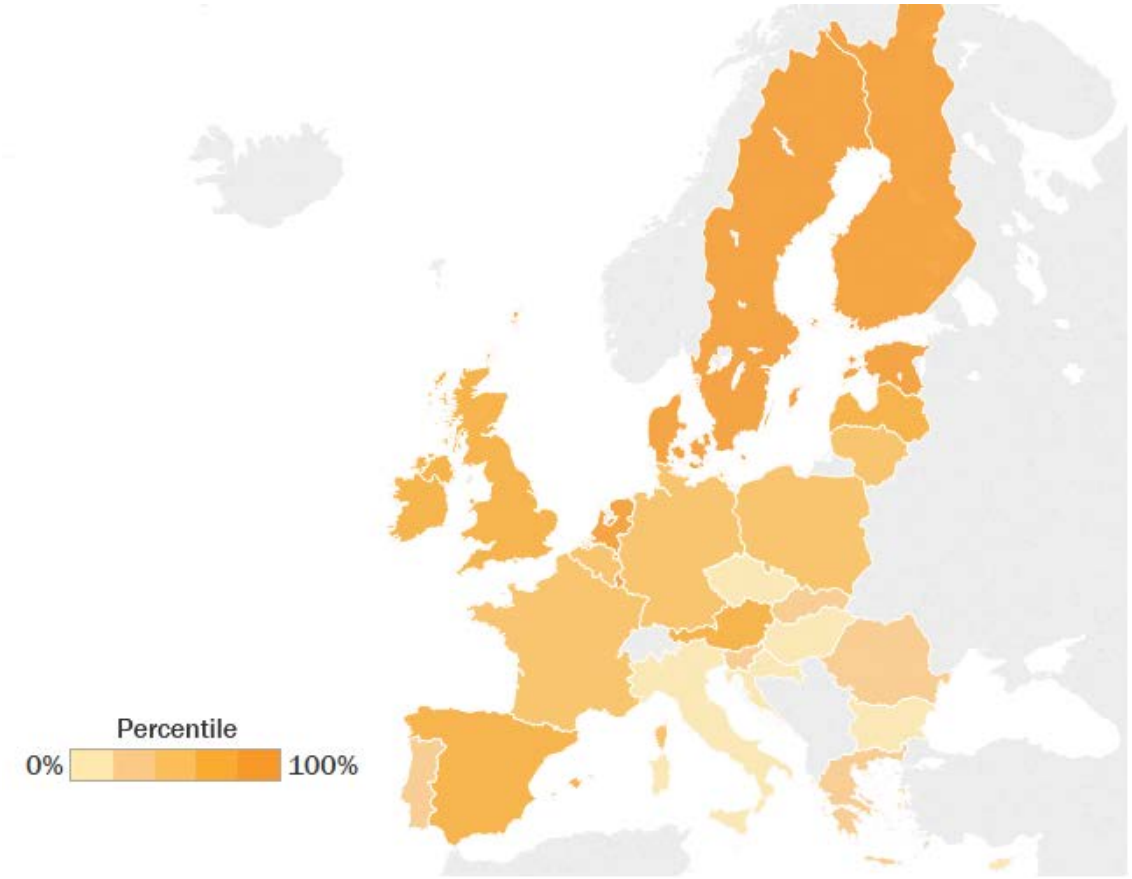
The bottom five countries are Hungary, Croatia, the Czech Republic, Bulgaria, and Cyprus. Cyprus came last for Internet of Things. While none of the others came last on any indicator, Bulgaria, Hungary, and the Czech Republic were in the bottom five for Internet of Things (along with Cyprus), Bulgaria and the Czech Republic were in the bottom five for e-government, Croatia and Cyprus were in the bottom five for business broadband, and Bulgaria, Croatia, and Cyprus were in the bottom five for household broadband.

The economic positions of different member states are somewhat apparent here: there is a moderate correlation of 0.54 between countries' technology scores and their GDP per capita. Given that several indicators in this category involve major infrastructural investment, this is not all that surprising. But as in other areas, Estonia outperforms many much wealthier countries, achieving sixth place. Germany, on the other hand, is in 15th place.

Table 17: Technology

Rank	Country	Score	Rank	Country	Score
1	Denmark	93.88	15	Germany	46.33
2	Sweden	84.45	16	Lithuania	43.10
3	Finland	80.03	17	Poland	42.94
4	Netherlands	75.01	18	Slovenia	41.77
5	Luxembourg	68.68	19	Greece	40.12
6	Estonia	67.17	20	Slovakia	36.64
7	Austria	64.55	21	Portugal	36.44
8	United Kingdom	63.26	22	Romania	35.97
9	Ireland	60.31	23	Italy	35.87
10	Spain	58.57	24	Hungary	33.13
11	Latvia	56.40	25	Croatia	29.31
12	Malta	52.67	26	Czech Republic	28.73
13	France	52.61	27	Bulgaria	23.36
14	Belgium	52.28	28	Cyprus	17.21

Map 17: Technology



INTERNET OF THINGS

The use of connected devices in member states' infrastructure and public services.

Why is this important? Organizations can use connected devices to automatically generate data and automated processes, which in turn helps them to improve productivity, inform planning and policy, cut energy use, and provide better services.

The rankings: The top five countries are Denmark, Sweden, Austria, the UK, and Finland. Denmark achieved the maximum score on smart meters and smart cities, and was in the large second-place group for smart ticketing alongside Sweden, Austria, and Finland. Sweden and Austria were also among the countries that received the maximum smart meters score, and came fourth and fifth respectively in smart cities.

The bottom five are Bulgaria, Hungary, Portugal, the Czech Republic, and Cyprus. Cyprus scored zero on all three measurements. The Czech Republic, Bulgaria, Hungary, and Portugal all scored zero for smart meters. Though all five scored low on smart cities, the highest-scoring of the five on that measure was Hungary. Bulgaria ranked higher on Internet of Things overall because of a better score for smart ticketing.

Methodology: This indicator is worth 40 percent of the technology category. It comprises three measurements, each worth one-third of the Internet of Things score: smart meters, smart ticketing, and smart cities

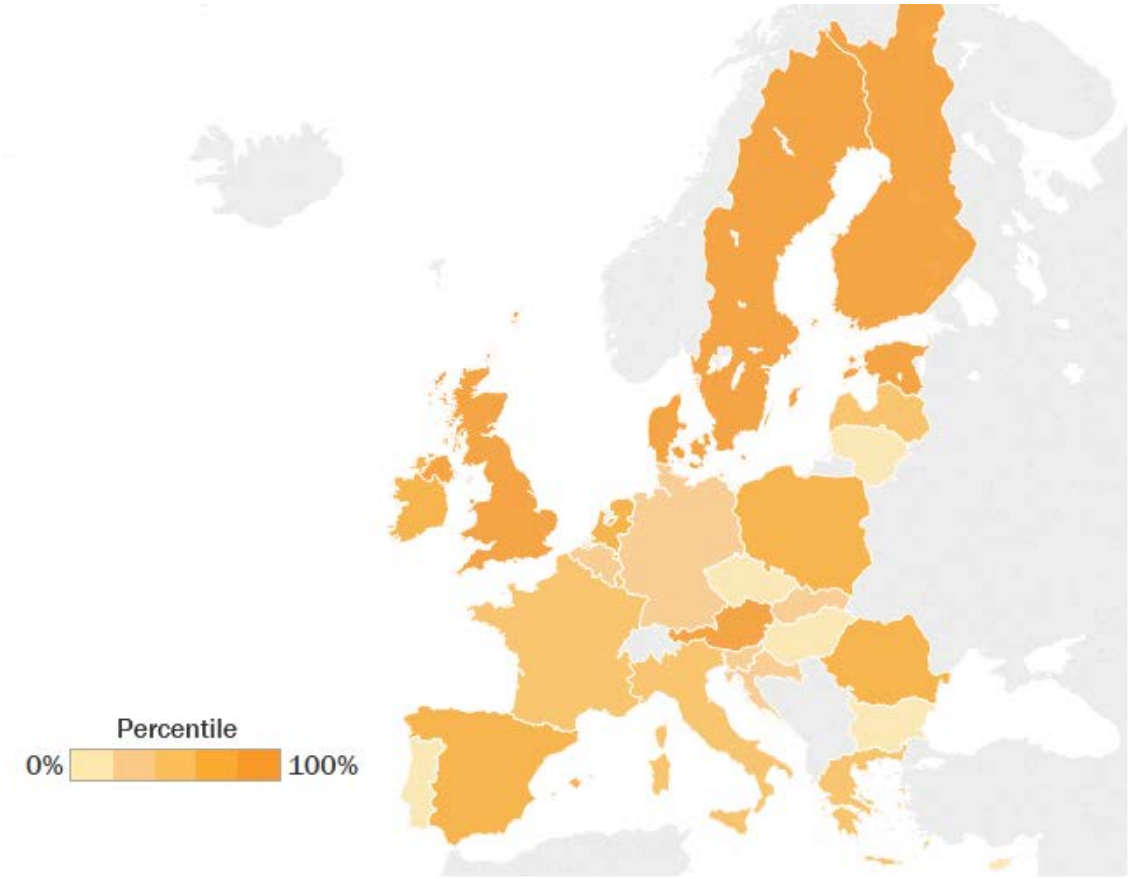
Source: Smart ticketing: Various sources including transport authority websites and other online references.

Smart cities: *Mapping Smart Cities in the EU,* page 39, (European Commission/RAND Corporation, January 2014), http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf.

Table 18: Internet of Things

Rank	Country	Score	Rank	Country	Score
1	Denmark	88.89	15	Greece	53.70
2	Sweden	83.76	16	France	53.22
3	Austria	77.78	17	Latvia	47.22
4	United Kingdom	75.98	18	Belgium	34.34
5	Finland	74.60	19	Slovenia	33.33
6	Estonia	66.67	20	Slovakia	31.94
7	Spain	66.10	21	Germany	30.71
8	Netherlands	63.70	22	Croatia	28.89
9	Ireland	62.22	23	Lithuania	27.78
10	Poland	61.57	24	Bulgaria	24.07
11	Romania	59.48	25	Hungary	14.44
12	Italy	58.41	26	Portugal	13.19
13	Luxembourg	55.56	27	Czech Republic	12.96
13	Malta	55.56	28	Cyprus	0.00

Map 18: Internet of Things



INTERNET OF THINGS: SMART METERS

The extent to which member states intend to meet EU targets for the rollout of smart meters.

Why is this important? Smart meters vastly increase the supply of energy-use data compared to traditional meters. Data from smart meters helps households to manage their consumption and costs, and provides utility companies and governments with improved insight into energy demand and how to manage the grid.

The rankings: At the time of the survey (see methodology), 16 countries had decided to meet the 3rd Energy Package target for rolling out smart meters: Austria, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Malta, the Netherlands, Spain, Sweden, the UK, Poland, and Romania—though in the last two, the official announcement of the decision was pending. Three countries—Germany, Latvia, and Slovakia—intended partial rollouts. Four did not intend to roll out smart meters, claiming the costs outweighed the benefits: Belgium, the Czech Republic, Lithuania, and Portugal. Four more had not yet reached a decision: Bulgaria, Cyprus, Hungary, and Slovenia. Finally, Croatia was exempt, because it joined the EU in 2013, four years after the adoption of the 3rd Energy Package and only a year before the publication of the survey.

Most countries' plans were based on their own cost-benefit analyses, but the social benefits of reusing data from smart meters are not country-specific, even if costs are. For example, installation costs varied from €56 per meter in Portugal to €330 in Flanders.[28] Countries with similar GDP per capita—such as Belgium and Finland—did not face the same costs and reached different conclusions, suggesting high costs indicate other inefficiencies that get in the way of public investment. For this reason, we treated all countries that decided not to roll out smart meters equally, regardless of the findings of their cost-benefit analyses. Moreover, some countries, such as Germany and Latvia, decided to push ahead with at least a partial roll out, despite negative findings in their cost-benefit analyses.

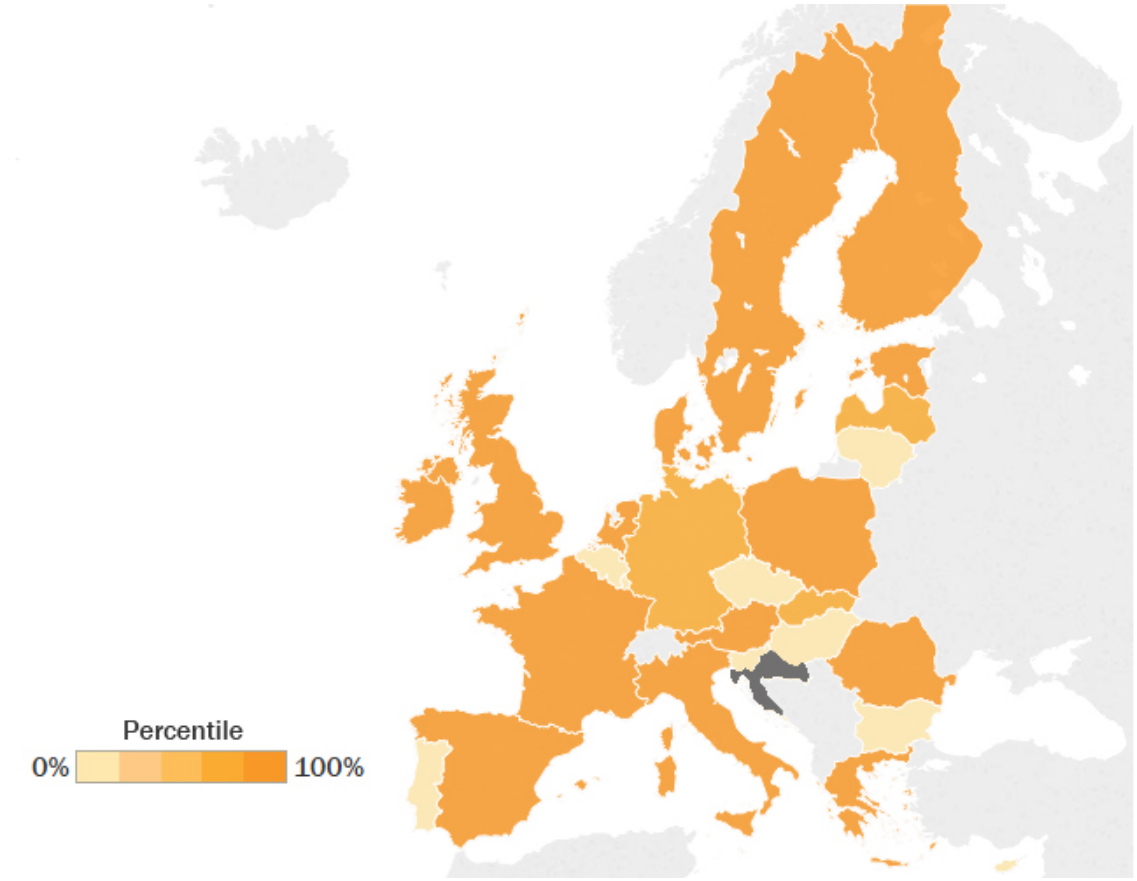
Methodology: The smart meters measurement grades the status of member states' plans for the roll-out of smart meters, following the requirements of the EU's 3rd Energy Package in 2009. Two points are given to countries that plan to install smart meters in 80 percent of homes by 2020, one point is given to those planning a partial roll out that will fall short of this target, and zero points to countries that have decided against introducing smart meters, or had not yet made a decision at the time of the progress report published by the Commission in June 2014. Croatia was not a member of the EU when the 3rd Energy Package was introduced and did not have to complete a cost-benefit analysis, but here we have treated Croatia the same as all other countries that do not have plans to rollout smart meters by 2020 and assigned it a score of zero, because the practical outcome of Croatia's circumstances is the same.

Source: *Commission Staff Working Document: Cost-benefit analyses and state of play of smart metering deployment in the EU-27 SWD(2014) 189 Final,* page 9 (European Commission, June 17, 2014), http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52014SC0189

Table 19: Internet of Things—Smart Meters

Rank	Country	Score	Rank	Country	Score
1	Austria	2	1	United Kingdom	2
1	Denmark	2	16	Germany	1
1	Estonia	2	16	Latvia	1
1	Finland	2	16	Slovakia	1
1	France	2	19	Belgium	0
1	Greece	2	19	Bulgaria	0
1	Ireland	2	19	Cyprus	0
1	Italy	2	19	Czech Republic	0
1	Malta	2	19	Hungary	0
1	Netherlands	2	19	Lithuania	0
1	Poland	2	19	Luxembourg	0
1	Romania	2	19	Portugal	0
1	Spain	2	19	Slovenia	0
1	Sweden	2	19	Croatia	0

Map 19: Internet of Things—Smart Meters



INTERNET OF THINGS: SMART TICKETING

The extent of integrated and smart ticketing systems in capital cities' transport systems.

Why is this important? Smart ticketing is integrated, automated ticketing systems that yield data about how commuters use a city's transport system. Cities can use prepaid cards and apps to automatically collect data about how people are using the transport infrastructure to move around a city. Integrated ticketing, where all major modes of public transport share the same ticketing system, generates data about commuters, even as they move across different modes of transport. Cities can use the data to manage existing infrastructure and plan upgrades to the transport system to meet changing needs.

The rankings: The UK was the only country to receive the maximum score for a fully integrated system where commuters can use smartcards as well as make direct payments by credit or debit card. Eighteen countries had integrated smartcard systems in their capital's transport network: Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Romania, Slovenia, Spain, Sweden, and Croatia.

Portugal received one point, because though there is a smartcard system on the Lisbon metro, it is not transferable across tram and bus services. The Czech Republic, Germany, Hungary, Italy, and Slovakia each received one point, because though their capitals' transport tickets are fully transferable across different modes of transport, there are no smartcards.

Although Valletta has only one mode of public transport—buses—Malta nevertheless received two points because there is a single smartcard-based ticketing system in place. In contrast, Cyprus received zero, because its paper tickets are not transferable between Nicosia's rival bus companies.

France and Greece each received 1.5 points, because there are plans to roll out both smartcard-based ticketing in Athens and contactless payments in Paris. Paris offers fixed-term smartcards, not rechargeable wallets that allow commuters to pay as they go.

Most national capitals have an integrated RFID ticketing system, but no function for direct contactless payments in place of ticketing. There were variations among this group. For example, Copenhagen's smartcards are ostensibly for residents only, while non-residents must pay a surcharge for "anonymous" cards, but they can load single tickets onto a smartphone. Like Copenhagen, Tallinn has preferential rates for residents with personalized cards. Helsinki also offers SMS-based ticketing, and Luxembourg City allows smartphone-based tickets—all such alternatives qualified as equivalent to smart cards.

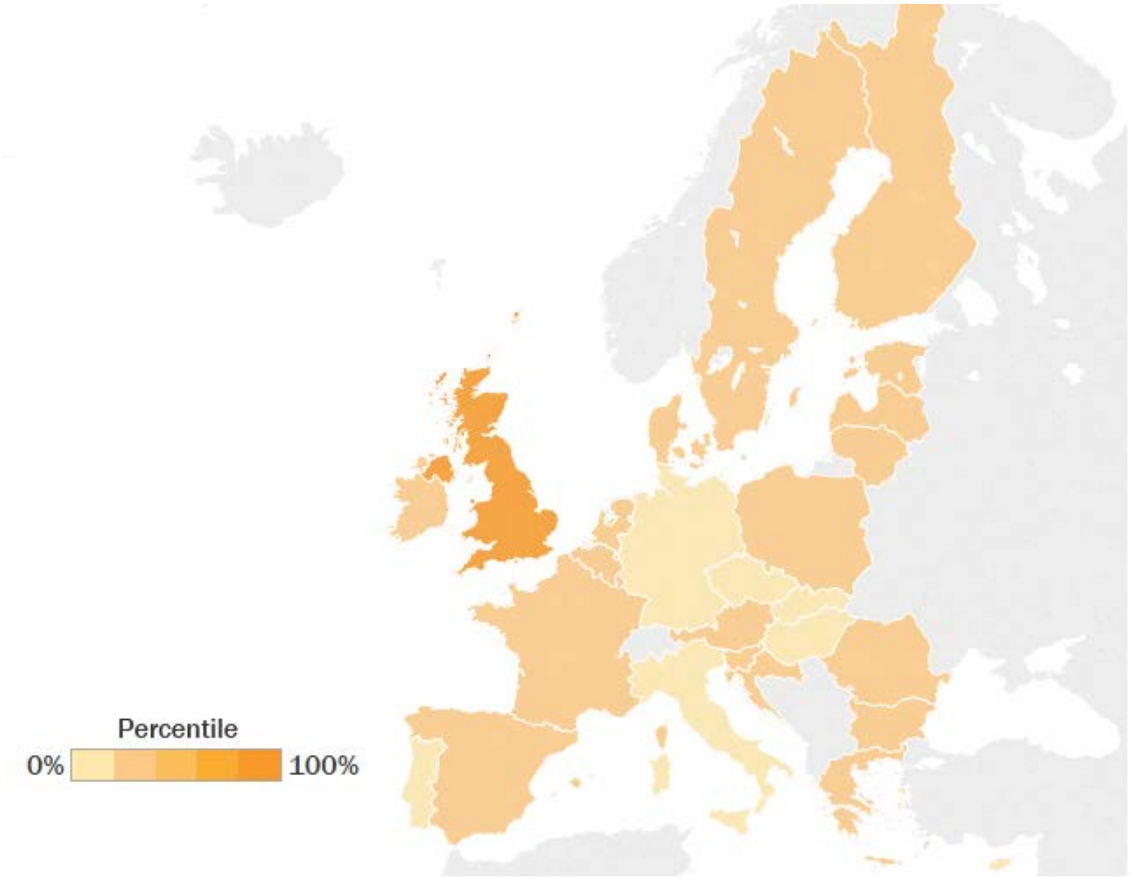
Methodology: We gave one point if the capital's transport network has a fully integrated ticketing system where tickets are transferrable across multiple modes of transport (such as subways, busses, and trams), or across services provided by different companies (such as rival bus companies). We awarded another point where commuters can use rechargeable cards or apps, and a third point if commuters can use their own contactless credit or debit cards.

Source: Various sources including transport authority websites and other online references.

Table 20: Internet of Things—Smart Ticketing

Rank	Country	Score	Rank	Country	Score
1	United Kingdom	3.00	2	Poland	2.00
2	Austria	2.00	2	Romania	2.00
2	Belgium	2.00	2	Slovenia	2.00
2	Bulgaria	2.00	2	Spain	2.00
2	Croatia	2.00	2	Sweden	2.00
2	Denmark	2.00	20	France	1.50
2	Estonia	2.00	20	Greece	1.50
2	Finland	2.00	22	Czech Republic	1.00
2	Ireland	2.00	22	Germany	1.00
2	Latvia	2.00	22	Hungary	1.00
2	Lithuania	2.00	22	Italy	1.00
2	Luxembourg	2.00	22	Portugal	1.00
2	Malta	2.00	22	Slovakia	1.00
2	Netherlands	2.00	28	Cyprus	0.00

Map 20: Internet of Things—Smart Ticketing



INTERNET OF THINGS: SMART CITIES

The approximate number of smart cities as a percentage of total cities in each member state.

Why is this important? Smart city projects frequently involve gathering data about a city's people, infrastructure, government operations, and natural environment, and using that data to improve well-being, increase efficiency, or create new business models. Therefore, smart cities are an important indicator of the extent of data-generating Internet of Things-equipped infrastructure in the urban environment.

The rankings: The RAND smart cities study (see methodology) groups countries in ranges, but when adjusted for the number of cities in each country, these ranges provide somewhat clearer rankings. The top five countries are Luxembourg, Denmark, and Slovenia tied for first with 100 percent, followed by Sweden with 84.62 percent and Austria with 66.67. The bottom five countries are Germany, Portugal, and, tied in 26th place, Bulgaria and the Czech Republic, followed by Malta in 28th place.

Methodology: The smart cities measurement takes the approximate number of smart cities in each country, as defined in a RAND Corporation report commissioned by the EU as "a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership." We divided calculated approximate number provided by the report as a percentage of the number of cities identified by a European Commission report, *Cities in Europe: The New OECD-EC Definition*. The RAND report does not give precise counts of smart cities, but groups them into those with 0, those with 1-3, 4-10, 11-30, and 31+. Though the cities themselves are plotted on a map, that map is too small and the markers too close together to count the number of cities accurately.

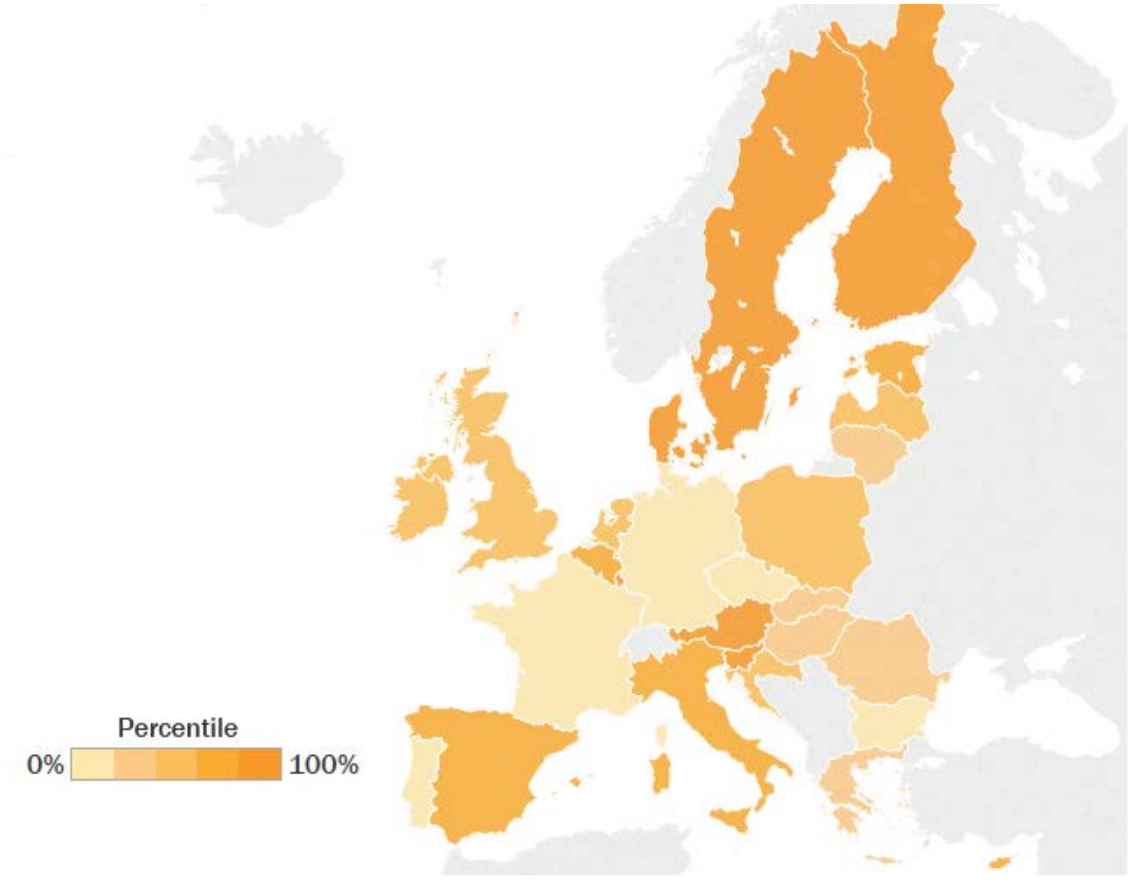
Source: *Mapping Smart Cities in the EU,* page 39, (European Commission/RAND Corporation, January 2014), http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf.

Numbers of cities: Lewis Dijkstra and Hugo Poelman, *Cities in Europe: The New OECD-EC Definition,* (European Commission, January 3, 2012), http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf.

Table 21: Internet of Things—Smart Cities

Rank	Country	Score	Rank	Country	Score
1	Denmark	100.00	15	Croatia	20.00
1	Luxembourg	100.00	15	Ireland	20.00
1	Slovenia	100.00	17	Poland	18.03
4	Sweden	84.62	18	Lithuania	16.67
5	Austria	66.67	19	Slovakia	12.50
6	Finland	57.14	20	Romania	11.76
7	Cyprus	50.00	21	Greece	11.11
8	Italy	41.89	22	Hungary	10.00
9	Belgium	36.36	23	France	9.65
10	Estonia	33.33	24	Germany	8.80
11	Spain	31.63	25	Portugal	6.25
12	United Kingdom	27.93	26	Bulgaria	5.56
13	Latvia	25.00	26	Czech Republic	5.56
14	Netherlands	24.44	28	Malta	0.00

Map 21: Internet of Things—Smart Cities



E-GOVERNMENT

The extent to which citizens access government services via the Internet.

Why is this important? E-Government makes it easier for government to collect data about how public services are functioning, by automating and digitizing those services. Establishing digital channels for accessing public services is the first step governments need to take on the road to deploying more advanced technologies, such as artificial intelligence, to make interactions with government as convenient and hassle-free as possible.[29]

The rankings: The top five countries are Denmark, Finland, Sweden, Estonia, and Luxembourg, while the bottom five are the Czech Republic, Poland, Italy, Bulgaria, and Romania. The average proportion of respondents to have used online services in the last year was 51.89 percent.

This is the best-available indicator for comparing e-government in all of the EU's 28 member states, because it highlights not only the extent to which online services are available, but also which citizens actually use them. However, this indicator is imperfect, because many of those answering "no" may have had no reason to interact with government at all, online or offline. As a result, this metric may give a slight advantage to countries that burden their citizens with frequent bureaucratic obligations, but allow them to fulfill those obligations digitally.

All of the leading countries have up-and-running digital identity systems that make it easy for citizens to prove their identities online, allowing governments to digitize a much wider variety of common transactions than those still struggling with digital identity management. Another key characteristic of the leading countries is that they adopted their first digital strategies earlier than most others. For example, Estonia's e-government strategy dates back to the Principles of the Estonian Information Policy document of 1998, seven years before the country joined the EU. Denmark and Finland adopted e-government strategies around 2002. Though leading countries' digital strategies focus largely on digitizing transactions in order to make interactions with government more convenient for citizens, they also include efforts to promote wider use of ICT and data in society, For example, Finland's Open Government Action plan, established in 2015, when Finland was already a leader in digital government, sought to promote the use of open government data by young people.[30]

Lower-scoring countries' e-government policies mostly appeared later, and were less ambitious. For example, Bulgaria and Romania only adopted comprehensive e-government strategies around 2008-9, and their objectives—particularly in Romania's case—were more about the introduction of ICT into conventional public services than shifting them online. However e-government also appears to be limited by a lack of broadband access: only 70.11 percent of Romanians and 62.82 percent of Bulgarians have broadband access (although those that have it have faster connections than most other Europeans), and only around half use the Internet once per week[31]

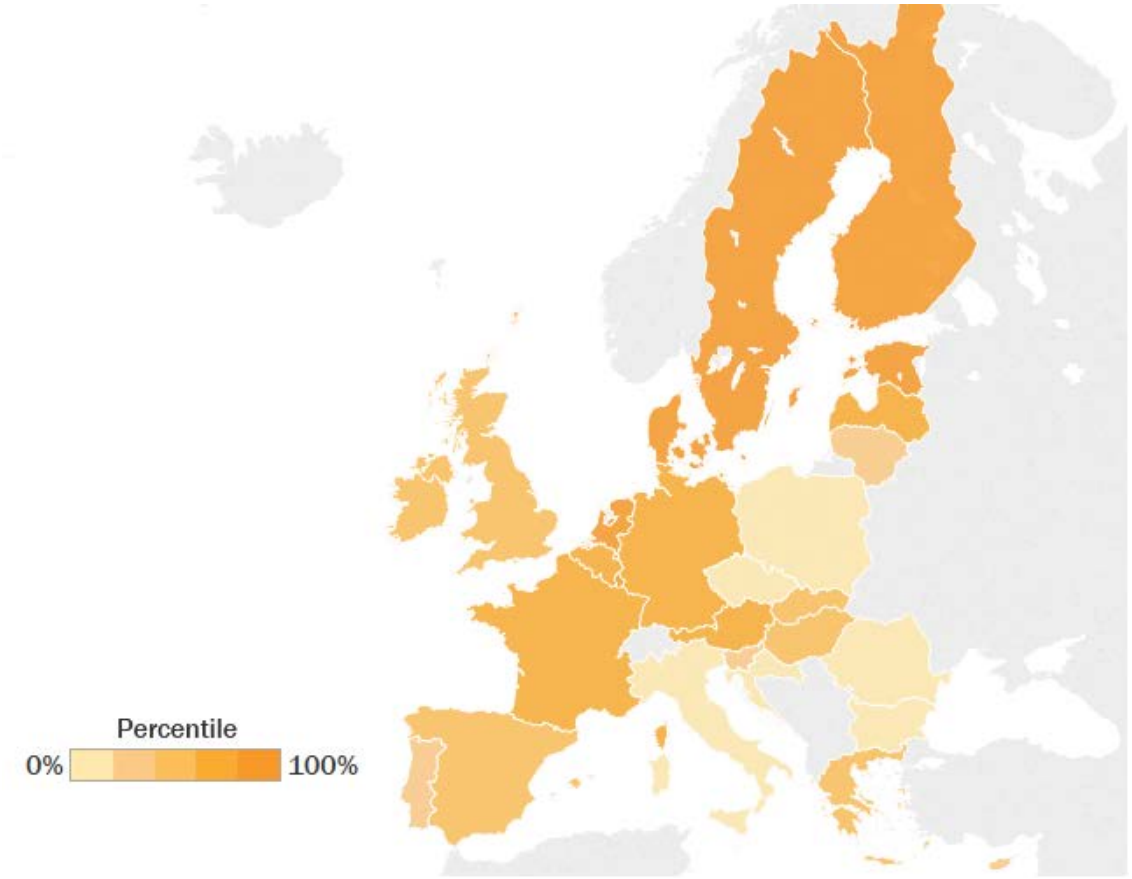
Methodology: This indicator measures the percentage of survey respondents who said they had used an e-government service at least once in the last twelve months. This indicator is worth 30 percent of the technology category.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 22: E-Government

Rank	Country	Percentage	Rank	Country	Percentage
1	Denmark	88.32%	15	Greece	48.89%
2	Finland	81.61%	16	Hungary	48.21%
3	Sweden	77.88%	17	Slovakia	47.94%
4	Estonia	76.93%	18	Slovenia	45.36%
5	Luxembourg	76.39%	19	Lithuania	44.89%
6	Netherlands	76.10%	20	Portugal	44.68%
7	Latvia	69.45%	21	Malta	43.85%
8	France	65.86%	22	Cyprus	38.38%
9	Austria	59.98%	23	Croatia	36.18%
10	Belgium	54.90%	24	Czech Republic	35.90%
11	Germany	54.57%	25	Poland	30.22%
12	United Kingdom	52.62%	26	Italy	24.10%
13	Ireland	51.77%	27	Bulgaria	18.60%
14	Spain	50.14%	28	Romania	9.07%

Map 22: E-Government



BROADBAND IN BUSINESS

The proportion of businesses with access to broadband and high-speed broadband Internet.

Why is this important? Broadband connections—particularly fast ones—matter because they enable businesses to participate in e-commerce and use data-intensive, cloud-based services.

The rankings: The top five countries are Denmark, Sweden, the Netherlands, Belgium, and Lithuania. The bottom five are Slovakia, Croatia, Cyprus, Italy, and Greece.

There is not much correlation between businesses' access to broadband and access to high-speed broadband: the coefficient is just 0.27. For example, Slovenian businesses enjoy the highest rate of broadband access in the EU (99.21 percent) but the country is in 17th place for high speed access (31.63 percent). The Czech Republic has the fifth-highest rate of access (97.16 percent) but only the 22nd highest rate of high-speed access (24.22 percent).

The threshold of 30 Mbps for fast business broadband is well above the average household broadband speed in every EU country, which masks variations in speed and may exaggerate the differences between "fast" and "slow" countries. However, there is a correlation of 0.72 between household speeds and rates of businesses' access to high-speed broadband.

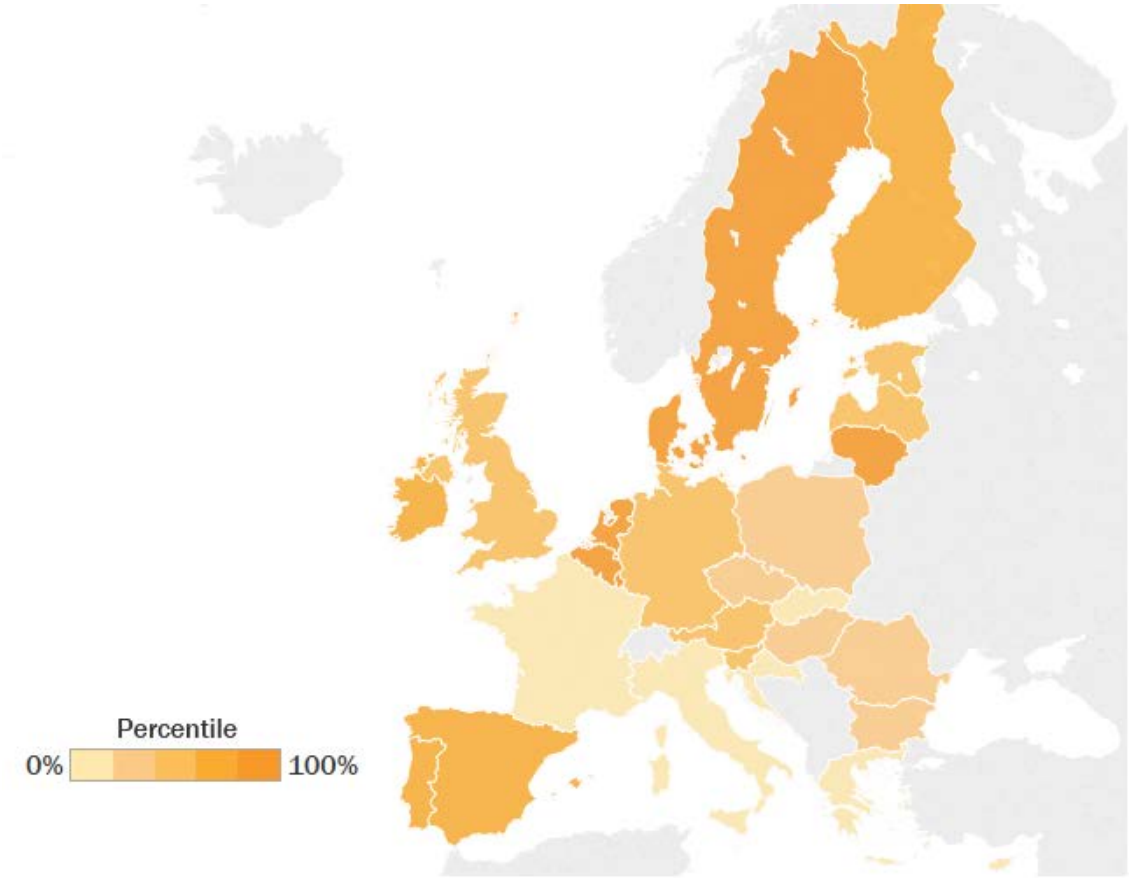
Methodology: This indicator is worth 20 percent of the technology category. There are two measurements: the percentage of businesses with fixed broadband connections (weighted 25 percent) and the percentage of businesses with fixed broadband connections faster than 30 Mbps (weighted 75 percent).

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 23: Broadband in Business

Rank	Country	Score	Rank	Country	Score
1	Denmark	99.34	15	Latvia	48.79
2	Sweden	80.51	16	United Kingdom	44.49
3	Netherlands	80.03	17	Austria	42.94
4	Belgium	76.57	18	Romania	39.42
5	Lithuania	73.77	19	Czech Republic	38.05
6	Luxembourg	72.40	20	Hungary	36.98
7	Portugal	71.37	21	Bulgaria	36.83
8	Finland	71.07	22	Poland	32.92
9	Ireland	65.60	23	France	30.83
10	Malta	63.02	24	Slovakia	24.65
11	Spain	55.71	25	Croatia	24.42
12	Slovenia	51.23	26	Cyprus	22.16
13	Germany	50.99	27	Italy	19.89
14	Estonia	50.11	28	Greece	12.44

Map 23: Broadband in Business



BROADBAND IN BUSINESS: CONNECTIONS OVER 30 MBPS

The percentage of businesses with broadband Internet connections faster than 30 Mbps.

Why is this important? Many important data-intensive business applications and services require fast Internet connections. For example, small businesses can benefit from analyzing big data, but only if they have high-speed access to the cloud computing infrastructure that supports such advanced data processing at prices they can afford.

The rankings: The top five countries are Denmark, Sweden, the Netherlands, Belgium, and Lithuania. The bottom five are Croatia, France, Greece, Italy, and Cyprus. The average percentage for all countries is 35.88 percent. Denmark is well ahead with 63.62 percent, compared to 54.90 percent in Sweden, and 49.27 percent in Lithuania. Just 14.42 percent of business connections in Cyprus are faster than 30 Mbps.

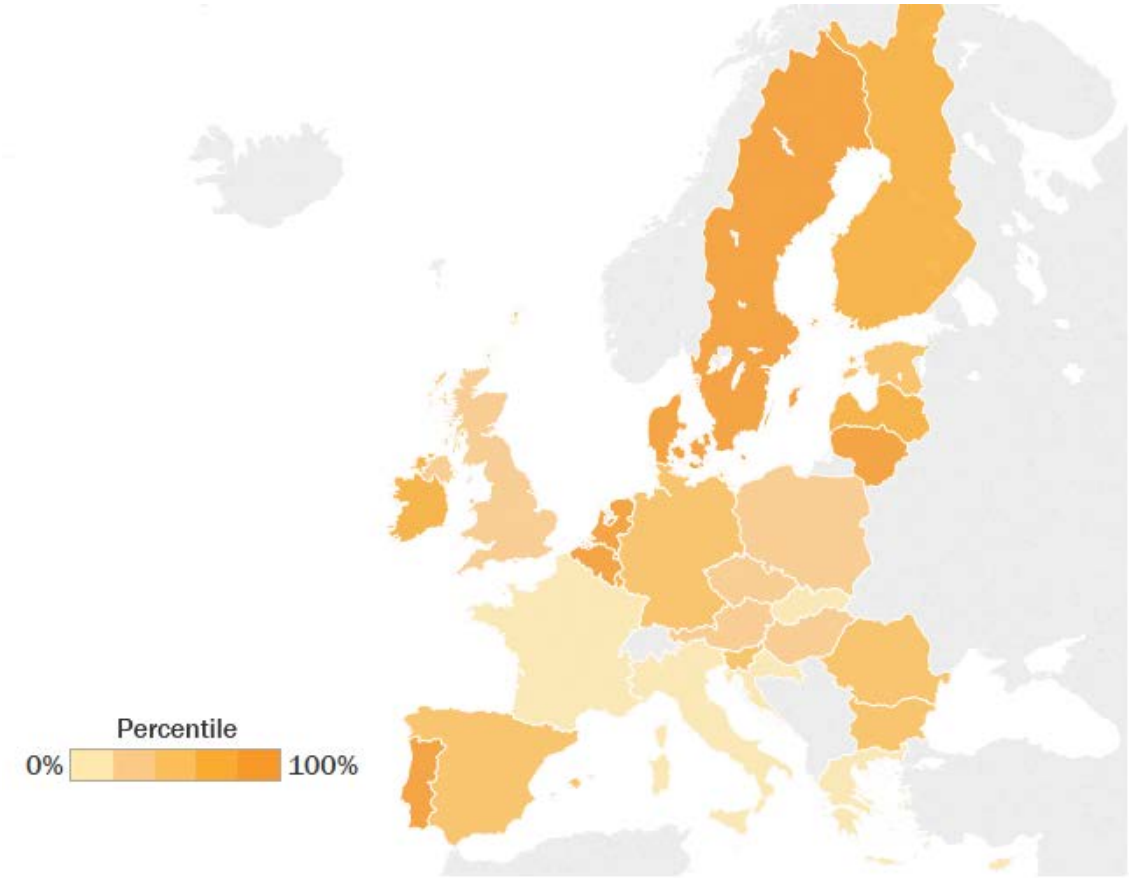
Methodology: This shows the percentage of businesses with fixed broadband connections faster than 30 Mbps. It is worth 75 percent of the broadband in business indicator.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 24: Broadband in Business—Connections over 30 Mbps

Rank	Country	Percentage	Rank	Country	Percentage
1	Denmark	63.62%	15	Germany	35.37%
2	Sweden	54.90%	16	Estonia	34.51%
3	Netherlands	51.72%	17	Slovenia	31.63%
4	Belgium	50.28%	18	Austria	30.56%
5	Lithuania	49.27%	19	United Kingdom	30.27%
6	Portugal	48.56%	20	Hungary	29.12%
7	Luxembourg	47.75%	21	Poland	27.07%
8	Finland	45.81%	22	Czech Republic	24.22%
9	Malta	43.15%	23	Slovakia	22.44%
10	Ireland	42.99%	24	Croatia	22.08%
11	Latvia	38.64%	25	France	21.75%
12	Bulgaria	38.58%	26	Greece	15.27%
13	Spain	38.42%	27	Italy	15.20%
14	Romania	37.06%	28	Cyprus	14.42%

Map 24: Broadband in Business—Connections over 30 Mbps



BROADBAND IN BUSINESS: CONNECTIONS

The proportion of businesses with access to broadband Internet.

Why is this important? Modern businesses need Internet access. At the smallest scale, they need it to buy supplies and sell their goods and services, and at the larger scale, they need it to manage the company's operations. And at any scale, it is impossible for a company to participate in the data economy without an Internet connection.

The rankings: The top five countries are Slovenia, Denmark, Finland, the Netherlands, and the Czech Republic. All have connection rates above 97 percent, from 97.16 percent in the Netherlands to 99.21 percent in Slovenia. The bottom five countries are Slovakia, Latvia, Greece, Romania, and Bulgaria, with percentages ranging from 85.64 in Slovakia down to 72.21 percent in Bulgaria. As with household connections, there is more variation at the lower end than at the top: broadband access is such a basic necessity that Europe as a whole is moving towards universal access, so outliers can only conceivably occur at the bottom end.

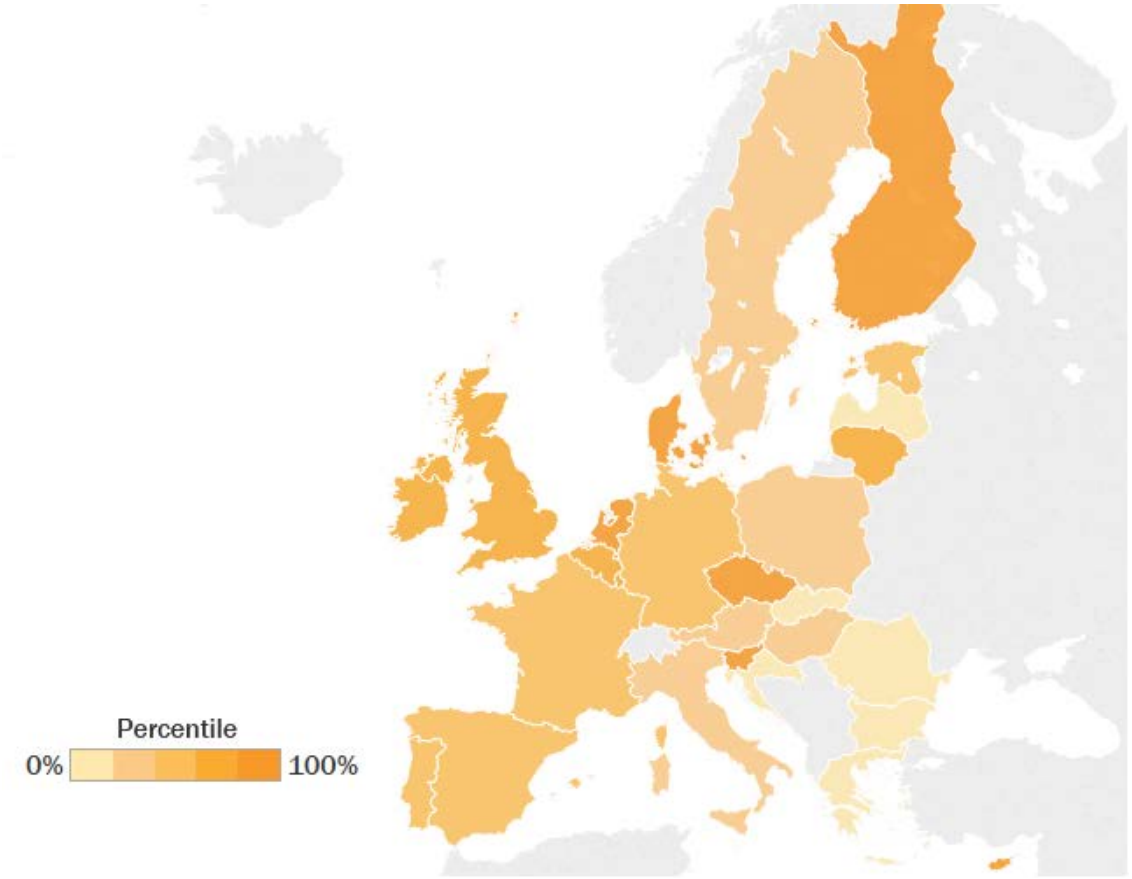
Methodology: This shows the percentage of businesses with broadband connections. It is worth 25 percent of the broadband in business indicator.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 25: Broadband in Business—Connections

Rank	Country	Percentage	Rank	Country	Percentage
1	Slovenia	99.21%	15	Malta	92.98%
2	Denmark	98.50%	16	Spain	92.87%
3	Finland	97.29%	17	Germany	92.79%
4	Netherlands	97.23%	18	Sweden	92.53%
5	Czech Republic	97.16%	19	Italy	92.40%
6	Cyprus	96.14%	20	Austria	92.02%
7	Ireland	96.02%	21	Hungary	87.95%
8	Belgium	95.87%	22	Poland	86.93%
9	Luxembourg	95.53%	23	Croatia	85.98%
10	Lithuania	94.50%	24	Slovakia	85.64%
11	United Kingdom	94.16%	25	Latvia	85.03%
12	France	93.44%	26	Greece	84.24%
13	Estonia	93.26%	27	Romania	77.52%
14	Portugal	93.08%	28	Bulgaria	72.21%

Map 25: Broadband in Business—Connections



BROADBAND IN HOUSEHOLDS

The availability and speed of broadband Internet connections in households.

Why is this important? Widespread access to high-speed broadband connections makes it easier for individuals to participate in the data economy, by giving them direct access to it from their homes.

The rankings: The top five countries are Sweden, Finland, Denmark, the Netherlands, and the UK. The bottom five are Italy, Bulgaria, Croatia, Cyprus, and Greece. The average connection speed in Q1 2017 was 14.33 megabits per second (Mbps), and the average percentage of households with broadband access in 2016 was 80.97 percent.

Sweden's average speed was 22.54 Mbps, the highest in the EU, but it ranked seventh for access, behind Luxembourg (96.76 percent), the Netherlands (95.41 percent), the United Kingdom (91.90 percent), Denmark (91.60 percent), Finland (91.21 percent), and Germany 89.60 percent).

There is a positive correlation of 0.42 between speed and access. Several countries did well on one measurement but were dragged down by the other. Six countries with above-average scores for speed scored below average for access (Latvia, the Czech Republic, Romania, Bulgaria, Lithuania, and Hungary), while four with above-average scores for access scored below average for speed (Luxembourg, Estonia, Austria, and Malta).

Luxembourg, which had the highest rate of broadband access in the EU in 2016, ranks 22nd for average speed with 11.59 Mbps. Romania had the fifth-highest average speed (16.99 Mbps) but the third-lowest rate of access (70.11 percent). Bulgaria had the 11th-highest average speed (15.54 Mbps) but the lowest rate of broadband access (62.81 percent).

Methodology: The indicator is worth ten percent of the technology category. It comprises two equally-weighted measurements: the percentage of households with fixed or mobile broadband connections in 2016, according to the European Commission's Digital Scoreboard, and the average household fixed connection speed in the first quarter of 2017, according to Akamai.

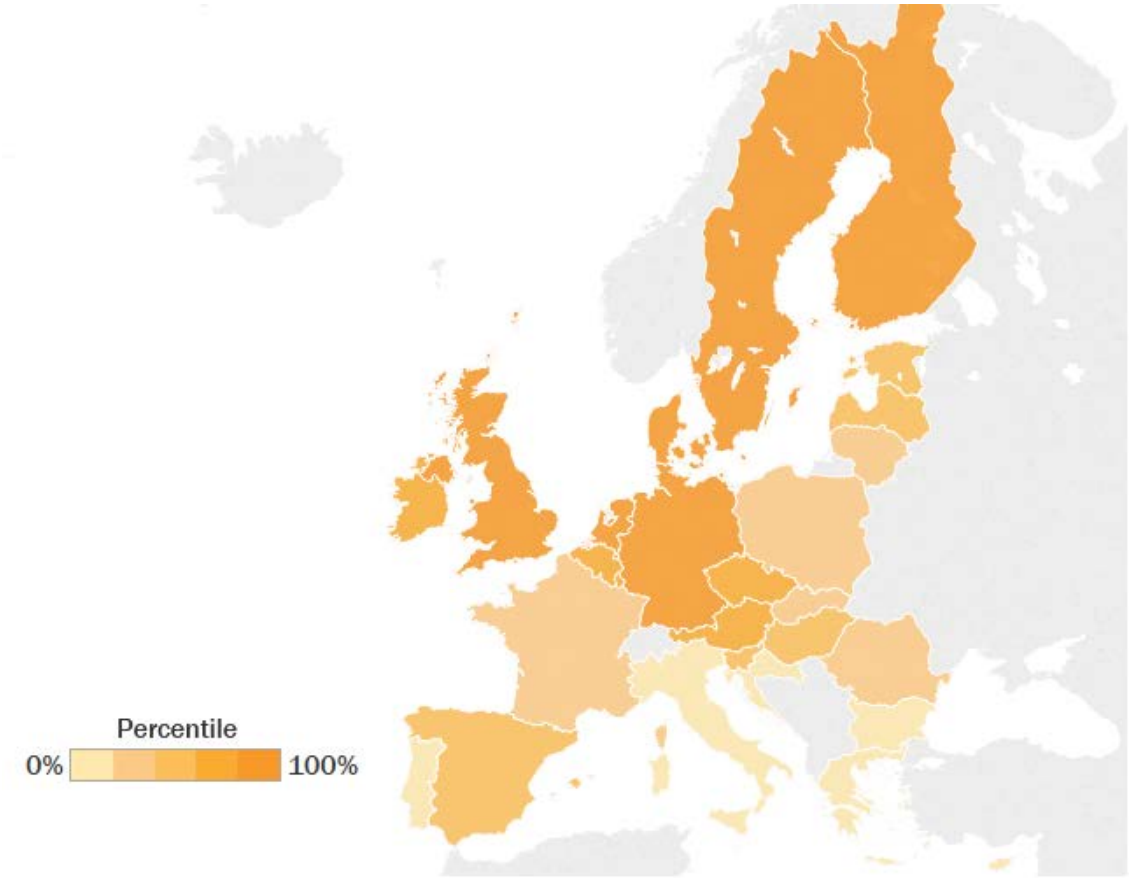
Source: Speed: David Belson (editor), *Akamai's State of the Internet Q1 2017 Report*, (Akamai, 2017), https://www.akamai.com/us/en/about/our-thinking/state-of-the-Internet-report/state-of-the-Internet-connectivity-visualization.jsp.

Connections: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 26: Broadband in Households

Rank	Country	Score	Rank	Country	Score
1	Sweden	88.01	15	Estonia	47.95
2	Finland	85.12	16	Malta	46.79
3	Denmark	84.59	17	Slovenia	44.55
4	Netherlands	81.50	18	Romania	42.98
5	United Kingdom	74.84	19	Slovakia	42.18
6	Germany	66.26	20	Poland	37.21
7	Luxembourg	64.97	21	Lithuania	36.75
8	Ireland	61.39	22	France	36.55
9	Belgium	58.81	23	Portugal	34.07
10	Czech Republic	57.84	24	Italy	28.44
11	Austria	55.79	25	Bulgaria	27.60
12	Spain	54.43	26	Croatia	26.07
13	Hungary	51.41	27	Cyprus	16.77
14	Latvia	48.99	28	Greece	10.76

Map 26: Broadband in Households



BROADBAND IN HOUSEHOLDS: ACCESS

The percentage of households with access to broadband Internet.

Why is this important? A broadband connection is a basic necessity for participation in many facets of the data economy and for access to the benefits of data innovation. Most digital services are inaccessible without broadband access, and the Internet of Things-based services, such as smart homes and wearable devices, cannot function properly without an adequate Internet connection. Therefore, it is important to measure the number of households with access to a broadband connection.

The rankings: The top five countries are Luxembourg, the Netherlands, the UK, Denmark, and Finland. All have access rates above 90 percent, from 91.21 percent in Finland to 96.78 percent in Luxembourg. The five-lowest ranking countries are Portugal, Lithuania, Romania, Greece, and Bulgaria. The largest gap between any two consecutively-ranked countries is at the very bottom: only 62.81 percent of households have broadband access in Bulgaria, and the country lags quite some way behind Greece, where 68.06 percent have access.

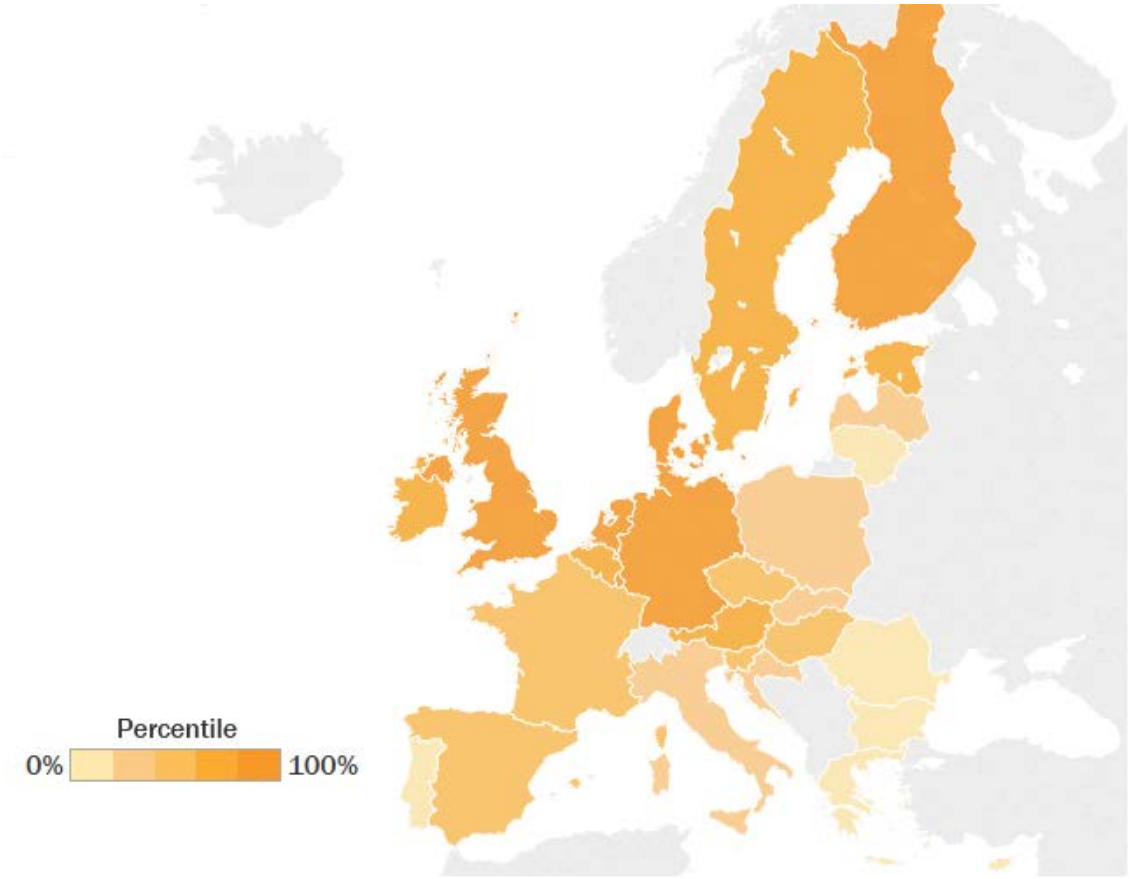
Methodology: This shows the percentage of households with a broadband connection in 2016. It is worth 50 percent of the broadband in households score.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 27: Broadband in Households—Access

Rank	Country	Percentage	Rank	Country	Percentage
1	Luxembourg	96.78%	15	Czech Republic	80.32%
2	Netherlands	95.41%	16	France	79.29%
3	United Kingdom	91.90%	17	Slovenia	78.42%
4	Denmark	91.60%	18	Slovakia	78.15%
5	Finland	91.21%	19	Italy	77.14%
6	Germany	89.60%	20	Croatia	76.87%
7	Sweden	88.63%	21	Poland	75.71%
8	Ireland	85.61%	22	Latvia	75.08%
9	Estonia	85.29%	23	Cyprus	74.20%
10	Austria	85.09%	24	Portugal	72.95%
11	Belgium	82.41%	25	Lithuania	71.02%
12	Malta	81.74%	26	Romania	70.11%
13	Spain	81.16%	27	Greece	68.06%
14	Hungary	80.56%	28	Bulgaria	62.81%

Map 27: Broadband in Households—Access



BROADBAND IN HOUSEHOLDS: SPEED

The average speed of Internet connections in each member state.

Why is this important? Just as fast Internet connections are important for businesses to participate in the data economy, so too do citizens need high-speed connections to access data-driven products, such as on-demand content streaming. Poor connection speeds are a contributing factor to the "digital divide" and differences in average speeds between countries are an indicator of how easily citizens can make the most of the digital economy.

The rankings: The top five countries are Sweden, Finland, Denmark, the Netherlands, and Romania. The variation between average speeds in these five countries is large, from 16.99 megabits per second (Mbps) in Romania to 22.54 Mbps in Sweden. These figures mask large variation in connection speeds that exists within member states, with cities often having average speeds well above the national average.

The bottom five countries are France, Italy, Croatia, Greece, and Cyprus. Their average speeds range from 10.76 Mbps in France down to 6.91 Mbps in Cyprus. Again, these figures likely mask wide variation, particularly in large countries like France.

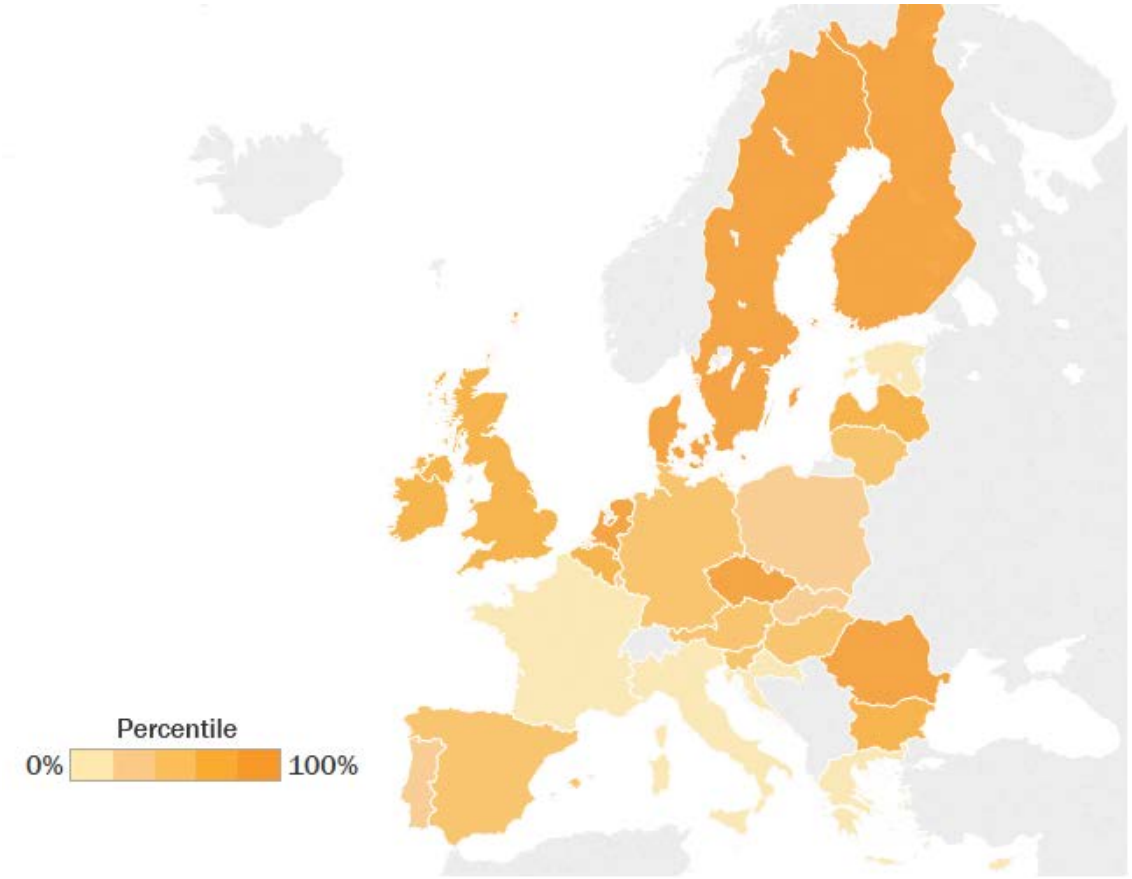
Methodology: This measurement shows the average broadband speed in Q1 2017.

Source: David Belson (editor), *Akamai's State of the Internet Q1 2017 Report*, (Akamai, 2017), https://www.akamai.com/us/en/about/our-thinking/state-of-the-Internet-report/state-of-the-Internet-connectivity-visualization.jsp.

Table 28: Broadband in Households—Speed

Rank	Country	Average Speed (Mbps)	Rank	Country	Average Speed (Mbps)
1	Sweden	22.54	15	Lithuania	14.62
2	Finland	20.45	16	Austria	14.10
3	Denmark	20.11	17	Slovenia	13.66
4	Netherlands	17.39	18	Slovakia	13.04
5	Romania	16.99	19	Portugal	12.89
6	Czech Republic	16.94	20	Malta	12.83
7	United Kingdom	16.92	21	Poland	12.61
8	Latvia	16.58	22	Luxembourg	11.59
9	Belgium	16.28	23	Estonia	11.56
10	Ireland	15.61	24	France	10.76
11	Bulgaria	15.54	25	Italy	9.21
12	Spain	15.49	26	Croatia	8.59
13	Germany	15.30	27	Greece	7.86
14	Hungary	14.81	28	Cyprus	6.91

Map 28: Broadband in Households—Speed



SECTION III: DEVELOPING HUMAN AND BUSINESS CAPITAL

This category examines how well-prepared member states' inhabitants and businesses are to participate in the data economy.

The category consists of three "people and firms" indicators: e-business, which represents the use of data-driven technologies within companies; workforce, which measures skills and expertise in the labor force; and education and civil society, which scores countries according to education programs that support the data economy and evidence of data-driven civil society groups.

The top five countries are Finland, the Netherlands, Denmark, Belgium, and the UK. Finland ranks first for both e-business and workforce, and fourth for education and civil society.

Denmark ranks fifth for e-businesses, third for workforce, and first for education and civil society. The Netherlands ranks only 11th for e-business, but scores higher than Denmark on the education and civil society indicator, achieving fourth place, and is fifth place for workforce.

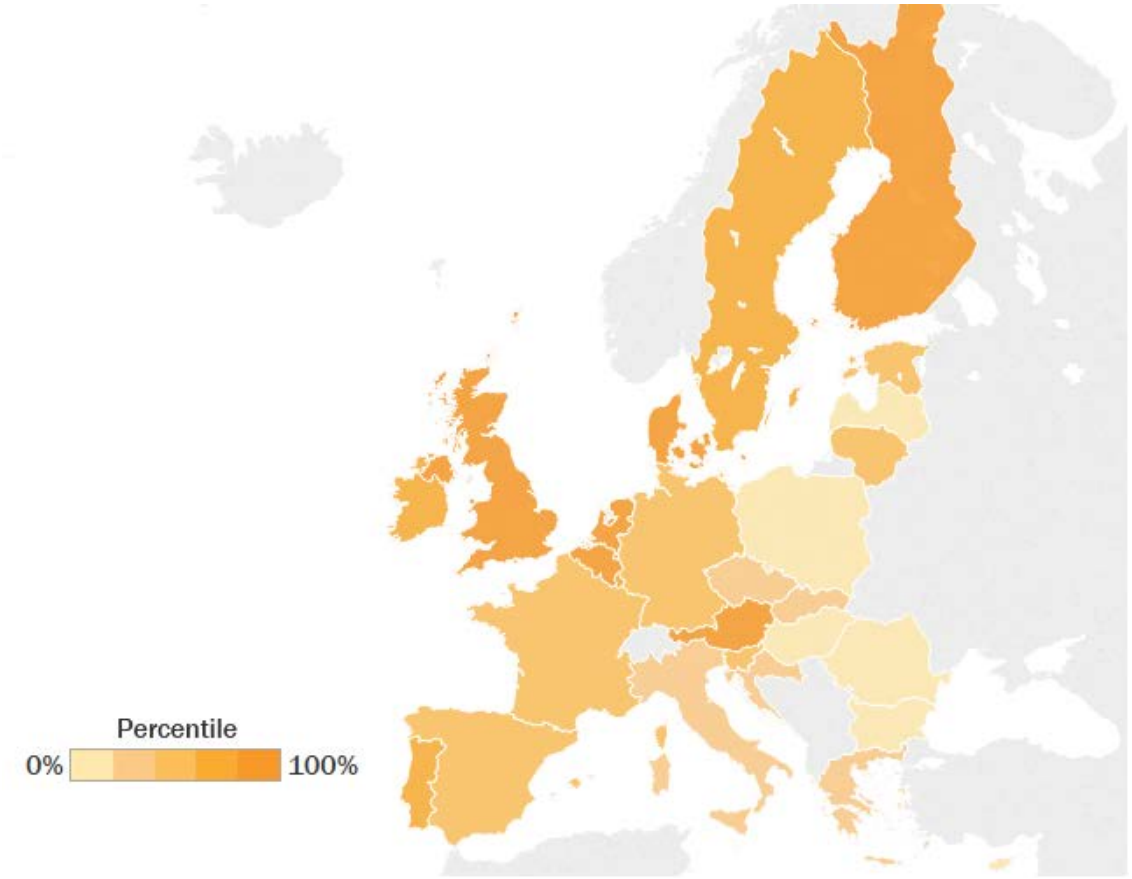
The bottom five countries are Hungary, Bulgaria, Poland, Cyprus, and Latvia. Latvia was below average on all measures. Cyprus outperformed Poland, Hungary, and Latvia on e-business by a considerable margin—in large part due to the well-above-average use of analytical customer relationship management (CRM) software by Cypriot businesses. Poland is in 15th place on education and civil society, but ranked low on the other two indicators in this section.

Though Estonia was a strong performer in data (first place) and technology (sixth place), it does less well in people and firms, and is in only 16th place, behind neighboring Lithuania. Belgium, on the other hand, does much better in people and firms than in the other categories, achieving fourth place, despite only reaching the middle-rankings on data and technology. The rest of the top five are strong performers throughout. As with the other categories, there is a modest correlation with GDP per capita, of 0.53.

Table 29: People and Firms

Rank	Country	Score	Rank	Country	Score
1	Finland	77.67	15	Lithuania	43.93
2	Netherlands	74.95	16	Estonia	42.77
3	Denmark	66.86	17	Spain	39.11
4	Belgium	63.94	18	Slovakia	35.96
5	United Kingdom	59.59	19	Croatia	33.81
6	Austria	58.33	20	Czech Republic	33.25
7	Sweden	58.30	21	Italy	31.53
8	Malta	54.29	22	Greece	27.71
9	Ireland	51.90	23	Romania	26.12
10	Luxembourg	50.11	24	Hungary	25.19
11	Portugal	47.75	25	Bulgaria	24.60
12	Germany	46.88	26	Poland	24.15
13	France	46.77	27	Cyprus	18.81
14	Slovenia	46.40	28	Latvia	16.79

Map 29: People and Firms



E-BUSINESS

The extent to which businesses use data-driven technologies to improve performance.

Why is this important? Businesses are not just producers of technology, they are important users of it too: this indicator measures the extent to which businesses use data-driven technologies to become more efficient and competitive.

The rankings: The top five countries are the Netherlands, Finland, Belgium, Malta, and Austria. Overall, use of e-business technologies appears low in the majority of member states: on none of the measurements do more than two countries have over 50 percent of businesses using e-business technologies, and averages are between 10 and 34 percent.

Finland achieves very high scores for the use of RFID (28.86 percent of businesses, compared to an average of 10.86 percent) and cloud computing (56.92 percent of businesses, average of 22.26 percent), and also scores very high on the use of customer relationship management (CRM) software (28.11 percent, average 20.61 percent). Finland is above average on all the other e-business measurements. The Netherlands ranks first, largely because of its lead in the use of big data, which 19.07 percent of Dutch businesses use, compared to an average of 11.06 percent. Belgium is above average on all measurements, and does better than both Finland and the Netherlands on the use of enterprise resource planning (ERP) software (50.04 percent of Belgian businesses, compared to an average of 33.79 percent).

The bottom five countries in ranking are Bulgaria, Cyprus, Poland, Hungary, and Latvia. Hungary scores below average on all e-business measurements. It has the lowest use of CRM in the EU, at 9.18 percent of businesses, and Hungarian firms' use of big data was just 6.96 percent. Latvia and Poland are also below average on all measures.

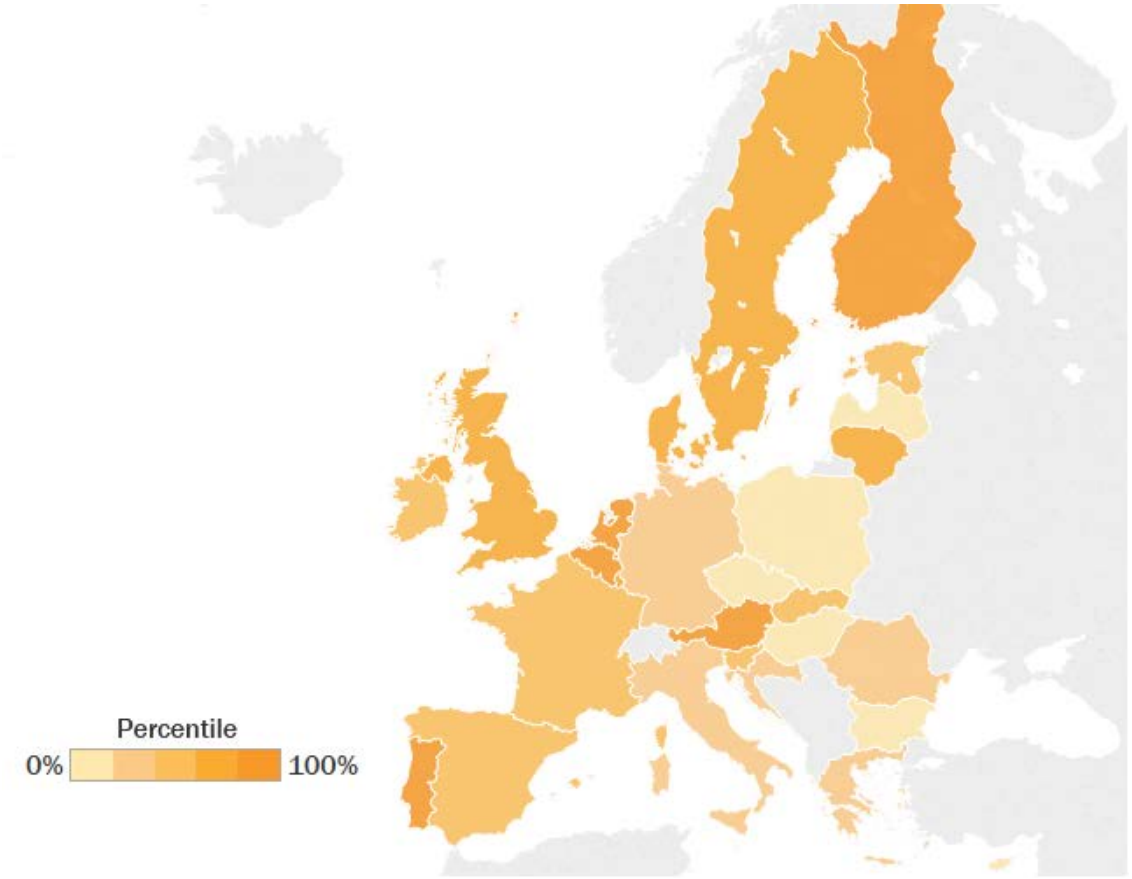
Methodology: The e-business indicator is worth 50 percent of the people and firms category. It consists of five different measurements from the European Commission's Digital Scoreboard 2014-2016: the use of big data by enterprises in 2016 (weighted 50 percent); use of cloud computing by enterprises in 2016 (weighted 12.5 percent); enterprises using Radio Frequency Identification (RFID) technologies in 2014 (weighted 12.5 percent); enterprises who organize their business processes using enterprise resource planning (ERP) tools in 2015 (weighted 12.5 percent); and use of analytical customer relationship software (CRM) tools by enterprises in 2015 (weighted 12.5 percent).

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 30: E-Business

Rank	Country	Score	Rank	Country	Score
1	Netherlands	84.11	15	France	44.29
2	Finland	79.93	16	Slovakia	42.17
3	Belgium	77.74	17	Spain	41.79
4	Malta	73.70	18	Germany	40.41
5	Austria	62.81	19	Italy	39.86
6	Portugal	59.93	20	Croatia	38.04
7	Denmark	58.82	21	Greece	37.27
8	Luxembourg	56.41	22	Romania	34.72
9	Sweden	53.96	23	Czech Republic	31.34
10	United Kingdom	53.91	24	Bulgaria	29.16
11	Lithuania	51.83	25	Cyprus	23.72
12	Estonia	46.47	26	Poland	18.48
13	Slovenia	46.17	27	Hungary	16.93
14	Ireland	45.23	28	Latvia	11.17

Map 30: E-Business



E-BUSINESS: USE OF BIG DATA

The percentage of businesses analyzing and using big data from any source.

Why is this important? This is the broadest of the e-business measurements, but it gets to the heart of why data innovation in business matters: businesses that analyze and use big data can make better decisions and become more competitive.[32] Businesses can use big data for an uncountable number of purposes, such as fraud detection, quality assurance, optimizing maintenance routines, and improving customer relations.[33]

The rankings: The top five countries are the Netherlands, Malta, Belgium, the UK, and Finland. The bottom five are Bulgaria, Hungary, Poland, Germany, and Cyprus. The average percentage of businesses using big data was just 11.06 percent. Germany's result is surprising, given the importance of big data in improving competitiveness in manufacturing, and the importance of manufacturing in Germany. Germany scored high on RFID, ERP, and CRM, but low on big data, and on the use of cloud computing—something which is essential for handling big data.

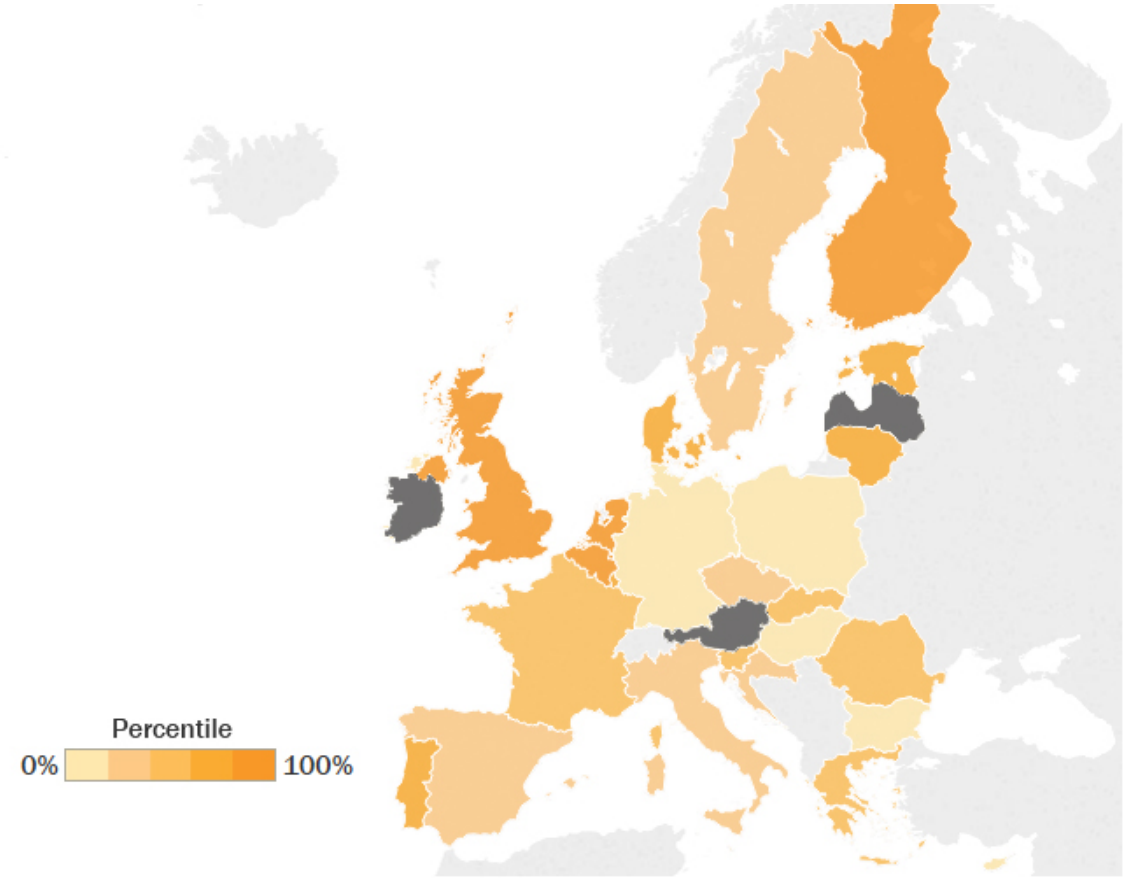
Methodology: The percentage of businesses analyzing big data from any source. This data was not available for Austria, Ireland, or Latvia.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 31: E-Business—Use of Big Data
(Data not available for Austria, Ireland, or Latvia)

Rank	Country	Percentage	Rank	Country	Percentage
1	Netherlands	19.07%	14	Slovenia	11.00%
2	Malta	18.63%	15	Slovakia	10.78%
3	Belgium	17.00%	16	Sweden	9.93%
4	United Kingdom	15.40%	17	Croatia	9.30%
5	Finland	14.78%	18	Italy	9.04%
6	Portugal	13.39%	19	Czech Republic	8.51%
7	Estonia	12.74%	20	Spain	8.29%
8	Luxembourg	12.53%	21	Bulgaria	7.23%
9	Lithuania	12.02%	22	Hungary	6.96%
10	Denmark	11.71%	23	Poland	5.90%
11	Greece	11.42%	24	Germany	5.71%
12	France	11.32%	25	Cyprus	2.62%
13	Romania	11.18%			

Map 31: E-Business—Use of Big Data
(Data not available for Austria, Ireland, or Latvia)



E-BUSINESS: USE OF CLOUD COMPUTING

The percentage of businesses making use of cloud computing.

Why is this important? Cloud computing services grant businesses access to computing power and storage capacity that would otherwise fall well outside their budget, allowing them to run a far greater variety of data-intensive applications and collect a far greater quantity of data for analysis.

The rankings: The top five countries are Finland, Sweden, Denmark, Ireland, and the UK, and the bottom five are Greece, Latvia, Poland, Romania, and Bulgaria. The average number of businesses using cloud computing in each country was 22.26 percent.

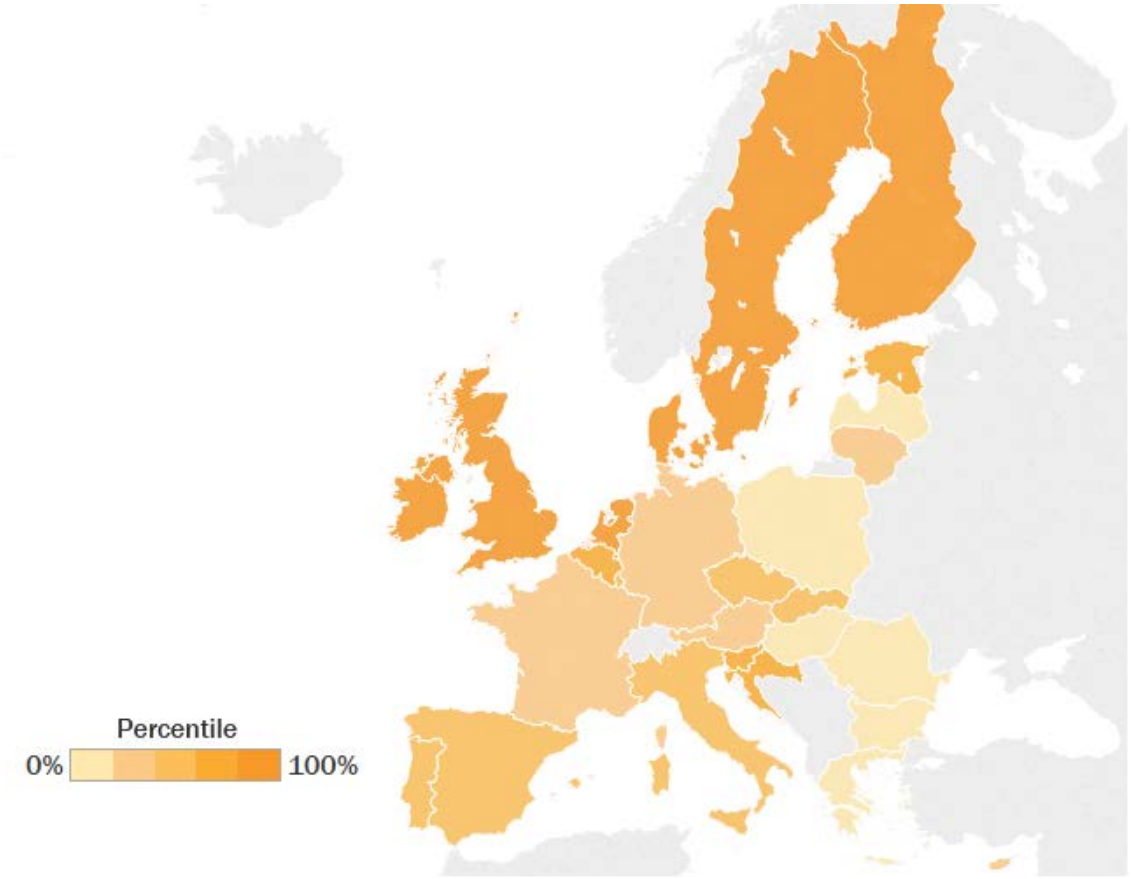
Methodology: This measurement shows the percentage of businesses using cloud-based services.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 32: E-Business—Use of Cloud Computing

Rank	Country	Percentage	Rank	Country	Percentage
1	Finland	56.92%	15	Czech Republic	18.00%
2	Sweden	48.16%	16	Portugal	17.95%
3	Denmark	41.60%	17	Slovakia	17.89%
4	Ireland	36.08%	18	France	17.11%
5	United Kingdom	34.66%	19	Austria	17.05%
6	Netherlands	34.53%	20	Lithuania	16.64%
7	Belgium	28.46%	21	Germany	16.26%
8	Malta	28.45%	22	Cyprus	15.26%
9	Estonia	22.84%	23	Hungary	12.19%
10	Croatia	22.61%	24	Greece	9.21%
11	Slovenia	22.17%	25	Latvia	8.37%
12	Italy	21.51%	26	Poland	8.17%
13	Luxembourg	18.83%	27	Romania	7.29%
14	Spain	18.34%	28	Bulgaria	6.70%

Map 32: E-Business—Use of Cloud Computing



E-BUSINESS: USE OF RADIO FREQUENCY IDENTIFICATION

The percentage of businesses using RFID technology to log physical objects.

Why is this important? RFID allows businesses to keep track of their inventories, buildings, and other physical assets digitally, providing them with data they can analyze to improve efficiency.

The rankings: The top five countries are Finland, Austria, Bulgaria, Belgium, and Luxembourg. The bottom five countries are Poland, Ireland, the Czech Republic, the United Kingdom, and Greece. The average percentage of businesses using RFID in each country is 10.96 percent.

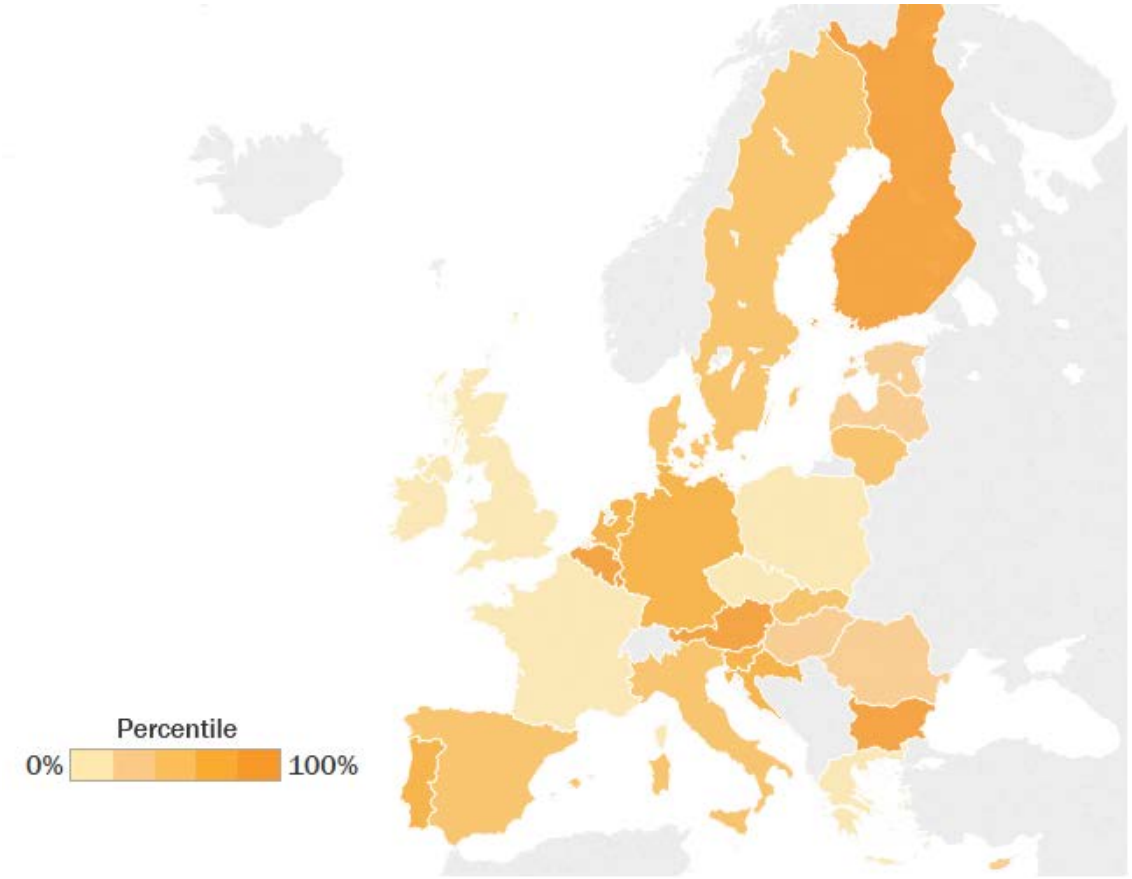
Methodology: This measurement shows the percentage of businesses using RFID devices.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 33: E-Business—Use of RFID

Rank	Country	Percentage	Rank	Country	Percentage
1	Finland	20.87%	15	Denmark	10.58%
2	Austria	18.32%	16	Italy	10.52%
3	Bulgaria	17.31%	17	Sweden	8.96%
4	Belgium	16.55%	18	Estonia	8.45%
5	Luxembourg	15.21%	19	Romania	8.07%
6	Malta	14.70%	20	Cyprus	8.03%
7	Portugal	14.50%	21	Latvia	7.61%
8	Germany	13.89%	22	Hungary	7.39%
9	Slovenia	13.38%	23	France	6.57%
10	Croatia	12.27%	24	Poland	6.15%
11	Netherlands	11.99%	25	Ireland	6.07%
12	Slovakia	11.62%	26	Czech Republic	5.80%
13	Spain	11.04%	27	United Kingdom	5.76%
14	Lithuania	10.86%	28	Greece	4.32%

Map 33: E-Business—Use of RFID



E-BUSINESS: USE OF ENTERPRISE RESOURCE PLANNING SOFTWARE

The percentage of businesses using ERP software to automate business processes.

Why is this important? ERP software automates business processes, such as scheduling tasks, and advanced forms of it use artificial intelligence to interpret data about the enterprise and adapt its routines and schedules accordingly.[34] It is therefore an importance source of data-driven efficiency in modern businesses.

The rankings: The top five countries are Germany, Belgium, Denmark, the Netherlands, and Portugal. The bottom five are Romania, Poland, the UK, Hungary, and Latvia. The average percentage of businesses using ERP in each country is 33.79 percent.

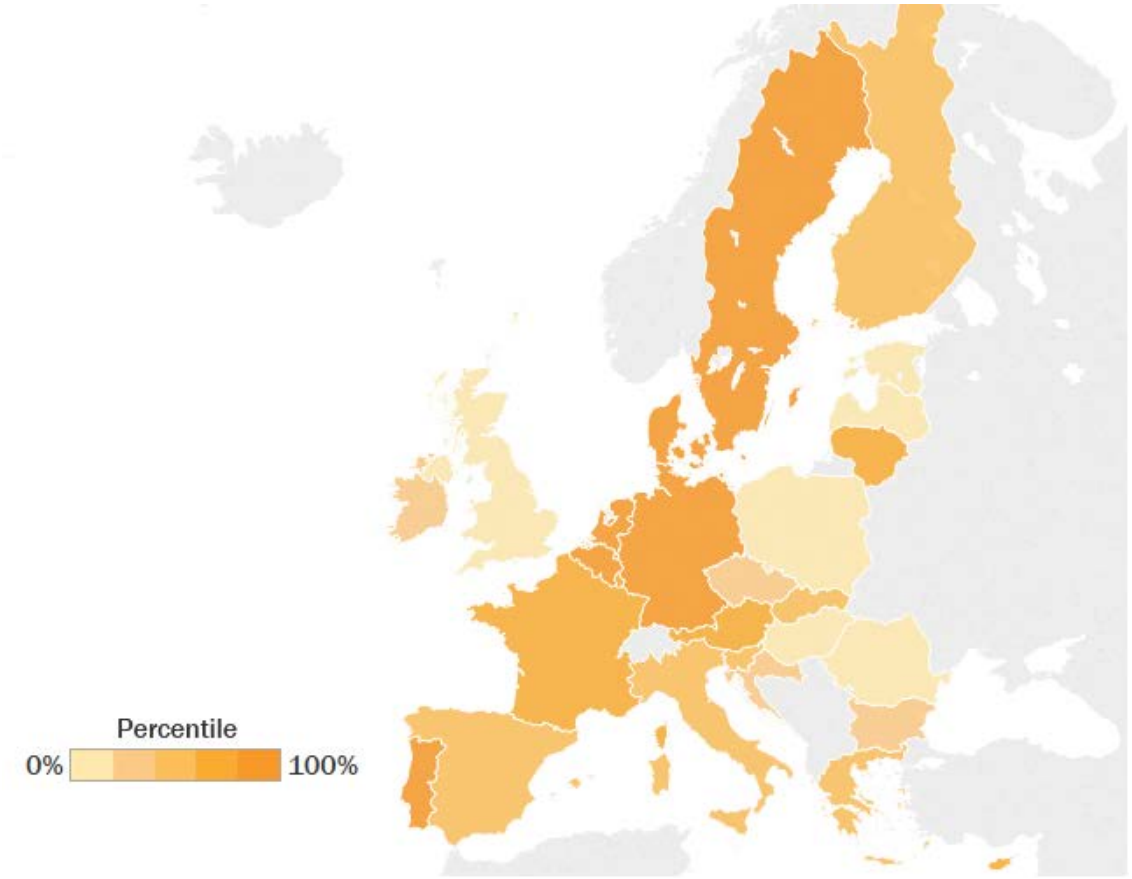
Methodology: This measurement shows the percentage of businesses using ERP software.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 34: E-Business—Use of ERP

Rank	Country	Percentage	Rank	Country	Percentage
1	Germany	56.48%	15	Spain	35.17%
2	Belgium	50.04%	16	Slovenia	32.90%
3	Denmark	46.52%	17	Slovakia	30.40%
4	Netherlands	44.75%	18	Czech Republic	30.25%
5	Portugal	43.84%	19	Malta	29.55%
6	Sweden	42.82%	20	Croatia	28.67%
7	Cyprus	42.77%	21	Ireland	25.07%
8	Austria	41.12%	22	Bulgaria	24.93%
9	Lithuania	40.10%	23	Estonia	22.25%
10	France	39.32%	24	Romania	21.99%
11	Luxembourg	38.73%	25	Poland	20.86%
12	Greece	36.53%	26	United Kingdom	16.70%
13	Finland	36.51%	27	Hungary	16.02%
14	Italy	35.92%	28	Latvia	15.86%

Map 34: E-Business—Use of ERP



E-BUSINESS: USE OF CUSTOMER RELATIONSHIP MANAGEMENT SOFTWARE

The percentage of businesses using CRM software to manage customer interactions.

Why is this important? CRM tools allow firms to build datasets that they can use to improve customer service and make it more efficient. CRM tools can analyze interactions and present salient information to staff, and automate some responses using artificial intelligence.[35]

The rankings: The top five countries are the Netherlands, Finland, Ireland, Spain, and Cyprus. The bottom five are Croatia, Greece, Latvia, Bulgaria, and Hungary. On average, 20.61 percent of businesses in each country use CRM.

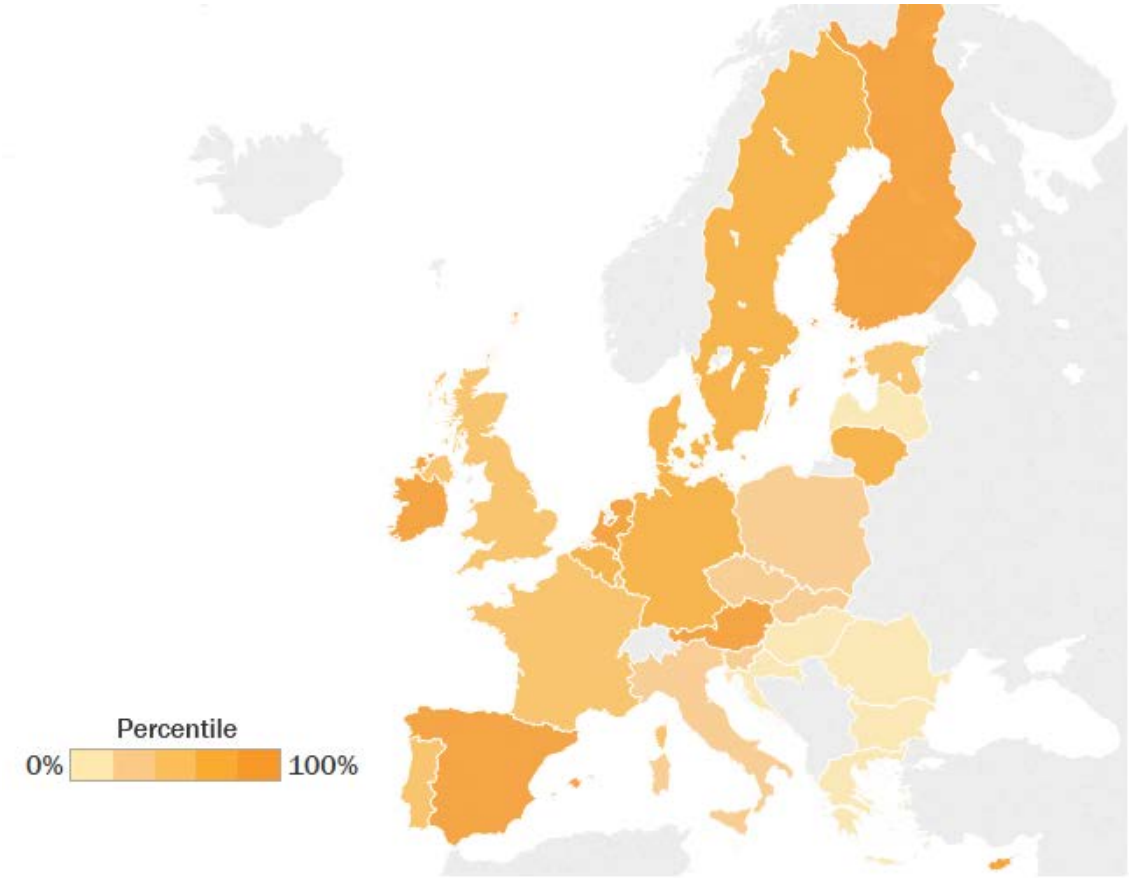
Methodology: This measurement shows the percentage of businesses using CRM software. It is worth 12.5 percent of the e-business indicator.

Source: *Digital scoreboard* (European Commission, 2016), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 35: E-Business—Use of CRM

Rank	Country	Percentage	Rank	Country	Percentage
1	Netherlands	29.57%	15	United Kingdom	20.21%
2	Finland	28.11%	16	Estonia	19.92%
3	Ireland	27.37%	17	France	19.50%
4	Spain	26.53%	18	Italy	18.66%
5	Cyprus	26.32%	19	Poland	17.69%
6	Austria	26.27%	20	Czech Republic	17.44%
7	Sweden	24.86%	21	Slovenia	16.95%
8	Germany	23.69%	22	Slovakia	16.69%
9	Belgium	23.61%	23	Romania	15.44%
10	Lithuania	22.84%	24	Croatia	15.40%
11	Denmark	22.78%	25	Greece	14.94%
12	Portugal	22.40%	26	Latvia	13.56%
13	Luxembourg	22.25%	27	Bulgaria	13.34%
14	Malta	21.52%	28	Hungary	9.18%

Map 35: E-Business—Use of CRM



WORKFORCE

The data skills of the labor force.

Why is this important? Success in the data economy requires a workforce with the skills necessary to operate the latest technology and process and analyze complex data sets.

The rankings: The top five countries are Finland, Luxembourg, Sweden, the Netherlands and Denmark. Finland ranks first for ICT specialists (6.5 percent of the workforce, compared to an EU 3.44 percent) but fourth for workers with above basic ICT skills (41 percent, EU average 29.04 percent) and second place for R&D personnel (9.52 per 1,000 population, EU average 5.29). On ICT skills, Luxembourg scores highest (56 percent), followed by Denmark (48 percent) and the Netherlands (43 percent). Sweden had the second-highest proportion of ICT specialists (6.1 percent). Denmark scores highest for R&D personnel (10.51 per 1,000 population).

The bottom five in ranking are Poland, Bulgaria, Cyprus, Greece, and Romania. Only nine percent of Romania's workforce has above basic ICT skills, the lowest percentage in the EU. Neighboring Bulgaria had the second-lowest proportion, 13 percent. However, ICT specialists make up a larger proportion of the Romanian workforce than of the Greek workforce (1.9 percent compared to 1.2 percent). Cyprus, meanwhile had the lowest proportion of R&D personnel (just under 1.5 per 1,000 population) of any EU country. Fifteen percent of both Cypriot and Polish workers had above-average ICT skills, a smaller percentage than Greece (16 percent) but a greater one than Bulgaria (13 percent). Poland did better than the other four due to its higher proportion of ICT specialists: 2.6 percent, which is below average, but still better than many higher-ranking countries Latvia (2.2 percent) Italy (2.5 percent), Lithuania (2.1 percent), Portugal (2.3 percent), and Spain (2.4 percent).

Methodology: The workforce indicator is worth 25 percent of the people and firms category. It combines three measurements: ICT specialists as a percentage of the employed workforce (weighted 50 percent), the percentage of the population with better than basic ICT skills (weighted 30 percent), and the number of R&D personnel per 1,000 population (weighted 20 percent).

Source: "Employed ICT Specialists – Total" *Eurostat,* [isoc_sks_itspt], (European Commission, last updated September 14, 2017).

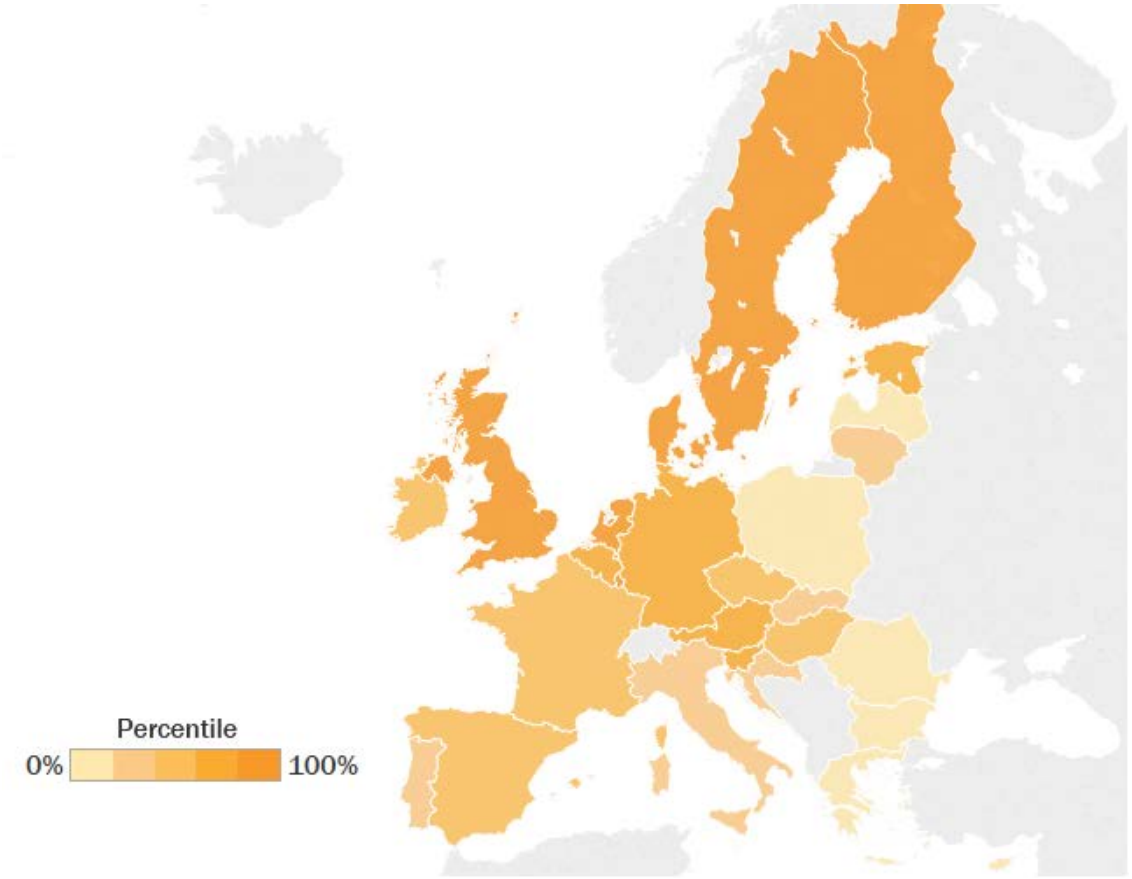
"Individuals' level of digital skills" *Eurostat,* [isoc_sk_dskl_i], (European Commission, last updated April 26, 2017).

"Population on 1 January by age and sex" *Eurostat,* [demo_pjan], (European Commission, last updated January 15, 2017).

Table 36: Workforce

Rank	Country	Score	Rank	Country	Score
1	Finland	88.25	15	Malta	42.74
2	Luxembourg	79.43	16	Hungary	36.02
3	Sweden	78.51	17	Spain	30.97
4	Netherlands	70.52	18	Slovakia	29.82
5	Denmark	70.37	19	Croatia	29.50
6	United Kingdom	65.87	20	Portugal	29.21
7	Austria	56.04	21	Lithuania	27.53
8	Estonia	54.53	22	Italy	24.43
9	Germany	53.40	23	Latvia	23.37
10	Belgium	52.63	24	Poland	19.81
11	Slovenia	46.17	25	Bulgaria	15.56
12	France	44.79	26	Cyprus	13.26
13	Ireland	44.08	27	Greece	10.00
14	Czech Republic	42.77	28	Romania	6.78

Map 36: Workforce



WORKFORCE: ICT SPECIALISTS IN EMPLOYMENT

The proportion of ICT specialists in the labor force.

Why is this important? To make the most of data-driven technologies, companies need ICT specialists with the expertise to deploy such technologies, integrate them with the firm's business processes, and train staff in how to use them.

The rankings: The top five countries are Finland first, Sweden second, the Netherlands and the UK tied in third place, and Luxembourg fifth. The bottom five are Cyprus and Latvia tied at 24th, Lithuania 26th, Romania 27th, and Greece 28th. The variation in the percentages between countries is, proportionally, quite large: from 1.2 percent in Greece to more than five times that in Finland, with 6.5 percent. The average percentage is 3.44 percent.

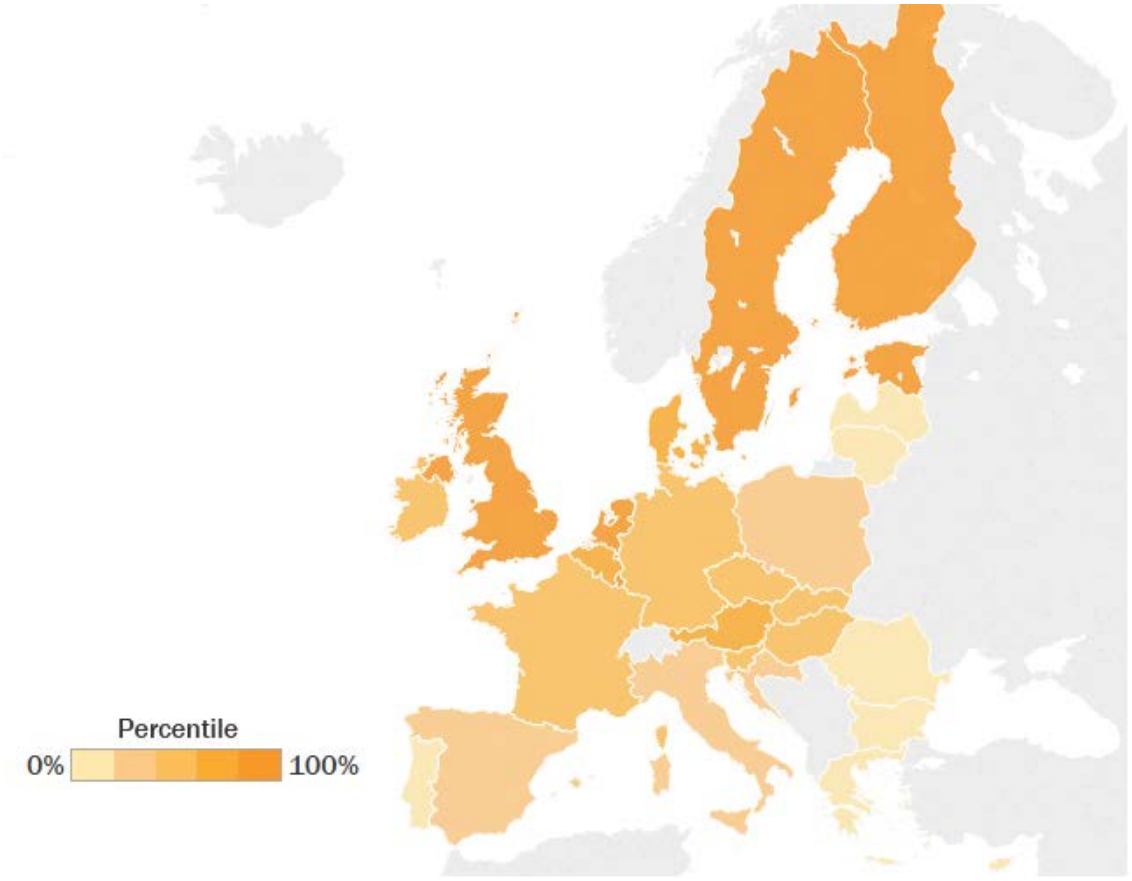
Methodology: This shows the number of employed ICT specialists as a percentage of the workforce in 2015.

Source: "Employed ICT Specialists – Total" *Eurostat,* [isoc_sks_itspt], (European Commission, last updated September 14, 2017).

Table 37: Workforce—ICT Specialists in Employment

Rank	Country	Percentage	Rank	Country	Percentage
1	Finland	6.50%	13	Malta	3.60%
2	Sweden	6.10%	13	Slovenia	3.60%
3	Netherlands	5.00%	17	Slovakia	2.80%
3	United Kingdom	5.00%	18	Croatia	2.70%
5	Luxembourg	4.60%	19	Poland	2.60%
6	Estonia	4.40%	20	Italy	2.50%
7	Belgium	4.20%	21	Spain	2.40%
8	Austria	4.00%	22	Bulgaria	2.30%
9	Denmark	3.90%	22	Portugal	2.30%
10	Czech Republic	3.70%	24	Cyprus	2.20%
10	Germany	3.70%	24	Latvia	2.20%
10	Ireland	3.70%	26	Lithuania	2.10%
13	France	3.60%	27	Romania	1.90%
13	Hungary	3.60%	28	Greece	1.20%

Map 37: Workforce—ICT Specialists in Employment



WORKFORCE: INDIVIDUALS WITH ABOVE BASIC ICT SKILLS

The percentage of the population with above basic ICT skills

Why is this important? Besides specialists in ICT, company bosses will also need the rest of their staff to develop more advanced ICT skills to make proper use of data throughout the business.

The rankings: The top five countries are Luxembourg, Denmark, the Netherlands, Finland, and the UK. The bottom five countries are Greece, Cyprus, Poland, Bulgaria, and Romania. Only in Luxembourg does more than half the population, 56 percent, have above basic skills. The percentages fall steadily as one moves down the rankings, to just nine percent in Romania. The average is just 29.04 percent. This highlights not only the large gap between countries, but also the need for Europe as a whole to improve the skills of its workforce.

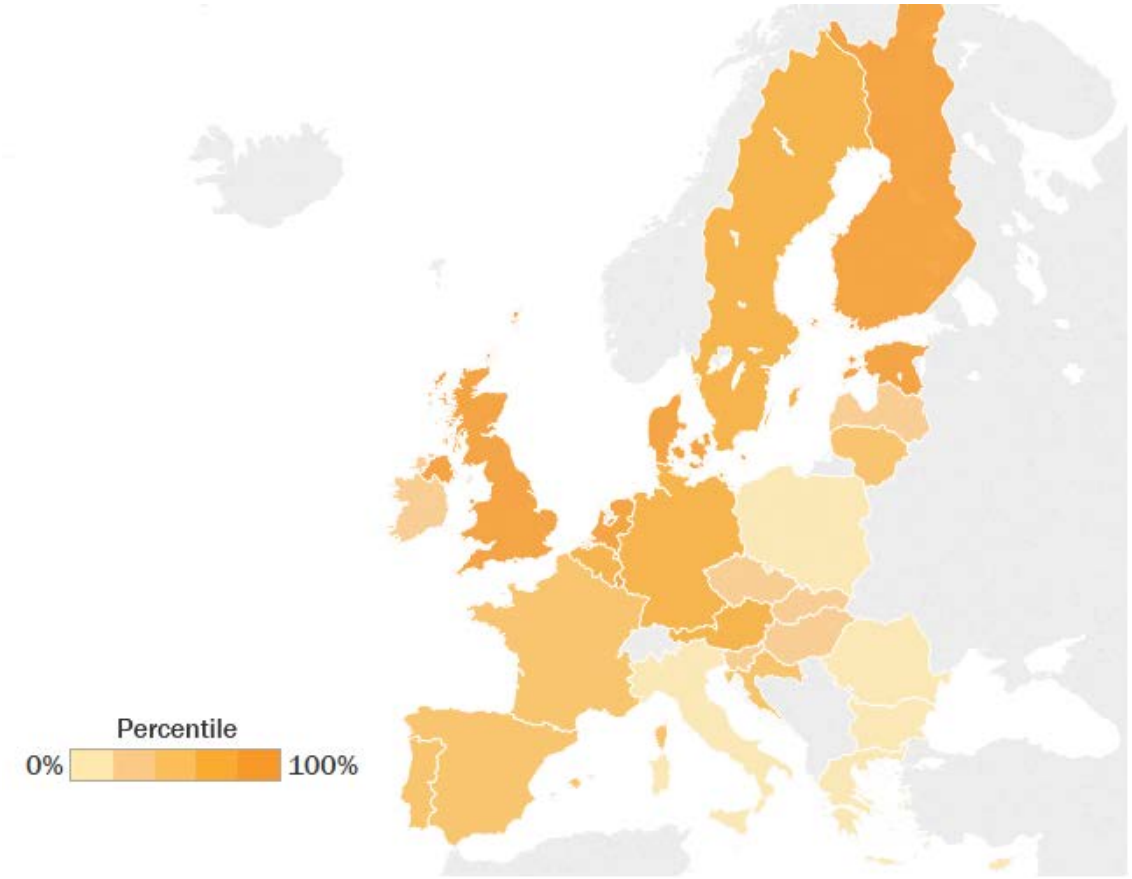
Methodology: This shows the percentage of the population identified as having better than basic ICT skills in 2015. This measurement is worth 30 percent of the workforce indicator.

Source: "Individuals' level of digital skills" *Eurostat,* [isoc_sk_dskl_i], (European Commission, last updated April 26, 2017).

Table 38: Workforce—Individuals With Above Basic ICT Skills

Rank	Country	Percentage	Rank	Country	Percentage
1	Luxembourg	56%	15	Portugal	28%
2	Denmark	48%	16	France	27%
3	Netherlands	43%	17	Latvia	26%
4	Finland	41%	17	Slovakia	26%
5	United Kingdom	40%	17	Slovenia	26%
6	Estonia	37%	20	Ireland	25%
7	Germany	35%	21	Czech Republic	23%
7	Sweden	35%	22	Hungary	22%
9	Malta	34%	23	Italy	19%
10	Austria	33%	24	Greece	16%
11	Belgium	31%	25	Cyprus	15%
12	Croatia	30%	25	Poland	15%
12	Lithuania	30%	27	Bulgaria	13%
12	Spain	30%	28	Romania	9%

Map 38: Workforce—Individuals With Above Basic ICT Skills



WORKFORCE: R&D PERSONNEL

The number of R&D personnel per employed in each member state, per 1,000 people.

Why is this important? R&D personnel are an important source of innovation in many businesses, as their job is to develop entirely novel processes, products, and services, as well as to improve on existing ones. As such, they play an important role in supporting data-driven innovation in businesses.

The rankings: The top five countries are Denmark, Finland, Luxembourg, Sweden, and Austria. The bottom five are Poland, Bulgaria, Croatia, Romania, and Cyprus. Like several other measurements in this category, the proportional differences between the top and bottom countries are huge. Denmark has 10.51 R&D personnel per 1,000 population, compared to only 1.49 in Cyprus. The average number of R&D personnel per 1,000 people is 5.29.

Methodology: This shows the number of employed R&D personnel (full time equivalents) per 1,000 population.

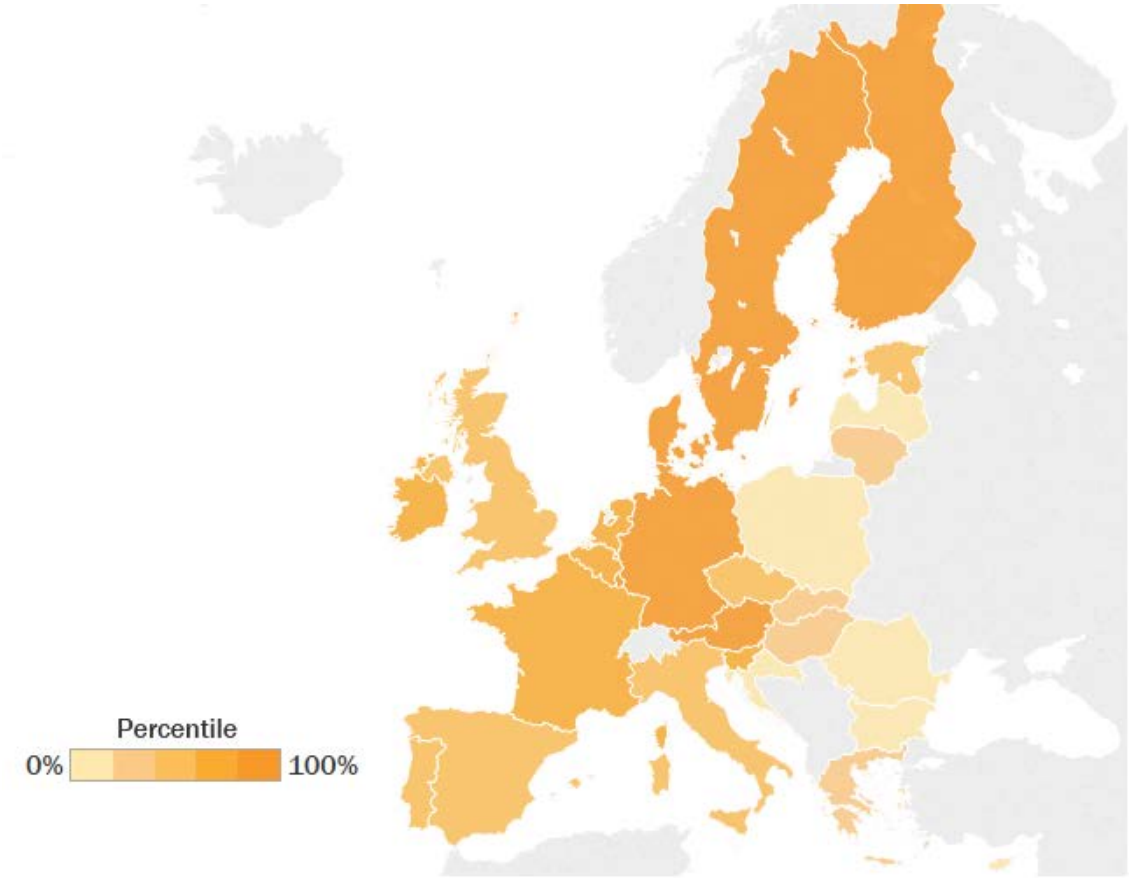
Source: Number of R&D Personnel: "Total R&D Personnel by sectors of performance, occupation, and sex" *Eurostat,* [rd_p_persocc], (European Commission, last updated March 6, 2017).

Population: "Population on 1 January by age and sex" *Eurostat,* [demo_pjan], (European Commission, last updated January 15, 2017).

Table 39: Workforce—R&D Personnel

Rank	Country	Per 1,000 Population	Rank	Country	Per 1,000 Population
1	Denmark	10.51	15	Estonia	4.41
2	Finland	9.53	16	Spain	4.31
3	Luxembourg	9.31	17	Italy	4.10
4	Sweden	8.56	18	Lithuania	4.04
5	Austria	7.94	19	Greece	3.99
6	Germany	7.45	20	Hungary	3.79
7	Netherlands	7.34	21	Malta	3.36
8	Slovenia	7.21	22	Slovakia	3.25
9	France	6.30	23	Latvia	2.89
10	Ireland	6.13	24	Poland	2.75
11	Belgium	6.13	25	Bulgaria	2.68
12	Czech Republic	6.12	26	Croatia	2.37
13	United Kingdom	6.11	27	Romania	1.58
14	Portugal	4.52	28	Cyprus	1.50

Map 39: Workforce—R&D Personnel



EDUCATION AND CIVIL SOCIETY

The extent to which education and civil society promote and encourage data skills and expertise.

Why is this important? This indicator measures how well member states' higher education systems are preparing young people for the data economy, and how well civil society provides outlets for those interested in practicing data science or learning more about it.

The rankings: The top five countries are Denmark, Ireland, the United Kingdom, Finland, and the Netherlands. The bottom five are Estonia, Italy, Latvia, Cyprus, and Luxembourg. Although Denmark does not rank first on any individual measurement, it comes out first on this indicator overall. The country ranks second for the number of advertised data-science groups: 0.30 per 10,000 inhabitants in Copenhagen, compared an average for EU capitals of 0.10. Only the Netherlands scores higher, with 0.31. Denmark's performances on the other two measurements are above average: 0.96 masters programs advertised per 10,000 students (5th highest, EU average 0.05) and 20.7 science and technology graduates per 1,000 inhabitants (joint 6th place with Spain, EU average 16.6).

Luxembourg, Cyprus, Latvia and Estonia had zero data science or big data master's programs advertised on MastersPortal. Italy had seven, or 0.38 per 10,000 students, but ranks lower than several countries with zero due to its poor performance on the other measurements. Rome had the smallest proportion of data science or big data groups advertised on Meetup: 0.01 per 10,000 inhabitants. Luxembourg has the smallest proportion of science and technology graduates—3.5 per 1,000 population, less than half next-place Cyprus with 9.2. Interestingly, the Netherlands—which came in fifth overall—also scored very low here, with only 9.9, putting it in 26th place for this measurement.

Methodology: The Education and Civil Society indicator is worth 25 percent of the people and firms category. It consists of three measurements: data-science groups in the capital city advertised on Meetup per 10,000 residents of the capital (weighted 40 percent), the number of science and technology graduates per 1,000 of national population aged 20-29 in 2012 (weighted 40 percent), and the number of data science and big data degree programs advertised on MastersPortal.eu per 10,000 students enrolled in tertiary education in 2015 (weighted 20 percent).

Source: Data-Science Degree programs: *MastersPortal,* http://www.mastersportal.eu, accessed March 2017.

Data-Science Groups: *Meetup,* www.meetup.com, accessed March 2017.

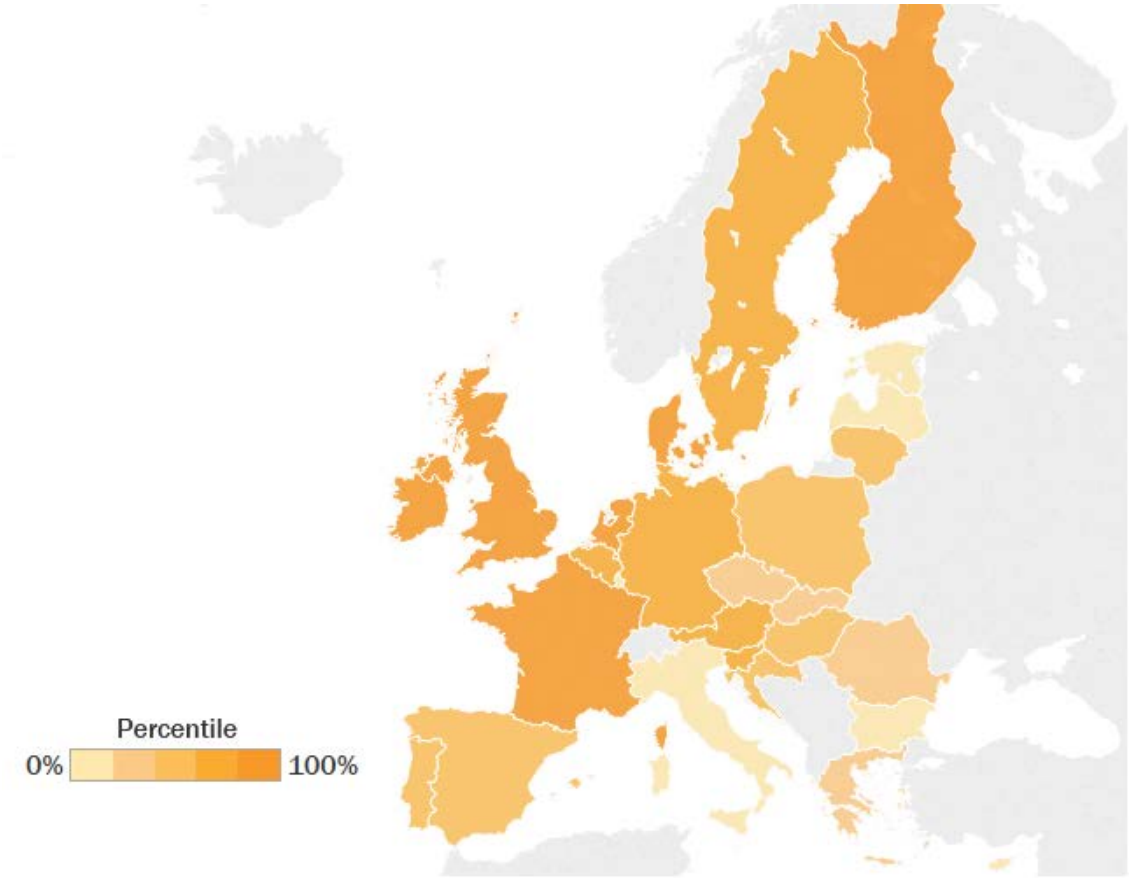
Science and Technology Graduates: "Science and technology graduates by sex" *Eurostat* [tps00188] (European Commission, last updated September 15, 2015).

City population data: "Population on 1 January by Age Groups and sex – cities and greater cities" *Eurostat,* [urb_cpop1] (European Commission, last updated September 12, 2017), http://ec.europa.eu/eurostat.

Table 40: Education and Civil Society

Rank	Country	Score	Rank	Country	Score
1	Denmark	79.42	15	Poland	39.82
2	Ireland	73.05	16	Hungary	30.87
3	United Kingdom	64.68	17	Croatia	29.67
4	Finland	62.58	18	Slovakia	29.66
5	Netherlands	61.05	19	Romania	28.26
6	France	53.72	20	Czech Republic	27.54
7	Germany	53.29	21	Malta	27.01
8	Austria	51.66	22	Greece	26.30
9	Belgium	47.68	23	Bulgaria	24.51
10	Slovenia	47.08	24	Estonia	23.62
11	Sweden	46.79	25	Italy	21.95
12	Lithuania	44.54	26	Latvia	21.46
13	Portugal	41.92	27	Cyprus	14.52
14	Spain	41.87	28	Luxembourg	8.19

Map 40: Education and Civil Society



EDUCATION AND CIVIL SOCIETY: DATA-SCIENCE GROUPS

The number of data science Meetup groups in each member state's capital city per 10,000 inhabitants.

Why is this important? Data-science groups are an indicator of how much interest there is in data science among civil society, and of activity in the field outside of institutions like businesses or universities. Data-science groups encourage knowledge sharing among data scientists, helping individuals to continue to develop their skills outside education and the workplace, and encouraging a very serendipitous kind of innovation, such as through uses of open data.[36]

The rankings: The top five countries are the Netherlands, Denmark, Ireland, Belgium, and Germany. The bottom five are Romania, Bulgaria, Greece, and Italy. The proportional gaps are huge: controlling for population, Amsterdam has over 20 times as many data-science groups as Rome, with 0.306 per 10,000 inhabitants in the former and 0.013 in the latter, and with an average of 0.098 per 10,000 people.

Methodology: This shows the number of groups for "data science" on Meetup in each member state's capital city, per 10,000 inhabitants of the capital. It is worth 40 percent of the education and civil society indicator.

Meetup's search algorithms help to avoid the problem of language bias by matching common keywords across languages. For example, a search for "Επιστήμη δεδομένων" (*Epistími dedoménon*, or "data science" in Greek) in German-speaking Vienna will nevertheless yield results such as "Hadoop User Group Vienna." For this reason, we searched in English and treated indicators for the three capital cities where English is an official language (London, Dublin, and Valetta) no differently from those where it is not.

The availability on Eurostat of cities' populations for each year varies, so we used the most recent year in each case. Wherever there was a choice between a city and a "greater" city, we chose the latter: for example, though Greater London is the largest city in the EU, the City of London has a population of just a few thousand people, and is not representative of London as an urban conglomeration.

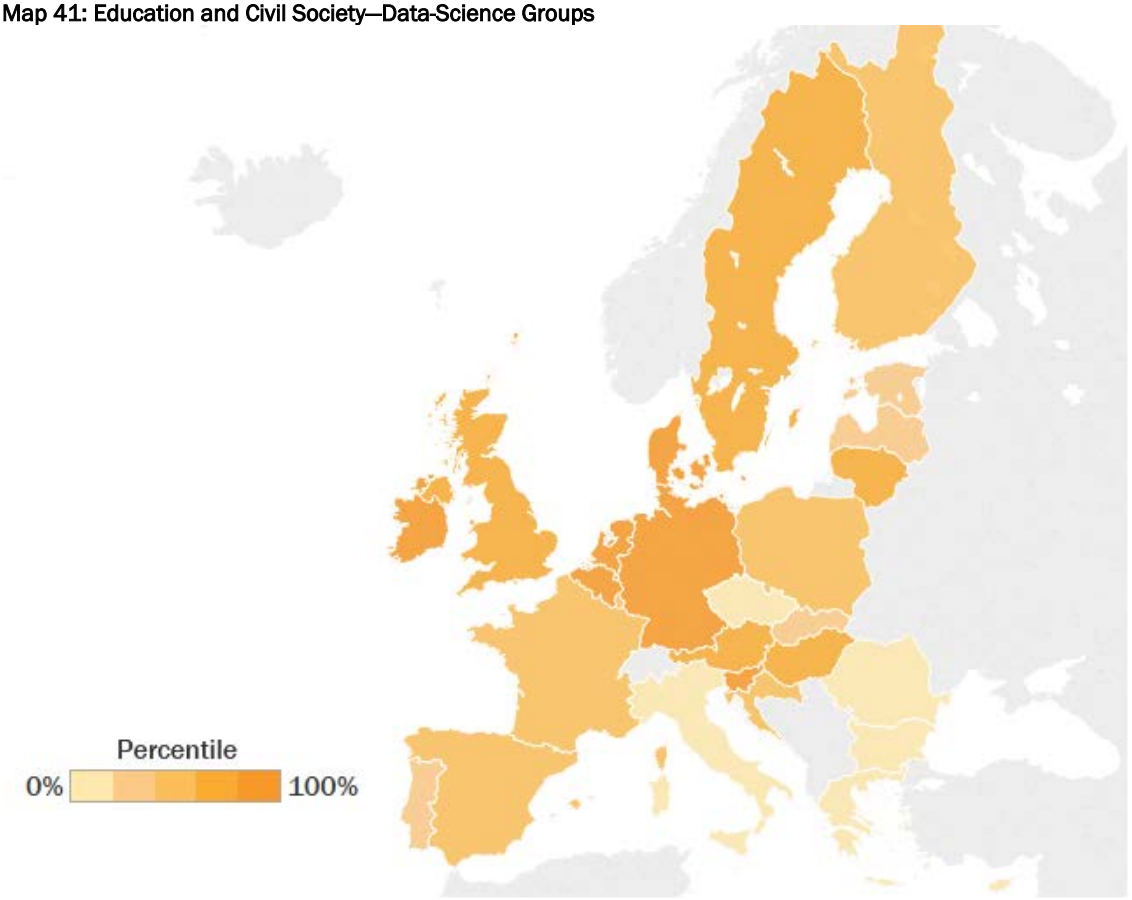
Source: Data-science groups: *Meetup,* www.meetup.com, accessed March 2017.

Capital city population: "Population on 1 January by age groups, and sex – cities and greater cities" *Eurostat* [urb_cpop1] (Last updated September 12, 2017).

Table 41: Education and Civil Society—Data-Science Groups

Rank	Country	Per 10,000 Inhabitants of Capital City	Rank	Country	Per 10,000 Inhabitants of Capital City
1	Netherlands	0.31	15	Finland	0.07
2	Denmark	0.30	16	Croatia	0.06
3	Ireland	0.20	17	Spain	0.06
4	Belgium	0.19	18	Portugal	0.05
5	Germany	0.18	19	Estonia	0.05
6	Slovenia	0.14	20	Malta	0.05
7	Hungary	0.13	21	Slovakia	0.05
8	United Kingdom	0.12	22	Latvia	0.05
9	Sweden	0.11	23	Cyprus	0.04
10	Austria	0.10	24	Romania	0.04
11	Lithuania	0.10	25	Czech Republic	0.03
12	France	0.09	26	Bulgaria	0.03
13	Poland	0.09	27	Greece	0.02
14	Luxembourg	0.07	28	Italy	0.01

Map 41: Education and Civil Society—Data-Science Groups



EDUCATION AND CIVIL SOCIETY: SCIENCE AND TECHNOLOGY GRADUATES

The number of people with science and technology degrees per 1,000 population.

Why is this important? The number of science and technology graduates provides a rough approximation of graduates with skills relevant to the data economy.

The rankings: The top five countries are Ireland, France, the UK, Austria, and Finland. The bottom five are Latvia, Hungary, the Netherlands, Cyprus, and Luxembourg. The average number of graduates is 16.9 in every 1,000, ranging from 24.7 in Ireland to just 3.5 in Luxembourg.

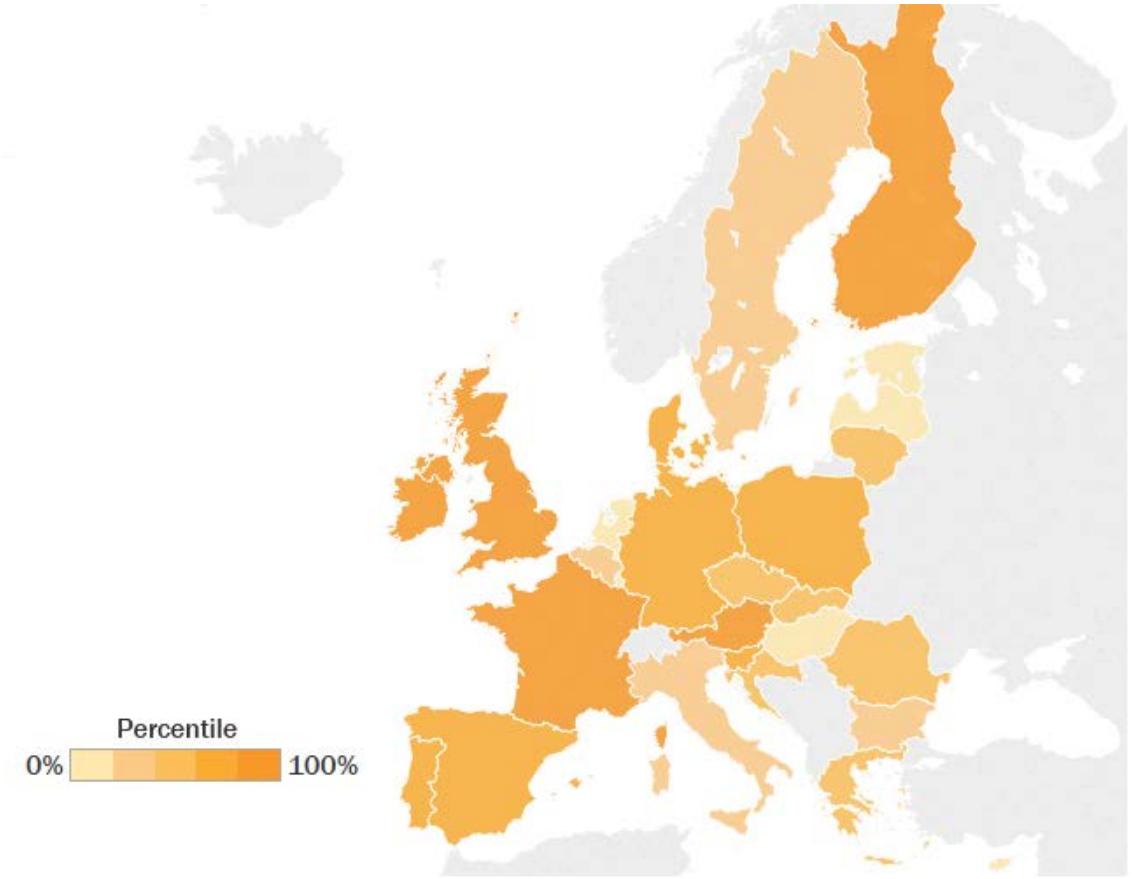
Methodology: This shows the number of people with science and technology degrees per 1,000 of the population aged 20-29 in 2014. It is worth 40 percent of the education and civil society indicator.

Source: *Digital scoreboard* (European Commission, 2014), http://digital-agenda-data.eu/charts/analyse-one-indicator-and-compare-countries, accessed September 25, 2017.

Table 42: Education and Civil Society—Science and Technology Graduates

Rank	Country	Per 1,000 Population	Rank	Country	Per 1,000 Population
1	Ireland	24.7	15	Greece	16.2
2	France	23.4	16	Romania	16.0
3	United Kingdom	22.7	17	Croatia	15.7
4	Austria	22.5	18	Malta	15.3
5	Finland	21.9	19	Sweden	14.6
6	Denmark	20.7	20	Belgium	13.9
6	Spain	20.7	21	Bulgaria	13.7
8	Portugal	20.4	22	Italy	13.6
9	Slovenia	19.3	23	Estonia	13.5
10	Poland	19.1	24	Latvia	12.5
11	Germany	18.7	25	Hungary	11.3
12	Lithuania	18.2	26	Netherlands	9.9
13	Slovakia	16.8	27	Cyprus	9.2
14	Czech Republic	16.6	28	Luxembourg	3.5

Map 42: Education and Civil Society—Science and Technology Graduates



EDUCATION AND CIVIL SOCIETY: DATA-SCIENCE DEGREE PROGRAMS

The number of advertised of data science postgraduate programs for international students, per 10,000 students enrolled in tertiary education.

Why is this important? Data science degree programs on offer in a given country serve as a proxy for how keen that country's higher education system is to attract and educate those with an affinity for data science and innovation, as well as demand from that country's professionals for additional training in this field. Data science is a field of study that brings together a variety of disciplines, particularly computer science and mathematics, dedicated to acquiring useful insights from the analysis of large datasets. The diverse skillset involved in the study of data science is vital for the pursuit of data innovation in the economy and in society, and is in short supply in today's labor market.

The rankings: The top five countries are Finland, the UK, Sweden, the Netherlands, and Denmark. The bottom ten countries all scored zero: Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Luxembourg, Malta, Slovakia, and Slovenia.

Given that this is a measurement of postgraduate degree programs aimed at international students who can speak English, it is interesting to see that after controlling for population, the top country is not English-speaking, and that only one of Europe's three countries where English is an official language (the UK, Ireland, and Malta) makes the top five—one of them is even relegated to the bottom five.

Methodology: This shows the number of courses listed under "Data Science and Big Data" on MastersPortal, a portal for postgraduate education in the EU. We express this figure per 10,000 students in tertiary education. It is worth 20 percent of the education and civil society indicator.

We weighted this measurement low due to the portal's bias towards degrees in English: it does not turn up data-science degrees in any other language.

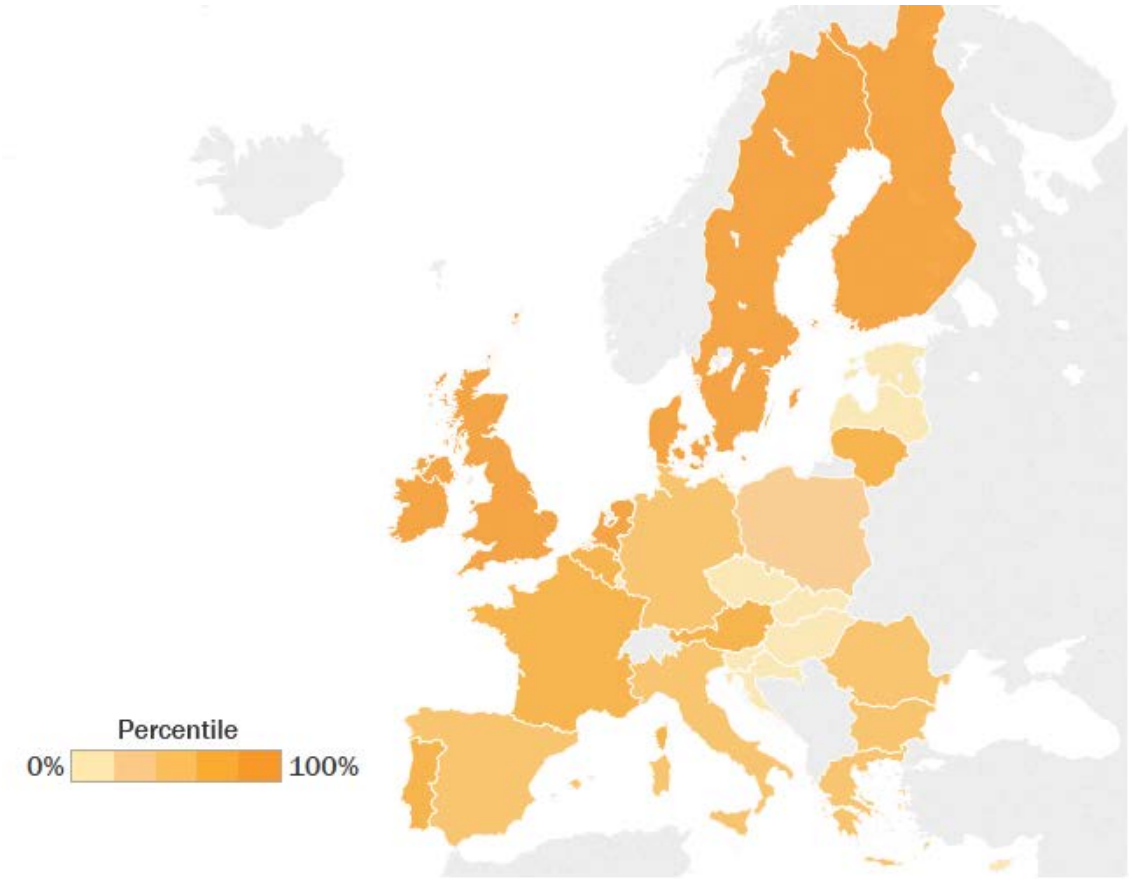
Source Data science degree programs: *MastersPortal,* http://www.mastersportal.eu, accessed March 2017.

Students enrolled in Tertiary Education in 2015: "Students enrolled in tertiary education by education level, programme orientation, sex, type of institution and intensity of participation" *Eurostat,* [educ_uoe_enrt01], (European Commission, last updated August 1, 2017).

Table 43: Education and Civil Society—Data-Science Degree Programs

Rank	Country	Per 10,000 Tertiary Students	Rank	Country	Per 10,000 Tertiary Students
1	Finland	2.64	15	Germany	0.27
2	United Kingdom	1.89	16	Romania	0.18
3	Sweden	1.63	17	Greece	0.15
4	Netherlands	1.19	18	Poland	0.06
5	Denmark	0.96	19	Croatia	0.00
6	Ireland	0.93	19	Cyprus	0.00
7	Lithuania	0.71	19	Czech Republic	0.00
8	France	0.70	19	Estonia	0.00
9	Belgium	0.59	19	Hungary	0.00
10	Portugal	0.59	19	Latvia	0.00
11	Austria	0.47	19	Luxembourg	0.00
12	Spain	0.46	19	Malta	0.00
13	Italy	0.38	19	Slovakia	0.00
14	Bulgaria	0.36	19	Slovenia	0.00

Map 43: Education and Civil Society—Data-Science Degree Programs



RECOMMENDATIONS

It is beyond the scope of this report to provide a detailed national data policy agenda, but it is nevertheless possible to identify policy priorities to support data innovation. These priorities should be to make data available for public and commercial use and to develop the necessary technological infrastructure, as well as human and firm capital, to make use of data.

MAXIMIZE THE SUPPLY OF REUSABLE DATA

To promote the availability of data and encourage businesses to use it, policymakers should adopt policies that enable the free flow of data. For example, article 20 of the General Data Protection Regulation (GDPR), which gives data subjects a right to data portability, provides a good template to give operators of data-generating machinery (such as cars) a similar right to access and share non-personal data. Both sets of rights are well-supported by the use of open application programming interfaces (APIs) such as those mandated under the EU's new payment services directive (PSD2), as these allow customers to share their data with third parties in exchange for new services.[37]

National policymakers in individual member states should not embellish European data-protection rules or create regulatory fragmentation, as this would undermine the digital single market and would be a barrier to cross-border data-driven trade.[38] In addition, both they and their EU-level counterparts in Brussels should resist and seek to overturn excessive restrictions that limit the benefits of data innovation, such as unnecessary rules on the use of cookies in web browsers, ill-conceived requirements for AI applications, and limitations on the real-time sharing of car data in emergencies. Such limitations are not only unnecessary, but dangerous, because they inhibit innovations that could protect and improve people's lives.[39] Policymakers should also undertake reviews of where exemptions to data-sharing regulations could be created to enable beneficial uses of data, such as easing legal restrictions on using AI with medical data.[40]

Governments should also use data. Those member states that have not already done so should appoint national chief data officers with responsibility for identifying areas within government and in the wider economy where policymakers can use data to solve problems and increase efficiency, as France did in 2014.[41] Several member states lag far behind in their progress towards operationalizing e-government programs and services: they should focus first on digitizing basic transactions between citizens and the state. A reliable means of verifying identity online is essential to digitize the more sensitive transactions, but most EU member states already have a lot of the work done for them in the form of their national identity registers, which can support the introduction of e-ID cards. In countries where this is politically unpopular, such as the UK, governments can pursue federated, data-driven alternatives, such as the GOV.UK Verify system.

Governments should insist on the best use of data in important regulated sectors, such as health care and energy. Having health-care practitioners share data electronically cuts costs, saves time, and reduces clerical errors, by ensuring staff have access to the most accurate, up-to-date information available when caring for patients. Whether a country's health service operates as a government service or on a regulated social-insurance model, European governments should establish legal mandates for the creation of electronic health records. Meanwhile, in utilities, smart meters provide an important insight into energy use in both households and businesses, supporting

new, data-driven approaches to grid management. The EU should continue to encourage all member states to adopt them and work to ensure consumers have access to their energy data.

Governments should also routinely publish open data and empower citizens to demand access to specific information that is not published. The EU should mandate an "open by default" policy for all tiers of public administration so that unless there is a compelling and clearly-defined reason why a dataset should not be published, government should make it freely available, freely reusable, and machine readable.

Member states should also introduce robust freedom-of-information laws, because they allow citizens to frame their own specific questions, and they can cover information that might be difficult to represent in a structured dataset, such as qualitative evidence in departmental reports. However, the effectiveness of freedom-of-information laws can be undermined by bureaucratic corruption: it requires strong institutions where the rule of law prevails.

To support the supply and reuse of data throughout society, the vast majority of European governments also need to reform their libel laws to protect against libel chill, because libel chill depresses the supply of potentially useful information by intimidating people from contributing to it, and only a handful of countries have adequate legal measures to guard against such suppression.

IMPROVE INFRASTRUCTURE THAT SUPPORTS DATA INNOVATION

To make the best possible use of all of this data, governments need to adopt and widely promote the latest technologies for collecting, sharing, and analyzing it.

For example, the Internet of Things can yield important data in public infrastructure. Sensors in roads and public transport networks can measure congestion and indicate how services are being used, which alerts maintenance teams to problems in real time and supports better long-term planning. Governments should use the Internet of Things to learn more about the state of the services and infrastructure they are responsible for, and they should act on that data to address problems before they become too costly. Smart-city strategies are a useful way to encourage the adoption of the Internet of Things and to identify viable use cases. While local governments should have ultimate responsibility for individual smart-city strategies, national governments and the EU should support their efforts with financial resources and information sharing from other projects elsewhere in Europe. Every member state's government should draw up a national strategy for deploying the Internet of Things, and promoting smart cities should be a key aspect of their plans.[42]

Moreover, connected wearable devices have tremendously important implications for managing long-term health conditions, and health care is one of the areas where the Internet of Things carries the greatest promise, particularly when combined with advanced data-analysis tools, like artificial intelligence. European governments should push health services to use the most up-to-date technologies available, and should help them do this both by providing adequate funding for new health-care technologies, and by clearing outdated regulatory barriers when they get in the way of clinical trials.[43]

Both the EU and member states should push for constant improvement of broadband Internet access for individuals and businesses. Where the market fails to serve sparsely populated areas adequately, governments should step in with direct investment and leadership in public-private

partnerships. Member states should also pool their powers of mobile spectrum allocation at the EU level, because this will permit the development of integrated, pan-European wireless broadband networks and reduce costs that are needlessly duplicated throughout the single market.

With widespread access to broadband Internet, governments can provide a wider variety of public services digitally. If combined with integration and digitization of back-office government procedures, and not just limited to the point of contact, digital services can enable bureaucracies to become far more responsive to citizens' needs. Governments can incorporate data collection and analysis into service delivery, and at the same time reduce costs and allow citizens access to services at their own convenience, with greater speed and efficiency.

DEVELOP DATA-SCIENCE AND DATA-LITERACY SKILLS IN WORKERS

Finally, governments should invest in developing human and business capital. The data economy is a knowledge economy, and as its importance grows in coming years, so too will the need for data-related skills. There were over 6 million data workers employed in the EU in 2016, and this is projected to rise to more than 10 million by 2020. But the gap between demand and supply of these workers will rise too, from 420,000 to 769,000 during the same period.[44] Efforts to tackle this problem through the education system should not stop with schoolchildren and university students: Governments should also invest in adult education programs take account of budgets and work schedules.

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ACKNOWLEDGEMENTS

The authors would like to thank the following for their advice and support in the writing and publication of this report: Robert Atkinson, John Wu, Alex Key, and Matt Beckwith. Any errors, inaccuracies, or shortcomings are the sole responsibility of the authors.

APPENDIX A: WEIGHTS

Indicator	Weight
SECTION 1: DATA	1,200
Data Economy	**480**
Data Market Size	240
Data Companies	240
Open Data	**240**
Implementation	120
Impact	120
Data Sharing in Health Care	**240**
Freedom of Information	**120**
Right to Information	84
Corruption	36
Protection against libel chill	**120**
Legal Safeguards	60
Costs	36
Special Plaintiffs	24
SECTION 2: TECHNOLOGY	1,200
Internet of Things	**480**
Smart Meters	160
Smart Ticketing	160
Smart Cities	160
E-Government	**360**
Business Broadband	**240**
Connections Over 30 Mbps	180
Connections	60
Household Broadband	**120**
Access	60
Speed	60
SECTION 3: PEOPLE AND FIRMS	1,200
E-Business	**600**
Big Data	300
Cloud Computing	75
RFID	75
ERP	75
CRM	75
Workforce	**300**
ICT Specialists	150
ICT Skills	90
R&D Personnel	60
Education and Civil Society	**300**
Data-Science Groups	120
Science and Technology Graduates	120
Data-Science Degrees	60
TOTAL	3,600

APPENDIX B: SCORES

	Overall		Data		Data Economy		Data Market Size		Data Companies	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	7	53.1	15	36.3	15	25.9	18	20.4	14	31.5
Belgium	10	47.9	22	27.5	16	23.5	17	21.1	16	25.9
Bulgaria	27	27.0	18	32.9	12	33.6	5	42.9	17	24.4
Croatia	24	30.0	26	21.2	24	12.4	19	20.1	26	4.7
Cyprus	28	26.9	7	44.6	2	55.7	2	62.6	4	48.7
Czech Republic	22	30.8	20	30.4	25	11.5	21	18.6	27	4.4
Denmark	1	71.1	3	52.7	5	44.5	11	34.4	3	54.6
Estonia	6	61.1	1	73.4	1	100.0	1	100.0	1	100.0
Finland	2	69.4	5	50.4	11	34.3	12	33.3	11	35.3
France	11	47.0	10	41.5	18	21.6	23	16.7	15	26.5
Germany	13	44.9	9	41.6	13	31.3	13	27.3	12	35.3
Greece	25	28.7	27	18.2	26	9.9	27	4.6	23	15.2
Hungary	26	27.5	25	24.0	20	18.4	20	19.4	21	17.4
Ireland	8	49.6	14	36.6	17	23.2	16	22.9	18	23.5
Italy	21	31.3	23	26.5	23	13.2	26	8.9	20	17.6
Latvia	18	37.2	13	38.5	9	38.1	8	35.3	10	40.9
Lithuania	15	43.7	8	44.1	10	38.0	9	35.1	9	40.9
Luxembourg	14	44.5	28	14.6	28	5.0	28	0.0	25	10.0
Malta	9	48.7	11	39.0	4	44.7	4	44.3	7	45.1
Netherlands	3	65.8	6	47.5	8	40.1	7	37.2	8	43.0
Poland	20	32.7	19	31.0	14	30.4	14	25.6	13	35.2
Portugal	16	39.1	17	33.0	7	40.3	10	34.7	6	45.9
Romania	23	30.6	21	29.7	21	17.0	22	18.2	22	15.8
Slovakia	19	35.2	16	33.0	19	19.3	15	25.6	24	13.0
Slovenia	17	37.4	24	24.1	27	5.1	25	10.2	28	0.0
Spain	12	45.5	12	38.8	22	16.3	24	11.2	19	21.3
Sweden	4	65.0	4	52.1	6	43.6	6	39.3	5	47.9
United Kingdom	5	63.5	2	67.6	3	53.6	3	48.0	2	59.2

	Open Data		Implementation		Impact		Data Sharing in Health care		Freedom of Information	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	6	62.5	9	42.1	4	83.0	13	27.1	25	38.7
Belgium	15	19.8	18	18.4	14	21.3	9	39.4	11	54.1
Bulgaria	17	19.7	13	27.6	19	11.7	26	3.8	19	49.4
Croatia	22	4.3	21	0.0	21	8.5	25	6.3	5	73.3
Cyprus	*	*	*	*	*	*	14	21.5	28	4.3
Czech Republic	11	32.3	15	26.3	11	38.3	16	20.8	22	47.6
Denmark	4	68.7	2	61.8	5	75.5	1	100.0	9	64.7
Estonia	18	19.1	13	27.6	20	10.6	3	77.1	8	69.8
Finland	9	46.0	7	47.4	9	44.7	4	71.1	1	86.4
France	2	77.7	2	61.8	2	93.6	10	39.4	14	51.9
Germany	5	67.4	5	59.2	5	75.5	15	21.4	12	53.8
Greece	15	19.8	18	18.4	14	21.3	19	13.3	26	37.1
Hungary	19	14.7	20	9.2	16	20.2	23	7.6	15	51.5
Ireland	13	26.8	10	35.5	17	18.1	11	36.6	6	71.1
Italy	10	37.4	10	35.5	10	39.4	12	29.9	18	49.8
Latvia	20	12.5	16	25.0	22	0.0	21	8.8	21	48.9
Lithuania	*	0.0	*	*	*	*	22	7.9	23	45.7
Luxembourg	*	0.0	*	*	*	*	18	14.4	27	24.5
Malta	*	0.0	*	*	*	*	17	14.6	16	50.9
Netherlands	7	62.5	6	*	7	72.3	2	81.9	7	70.2
Poland	21	12.2	21	0.0	13	24.5	24	6.4	10	55.7
Portugal	14	23.6	12	30.3	18	17.0	8	43.4	13	52.5
Romania	*	*	*	*	*	0.0	20	12.2	20	49.3
Slovakia	12	30.6	16	25.0	12	36.2	27	2.4	24	43.0
Slovenia	*	*	*	*	*	*	28	0.0	2	82.2
Spain	3	69.2	8	44.7	2	93.6	5	67.3	17	50.0
Sweden	8	55.3	4	60.5	8	50.0	6	58.5	4	78.7
United Kingdom	1	100.0	1	100.0	1	100.0	7	54.8	3	78.8

*Not available

	Right to Information		Corruption		Protection from Libel Chill		Legal Safeguards		Costs	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	26	25.6	9	69.4	15	41.7	12	25.0	22	64.1
Belgium	24	45.7	8	73.5	23	32.1	20	0.0	12	90.5
Bulgaria	8	70.5	28	0.0	18	40.1	20	0.0	15	89.1
Croatia	2	97.7	22	16.3	20	38.1	10	33.3	*	*
Cyprus	27	0.0	23	14.3	17	40.8	7	58.3	24	16.5
Czech Republic	17	55.8	19	28.6	2	85.1	2	83.3	14	89.2
Denmark	21	49.6	1	100.0	16	41.5	12	25.0	17	85.5
Estonia	5	74.4	11	59.2	5	78.9	5	75.0	10	93.6
Finland	3	81.4	2	98.0	1	87.2	1	100.0	19	79.5
France	21	49.6	12	57.1	19	38.3	20	0.0	4	99.8
Germany	25	41.9	5	81.6	26	19.1	20	0.0	23	52.5
Greece	20	50.4	27	6.1	24	29.3	20	0.0	8	97.6
Hungary	9	67.4	23	14.3	21	37.8	20	0.0	18	81.4
Ireland	6	73.6	10	65.3	6	75.8	7	58.3	3	99.8
Italy	10	65.9	26	12.2	22	34.1	19	8.3	5	99.8
Latvia	17	55.8	18	32.7	4	81.5	2	83.3	16	88.3
Lithuania	21	49.6	16	36.7	7	66.6	6	66.7	7	99.6
Luxembourg	27	0.0	5	81.6	13	43.2	17	16.7	9	94.1
Malta	14	60.5	19	28.6	27	4.5	20	0.0	26	3.8
Netherlands	12	63.6	4	85.7	25	24.6	20	0.0	20	70.8
Poland	13	61.2	13	42.9	12	45.8	12	25.0	1	100.0
Portugal	15	56.6	13	42.9	28	2.9	20	0.0	25	9.7
Romania	11	64.3	23	14.3	8	60.8	12	25.0	1	100.0
Slovakia	19	52.7	21	20.4	3	82.7	2	83.3	21	70.0
Slovenia	1	100.0	15	40.8	14	41.9	17	16.7	13	89.8
Spain	15	56.6	17	34.7	9	56.6	10	33.3	6	99.8
Sweden	7	71.3	3	95.9	10	53.2	12	25.0	11	91.3
United Kingdom	4	77.5	5	81.6	11	47.5	7	58.3	27	0.0

*Not available

	Special Plaintiffs		Technology		Internet of Things		Smart Meters		Smart Ticketing	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	12	50.0	7	64.6	3	77.8	1	100.0	2	66.7
Belgium	19	25.0	14	52.3	19	34.3	19	0.0	2	66.7
Bulgaria	6	66.7	27	23.4	24	24.1	19	0.0	2	66.7
Croatia	12	50.0	24	35.1	18	43.3	*	0.0	2	66.7
Cyprus	16	33.3	28	17.2	28	0.0	19	0.0	28	0.0
Czech Republic	4	83.3	26	28.7	27	13.0	19	0.0	22	33.3
Denmark	20	16.7	1	93.9	1	88.9	1	100.0	2	66.7
Estonia	6	66.7	6	67.2	6	66.7	1	100.0	2	66.7
Finland	6	66.7	3	80.0	5	74.6	1	100.0	2	66.7
France	15	41.7	13	52.6	16	53.2	1	100.0	20	50.0
Germany	20	16.7	15	46.3	22	30.7	16	50.0	22	33.3
Greece	26	0.0	19	40.1	15	53.7	1	100.0	20	50.0
Hungary	6	66.7	25	33.1	25	14.4	19	0.0	22	33.3
Ireland	4	83.3	9	60.3	9	62.2	1	100.0	2	66.7
Italy	26	0.0	23	35.9	12	58.4	1	100.0	22	33.3
Latvia	6	66.7	11	56.4	17	47.2	16	50.0	2	66.7
Lithuania	20	16.7	16	43.1	23	27.8	19	0.0	2	66.7
Luxembourg	16	33.3	5	68.7	13	55.6	19	0.0	2	66.7
Malta	20	16.7	12	52.7	13	55.6	1	100.0	2	66.7
Netherlands	20	16.7	4	75.0	8	63.7	1	100.0	2	66.7
Poland	20	16.7	17	42.9	10	61.6	1	100.0	2	66.7
Portugal	26	0.0	21	36.4	26	13.2	19	0.0	22	33.3
Romania	2	91.7	22	36.0	11	59.5	1	100.0	2	66.7
Slovakia	1	100.0	20	36.6	21	31.9	16	50.0	22	33.3
Slovenia	16	33.3	18	41.8	20	33.3	19	0.0	2	66.7
Spain	12	50.0	10	58.6	7	66.1	1	100.0	2	66.7
Sweden	6	66.7	2	84.5	2	83.8	1	100.0	2	66.7
United Kingdom	2	91.7	8	63.3	4	76.0	1	100.0	1	100.0

	Smart Cities		E-Government		Broadband in Business		Connections Over 30 Mbps		Connections	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	5	66.7	9	64.2	17	42.9	18	32.8	20	73.4
Belgium	9	36.4	10	57.8	4	76.6	4	72.9	8	87.6
Bulgaria	26	5.6	27	12.0	21	36.8	12	49.1	28	0.0
Croatia	15	20.0	23	34.2	25	24.4	24	15.6	23	51.0
Cyprus	7	50.0	22	37.0	26	22.2	28	0.0	6	88.6
Czech Republic	26	5.6	24	33.8	19	38.0	22	19.9	5	92.4
Denmark	1	100.0	1	100.0	1	99.3	1	100.0	2	97.4
Estonia	10	33.3	4	85.6	14	50.1	16	40.8	13	78.0
Finland	6	57.1	2	91.5	8	71.1	8	63.8	3	92.9
France	23	9.6	8	71.7	23	30.8	25	14.9	12	78.6
Germany	24	8.8	11	57.4	13	51.0	15	42.6	17	76.2
Greece	21	11.1	15	50.2	28	12.4	26	1.7	26	44.6
Hungary	22	10.0	16	49.4	20	37.0	20	29.9	21	58.3
Ireland	15	20.0	13	53.9	9	65.6	10	58.1	7	88.2
Italy	8	41.9	26	19.0	27	19.9	27	1.6	19	74.8
Latvia	13	25.0	7	76.2	15	48.8	11	49.2	25	47.5
Lithuania	18	16.7	19	45.2	5	73.8	5	70.8	10	82.6
Luxembourg	1	100.0	5	84.9	6	72.4	7	67.7	9	86.4
Malta	28	0.0	21	43.9	10	63.0	9	58.4	15	76.9
Netherlands	14	24.4	6	84.6	3	80.0	3	75.8	4	92.7
Poland	17	18.0	25	26.7	22	32.9	21	25.7	22	54.5
Portugal	25	6.3	20	44.9	7	71.4	6	69.4	14	77.3
Romania	20	11.8	28	0.0	18	39.4	14	46.0	27	19.7
Slovakia	19	12.5	17	49.0	24	24.7	23	16.3	24	49.7
Slovenia	1	100.0	18	45.8	12	51.2	17	35.0	1	100.0
Spain	11	31.6	14	51.8	11	55.7	13	48.8	16	76.5
Sweden	4	84.6	3	86.8	2	80.5	2	82.3	18	75.2
United Kingdom	12	27.9	12	54.9	16	44.5	19	32.2	11	81.3

	Broadband in Households		Access		Speed		E-Business		Use of Big Data	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	11	55.8	10	65.6	16	46.0	6	58.3	5	62.8
Belgium	9	58.8	11	57.7	9	59.9	4	63.9	3	77.7
Bulgaria	25	27.6	28	0.0	11	55.2	25	24.6	24	29.2
Croatia	26	26.1	20	41.4	26	10.7	19	33.8	20	38.0
Cyprus	27	16.8	23	33.5	28	0.0	27	18.8	25	23.7
Czech Republic	10	57.8	15	51.5	6	64.1	20	33.2	23	31.3
Denmark	3	84.6	4	84.8	3	84.4	3	66.9	7	58.8
Estonia	15	48.0	9	66.2	23	29.7	16	42.8	12	46.5
Finland	2	85.1	5	83.6	2	86.6	1	77.7	2	79.9
France	22	36.6	16	48.5	24	24.6	13	46.8	15	44.3
Germany	6	66.3	6	78.9	13	53.7	12	46.9	18	40.4
Greece	28	10.8	27	15.4	27	6.1	22	27.7	21	37.3
Hungary	13	51.4	14	52.3	14	50.6	24	25.2	27	16.9
Ireland	8	61.4	8	67.1	10	55.7	9	51.9	14	45.2
Italy	24	28.4	19	42.2	25	14.7	21	31.5	19	39.9
Latvia	14	49.0	22	36.1	8	61.9	28	16.8	28	11.2
Lithuania	21	36.7	25	24.2	15	49.3	15	43.9	11	51.8
Luxembourg	7	65.0	1	100.0	22	29.9	10	50.1	8	56.4
Malta	16	46.8	12	55.7	20	37.9	8	54.3	4	73.7
Netherlands	4	81.5	2	96.0	4	67.0	2	74.9	1	84.1
Poland	20	37.2	21	38.0	21	36.4	26	24.1	26	18.5
Portugal	23	34.1	24	29.9	19	38.3	11	47.7	6	59.9
Romania	18	43.0	26	21.5	5	64.5	23	26.1	22	34.7
Slovakia	19	42.2	18	45.2	18	39.2	18	36.0	16	42.2
Slovenia	17	44.6	17	46.0	17	43.1	14	46.4	13	46.2
Spain	12	54.4	13	54.0	12	54.9	17	39.1	17	41.8
Sweden	1	88.0	7	76.0	1	100.0	7	58.3	9	54.0
United Kingdom	5	74.8	3	85.7	7	64.0	5	59.6	10	53.9

	Use of Cloud Computing		Use of RFID		Use of ERP		Use of CRM		Workforce	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	19	20.6	2	84.6	8	62.2	6	83.8	7	56.0
Belgium	7	43.3	4	73.9	2	84.2	9	70.8	10	52.6
Bulgaria	28	0.0	3	78.5	22	22.3	27	20.4	25	15.6
Croatia	10	31.7	10	48.0	20	31.5	24	30.5	19	29.5
Cyprus	22	17.1	20	22.4	7	66.3	5	84.1	26	13.3
Czech Republic	15	22.5	26	9.0	18	35.4	20	40.5	14	42.8
Denmark	3	69.5	15	37.8	3	75.5	11	66.7	5	70.4
Estonia	9	32.1	18	25.0	23	15.7	16	52.7	8	54.5
Finland	1	100.0	1	100.0	13	50.8	2	92.8	1	88.3
France	18	20.7	23	13.6	10	57.8	17	50.6	12	44.8
Germany	21	19.0	8	57.8	1	100.0	8	71.2	9	53.4
Greece	24	5.0	28	0.0	12	50.9	25	28.3	27	10.0
Hungary	23	10.9	22	18.5	27	0.4	28	0.0	16	36.0
Ireland	4	58.5	25	10.6	21	22.7	3	89.2	13	44.1
Italy	12	29.5	16	37.4	14	49.4	18	46.5	22	24.4
Latvia	25	3.3	21	19.9	28	0.0	26	21.5	23	23.4
Lithuania	20	19.8	14	39.5	9	59.7	10	67.0	21	27.5
Luxembourg	13	24.2	5	65.8	11	56.3	13	64.1	2	79.4
Malta	8	43.3	6	62.7	19	33.7	14	60.5	15	42.7
Netherlands	6	55.4	11	46.3	4	71.1	1	100.0	4	70.5
Poland	26	2.9	24	11.1	25	12.3	19	41.7	24	19.8
Portugal	16	22.4	7	61.5	5	68.9	12	64.8	20	29.2
Romania	27	1.2	19	22.7	24	15.1	23	30.7	28	6.8
Slovakia	17	22.3	12	44.1	17	35.8	22	36.8	18	29.8
Slovenia	11	30.8	9	54.7	16	42.0	21	38.1	11	46.2
Spain	14	23.2	13	40.6	15	47.5	4	85.1	17	31.0
Sweden	2	82.6	17	28.0	6	66.4	7	76.9	3	78.5
United Kingdom	5	55.7	27	8.7	26	2.1	15	54.1	6	65.9

	ICT Specialists		Individuals With Above Basic Skills		R&D Personnel		Education and Civil Society		Data-Science Groups	
Country	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Austria	8	52.8	10	51.1	5	71.5	8	51.7	10	30.6
Belgium	7	56.6	11	46.8	11	51.4	9	47.7	4	58.9
Bulgaria	22	20.8	27	8.5	25	13.2	23	24.5	26	6.4
Croatia	18	28.3	12	44.7	26	9.7	17	29.7	16	16.6
Cyprus	24	18.9	25	12.8	28	0.0	27	14.5	23	9.4
Czech Republic	10	47.2	21	29.8	12	51.3	20	27.5	25	7.1
Denmark	9	50.9	2	83.0	1	100.0	1	79.4	2	99.4
Estonia	6	60.4	6	59.6	15	32.4	24	23.6	19	11.9
Finland	1	100.0	4	68.1	2	89.1	4	62.6	15	19.6
France	13	45.3	16	38.3	9	53.3	6	53.7	12	27.2
Germany	10	47.2	7	55.3	6	66.1	7	53.3	5	56.4
Greece	28	0.0	24	14.9	19	27.7	22	26.3	27	3.1
Hungary	13	45.3	22	27.7	20	25.4	16	30.9	7	40.4
Ireland	10	47.2	20	34.0	10	51.4	2	73.1	3	65.0
Italy	20	24.5	23	21.3	17	28.9	25	22.0	28	0.0
Latvia	24	18.9	17	36.2	23	15.4	26	21.5	22	11.2
Lithuania	26	17.0	12	44.7	18	28.2	12	44.5	11	28.6
Luxembourg	5	64.2	1	100.0	3	86.8	28	8.2	14	20.5
Malta	13	45.3	9	53.2	21	20.7	21	27.0	20	11.9
Netherlands	3	71.7	3	72.3	7	64.9	5	61.1	1	100.0
Poland	19	26.4	25	12.8	24	13.8	15	39.8	13	24.8
Portugal	22	20.8	15	40.4	14	33.5	13	41.9	18	13.9
Romania	27	13.2	28	0.0	27	0.9	19	28.3	24	8.2
Slovakia	17	30.2	17	36.2	22	19.4	18	29.7	21	11.4
Slovenia	13	45.3	17	36.2	8	63.4	10	47.1	6	43.2
Spain	21	22.6	12	44.7	16	31.2	14	41.9	17	14.9
Sweden	2	92.5	7	55.3	4	78.4	11	46.8	9	33.7
United Kingdom	3	71.7	5	66.0	13	51.2	3	64.7	8	35.4

	Science and Technology Graduates		Data-Science Degree Programs	
Country	Rank	Score	Rank	Score
Austria	4	89.6	11	17.8
Belgium	20	49.1	9	22.5
Bulgaria	21	48.1	14	13.6
Croatia	17	57.5	19	0.0
Cyprus	27	26.9	19	0.0
Czech Republic	14	61.8	19	0.0
Denmark	6	81.1	5	36.2
Estonia	23	47.2	19	0.0
Finland	5	86.8	1	100.0
France	2	93.9	8	26.5
Germany	11	71.7	15	10.2
Greece	15	59.9	17	5.6
Hungary	25	36.8	19	0.0
Ireland	1	100.0	6	35.2
Italy	22	47.6	13	14.5
Latvia	24	42.5	19	0.0
Lithuania	12	69.3	7	26.9
Luxembourg	28	0.0	19	0.0
Malta	18	55.7	19	0.0
Netherlands	26	30.2	4	44.9
Poland	10	73.6	18	2.3
Portugal	8	79.7	10	22.4
Romania	16	59.0	16	7.0
Slovakia	13	62.7	19	0.0
Slovenia	9	74.5	19	0.0
Spain	6	81.1	12	17.3
Sweden	19	52.4	3	61.8
United Kingdom	3	90.6	2	71.4

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