Monitoring the Digital Economy & Society 2016 - 2021

Executive Summary

In a matter of decades, digital technologies have transformed the way we communicate with others, conduct business, produce goods and services, the way we live, work, and spend our spare time. These, often rapid, developments hold a lot of promise for the future, in terms of wealth generation, technological advances, and improvement in the quality of life. At the same time, they also bring challenges associated with a shortage of skills, fast emerging new markets, consumer protection, industrial re-organisation, trust, security, and privacy.

The European Commission has continuously followed these developments, and in recognising their potential, brought digital policies to the forefront of its agenda. Their importance is also mirrored in the priorities of the new Juncker Commission, which counts the recently adopted Digital Single Market Strategy to one of its top priorities. The Strategy addresses policy areas ranging from eCommerce and tax regimes, through copyright and geo-blocking, Industry 4.0, skills, trust and security, to media platforms and digital public services – all affected by digitisation; all contributing to the emergence of the digital economy and society.

Another significant development in the political agenda of the current Commission has been the institution of the Better Regulation Guidelines – enshrining an enforced commitment to policy formation and subsequent monitoring and evaluation based on evidence that is underpinned by relevant, credible, and representative data.

Collectively, the breadth of the issues at stake and the impetus for evidence-based policy making has strengthened the need for punctual and reliable statistical information. Thus, in order to anticipate these needs, the Commission services have prepared a framework for Monitoring the Digital Economy and Society 2016-2021.

This framework document is a narrative of main policy developments and outlines the main data requirements to monitor European digital policies, information and communication technologies as well as their impact on the economy and society in the period 2016-2021. It revisits past data collections and exploitation of outputs from the Community Surveys on ICT Usage and e-Commerce in Enterprises, and on ICT Usage in Households and by Individuals, and lists new areas and data sources to be exploited in the future.

The present document has been endorsed by the Digital Agenda High Level Group, after a written consultation of Member State representatives and of the Eurostat Working group on Information Society Statistics.

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Introduction

In order to make well-informed policy choices, the Commission is increasingly reliant on the timely availability of relevant data. To ensure this availability, data collection frameworks need to be comprehensive and foreseen in advance.

The following chapter presents an outline of the data needs and considerations for the monitoring of the digital economy and society in the period of 2016 to 2021. It is based on the subsequent considerations:

a) Data needed for evidence-based policy making at EU and national levels, thus derived from the institutional responsibilities and from the initiatives on the corresponding policy agendas;
b) Continuous monitoring of the evolution of the European ICT infrastructure and its usage by citizens, enterprises, and the public sector (supply/demand);
c) Assessment of short-term trends and expected new developments;
d) Collection of supplementary data to contextualise certain phenomena.

The reasons for monitoring outlined above are in line with the new Better Regulation Guidelines[1], which emphasise the need for using the most robust evidence to support policy decisions, on the one hand, and the establishment of adequate monitoring frameworks, on the other.

On the 6th of May 2015, the European Commission unveiled its renewed Strategy for the creation of a Digital Single Market[2]. It envisages the free movement of goods and services without barriers in the offline, as well as the online world, offering the same level of consumer protection.

The **Digital Single Market Strategy** is based on three pillars:

a) Better access for consumers and businesses to online goods and services across Europe;
b) Creating the right conditions for digital networks and services to flourish;
c) Maximising the growth potential of the European Digital Economy.

The forthcoming actions under the three pillars will jointly address several issues to enable better access to goods and services, as well as content online. Assessment and removal of barriers to online trade, such as unjustified geo-blocking, stepped-up enforcement of consumer protection laws and simplification of the application of VAT regimes are some of the actions proposed. Furthermore, legislative reviews to reflect the developments in the telecommunications and media sectors will be undertaken to ensure access to networks, fair competition, and a safe online environment. Finally, the Digital Single Market Strategy will promote the acquisition of digital

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[1] http://ec.europa.eu/smart-regulation/better_regulation/documents/com_2015_215_en.pdf
[2] http://ec.europa.eu/priorities/digital-single-market/docs/dsm-communication_en.pdf

skills of European citizens to boost their confidence in conducting their affairs, be it shopping or accessing digital public services, online.

With the Digital Single Market Strategy, the European Commission acknowledges the "high demand from policy makers for reliable evidence to support better decision-making, monitor policy implementation, as well as measure new economic and social phenomena"[2]. Furthermore, "the Commission will also seek to improve the quality of the data and analysis needed to underpin the Digital Single Market by pooling the relevant knowledge and making it easily accessible to the public. It will further develop its **Digital Economy and Society Index**[3] indicator. The Commission will report regularly on progress for the Strategy"[2]. And despite new data collection and analysis methods emerging, e.g. the exploitation of large volumes of data or "big data", policymakers are increasingly reliant on traditional sources of statistics, in particular Official Statistics which, nevertheless, may incorporate new methods for collecting reliable and high quality statistical information. Hence, the Commission also recognises that "the necessary infrastructure for such information, especially for official statistics, must be an integral part of the policy measures"[2].

From the inception of the i2010 initiative, and subsequently the Digital Agenda for Europe, two consecutive benchmarking frameworks have proven an important asset in monitoring and benchmarking current trends in the fast-paced area of digital economy and society, on the one hand, as well as in taking stock of progress over time on the other. The Benchmarking Digital Europe framework for 2011-2015 also paved the way to the design of new composite indices, such as the Digital Economy and Society Index (DESI)[4] and the Digital Skills Indicator (DSI). While the benchmarking of countries will continue, notably, in the context of the European Semester[5] exercise, greater emphasis will be put on the systematic collection of data for policy, and monitoring of policy developments related to the Digital Single Market strategy.

Historically, the predominant **sources of data** have been:

   a) The Eurostat Surveys on ICT Usage in Households and by Individuals[6], and ICT Usage and e-Commerce in Enterprises[7];
   b) Eurostat secondary statistics indicators on the ICT sector and ICT specialists;
   c) Data supplied by the National Regulatory Authorities for the telecommunications market;
   d) Periodical studies procured by the Commission services in policy areas where official statistics are not available;
   e) Ad hoc surveys on specific issues.

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[3] DESI overall index, calculated as the weighted average of five dimensions: 1 Connectivity (25%), 2 Human Capital (25%), 3 Use of Internet (15%), 4 Integration of Digital Technology (20%) and 5 Digital Public Services (15%). For a comprehensive description, see Annex IV.
[4] http://ec.europa.eu/digital-agenda/en/digital-economy-and-society-index-desi
[5] http://ec.europa.eu/europe2020/making-it-happen/index_en.htm
[6] http://ec.europa.eu/eurostat/statistics-explained/index.php/Information_society_statistics_-_households_and_individuals
[6] http://ec.europa.eu/eurostat/statistics-explained/index.php/Information_society_statistics_-_enterprises

Of all of the abovementioned sources, the Eurostat surveys have proven to be a key source of data because of their capacity to adapt to changing data needs and the short publication cycle[8]. Currently, the surveys are revised and updated annually, and are organised around a number of topics or modules. Each year, provisions are made to include an ad-hoc or special module to examine an emerging trend or an understudied phenomenon. The surveys are conducted in all Member States, Norway, Iceland, and some candidate countries according to a common model questionnaire and a harmonised methodology with the reference period in January for the enterprise survey and the first quarter of the year for the households and individuals survey. The results are made available by Eurostat at the end of the year. The attractiveness of official statistics as a source lies in the quality of information, in this case, in the representativeness and reliability of the data from the surveys, achieved through the large samples drawn in each participant country.

In the area of digital economy and society the European Commission has been **reporting** its **benchmarking indicators via the Digital Agenda Scoreboard**[9], and has promoted open access and re-use of its datasets. The Scoreboard is an informative website, including annual reports[10] on the main policy domains, a repository of studies[11] and reports, and an <u>interactive visualisation tool</u>[12] for a selection of statistical indicators.

The Conceptual Framework for Monitoring the Digital Economy and Society 2016-2021

This document looks at the digital economy and society from a policy-maker's point of view, where data needs are policy-driven and contextualised, rather than dictated by information available on the supply or demand side alone.

The new framework is built on the previous one, taking into account the current trends in the digital economy and society, and focuses on the following **broad themes**:

- The ICT sector as a supplier of general purpose technologies;
- Broadband as key infrastructure;
- The digitisation of the economy;
- eCommerce at the core of the Digital Single Market;
- Trust, Security, Data Protection and Privacy;

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[8] The availability of the main results in December of the collection year ensures relevant and timely data for usage in policy monitoring and design.
[9] http://ec.europa.eu/digital-agenda/en/digital-agenda-scoreboard
[10] http://ec.europa.eu/digital-agenda/en/download-scoreboard-reports
[11] http://ec.europa.eu/digital-agenda/en/newsroom/smart-studies
[12] http://digital-agenda-data.eu/

- Internet Usage by Citizens;
- Consumption of Online Content;
- Digital Skills and ICT Occupations;
- Online Public Services.

The above mentioned broad themes for structuring the digital economy and society are not mutually exclusive and must be seen as interrelated. The ICT sector as the generator of new technologies applicable across a wide range of other sectors, and the provision of high-speed Internet have led to an increasing digitisation of manufacturing and content delivery, exploitation of platforms for eCommerce, and the need for new skills. At the same time, it has also changed the way Internet is used not only by businesses, but also by consumers, thereby raising questions about trust, security, and the protection of personal data.

It has to be born in mind that each of these themes have to be looked at from both the perspective of the suppliers of technology and infrastructure, as well as from the consumers' point of view (i.e. usage), be it individual users, enterprises, or public authorities.

Alongside other data received from telecommunications regulatory authorities, the Communications Committee, and ad hoc studies/surveys, it is envisaged that the Eurostat surveys on ICT usage will remain the main source of statistical information. High quality statistics may in the future also incorporate information coming from relevant administrative data sources and other data collection methods. Other Eurostat datasets also include relevant indicators on the pervasive nature of digital technologies and will be consulted.

Moreover, attention will be paid to data that could be collected exploiting the Internet as a data source, the multiple digital footprints we create, and the rise in the publication of open data sets by organisations.

To be a practical roadmap for DG CONNECT and its main partners, the thematic chapters of the monitoring framework focus alternatively on sources and/or on specific indicators. They also outline the key indicators and their purpose, namely:

- Indicators for benchmarking MS performance;
- Indicators for benchmarking the EU against the Rest of the World;
- Key indicators for composite indices or for monitoring of specific policies.

Moreover the document lists the foreseen periodicity of the indicator and the source of data to optimise the usage of resources, reduce burden, and fit priorities.

1. The ICT Sector and Research, Development and Innovation

The ICT sector[13] is important for Europe, both because of its strategic role and the growth and employment potential in the sector itself, but also because opportunities that a dynamic and energetic ICT industry bring to other business sectors, the public sector, and to consumers.

Despite being one of the most dynamic sectors, the ICT sector has not been left unscathed by the economic crisis in Europe. However, overall it has shown resilience. The share of value added by the ICT sector as a percentage of the GDP has remained stable at around 4% in 2011 and 2012, driving over 17% of the total Business Expenditure on Research and Development (BERD). At the same time, employment in the sector has slightly increased from 2.73% to 2.76%, and so have private investments into R&D expenditure (i.e. BERD equalled 5.51% versus 5.59% of Value Added) over the same period[14]. Moreover, it is one of the few sectors that enable the creation of general purpose technologies, whose pervasiveness through the economy and society contributes to the digitisation of the economy. However, it also creates environmental challenges that need to be addressed in the context of the circular economy[15].

The value added in the ICT sector, the share of the ICT sector as a percentage of the GDP, and the employment generated by the sector are important indicators of growth. Furthermore, statistics on the ICT BERD, public funding for research in ICT (GBAORD-Government Budget Appropriations and Outlays for Research and Development), and employment in ICT R&D also contribute to the monitoring of the progress toward the achievement of European policies in this area.

To monitor the **future growth of the sector** following headline indicators will continue to be collected:

- Share of the ICT sector in the economy measured as a proportion of GDP and of total employment;
- Growth of the ICT sector measured as a percentage change of value added at current prices and expressed in Purchasing Power Standard;
- Ratio of the productivity level in the ICT sector with respect to the entire economy;
- Productivity growth in the ICT sector;
- Size and nominal growth of ICT markets, including a mapping of European and non-European "pure players" (Sources: to be determined);
- Import and export of ICT goods and services;

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[13] As defined in the 2008 revision of the OECD definition
[14] http://is.jrc.ec.europa.eu/pages/ISG/documents/PREDICT2014.pdf
[15] The European Commission is currently finalising the Circular Economy Strategy, to be published by the end of 2015, http://ec.europa.eu/environment/circular-economy/index_en.htm

- Demography of enterprises in the ICT sector;
- R&D expenditure by the ICT sector as a % of GDP;
- R&D expenditure by the ICT sector as a % of total R&D expenditure in the business sector (BERD);
- R&D expenditure by the ICT sector as a % of the value added (of the ICT Sector).

Sources: Eurostat (ICT sector statistics based on Structural Business Statistics, National Accounts), the Predict Project[16], and various market studies.

In addition to being a research intensive sector, the ICT sector is also engaged in collaboration with public research organisations at the European level through **the European Framework Programme for Research and Innovation – Horizon2020**[17]. The following indicators have been established and will be further explored to assess progress of this programme:

- Gross Domestic Expenditure on Research and Development (GERD) as a % of GDP (all sectors);
- Fast-growing enterprises in the ICT sector and in the rest of the economy;
- Number of publications;
- Number of patent applications;
- Research infrastructures accessible to all researchers in Europe and beyond;
- Total investments mobilised via debt financing and Venture Capital investments;
- Share of participating SMEs introducing innovations new to the company or the market.

Sources: Eurostat (Structural Business Statistics, Business Demography, Community Innovation Survey), European Commission data.

The number of patents and publications will be aggregated from the periodic reports of the beneficiaries. Pilot projects are envisaged to ensure comparability of patents and publications across the Framework Programmes. The possibility to use the data collected as part of the Eurostat Community Innovation Survey to gain insights, specifically, into enterprises in the ICT sector will also be investigated.

At the same time, the Institute of Prospective Studies (IPTS) of the European Commission Joint Research Centre (JRC) has developed a composite indicator for measuring innovation output taking into account:

- Technological innovation as measured by patents;
- Employment in knowledge-intensive activities as a % of total employment;
- The average of the share of medium and high-tech goods and services in a countries export;
- Employment dynamism of fast-growing enterprises in innovative sectors[18].

Sources: European Patent Office, OECD (PatStat), Eurostat (Labour Force Survey, COMEXT, Community Innovation Survey), UN (Comtrade).

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[16] http://is.jrc.ec.europa.eu/pages/ISG/PREDICT.html
[17] http://ec.europa.eu/research/horizon2020/pdf/proposals/com(2011)_809_final.pdf
[18] https://ec.europa.eu/jrc/sites/default/files/ioi_methodsology_report_2014.pdf

Attempts have been made to quantify the **contribution of ICT to innovation**[19] as part of the European Innovation Policies for the Digital Shift (EURIPIDIS)[20] project. Further research on the innovative output of the European ICT sector is to be considered, included using CIS results.

Another area of policy interest is the **digitisation of creative industries**, the production and distribution of digital content, and the contribution of specific ICT sub-sectors (such as programming, software and music publishing, hosting, and web portals) to this process. According to the 2012 Communication "Cultural and creative sectors for growth and jobs in the EU"[21]. UNESCO[22] creative industries encompass cultural industries (that is industries combining the creation, production, and commercialisation of creative contents, which are intangible and cultural in nature) and all cultural and artistic production, where the product or service contains a substantial element of artistic or creative endeavour. An alternate definition has been "those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property"[23].

These industries have embraced ICT to develop new business models for the digital environment, thereby generating 4.4% of the European GDP, 6.8% of value added (as a percentage of GDP) in 2011, and representing 3.8% of the European workforce[24]. Recently, the recorded music industry saw revenues from digital channels of 6.8% in 2014 in Europe[25]. Altogether, consumer spending in the creative sector is up 25% from 2001, with all growth driven by digital media[26].

A number of exploratory studies of the **media and content industries**[27] and their specific sub-sectors (i.e. the video games software industry, the television industry, the book publishing industry, the film sector, the newspaper publishing industry, and the music industry) have been undertaken by IPTS in the period of 2009-2012. These case studies have documented the advent of the digitisation of the creative industries, the change in the production and consumption of digital content, the emergence of new market players from other sectors (notably, the ICT sector), and the restructuring of the established ecosystems[28].

The abovementioned digital shift in the creative industries warrants an inclusion of these industries[29] in the analysis alongside the ICT sector, and a further exploration of the contribution of these industries to growth and jobs in Europe using indicators as the following:
- Share of the creative industries in the economy measured as a proportion of GDP and of total employment;

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[19] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC94372/jrc94372.pdf
[20] http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/EURIPIDIS.index.html
[21] http://www.europarl.europa.eu/registre/docs_autres_institutions/commission_europeenne/com/2012/0537/COM_COM(2012)0537_EN.pdf
[22] http://portal.unesco.org/culture/en/files/30297/11942616973cultural_stat_EN.pdf/cultural_stat_EN.pdf
[23] https://www.gov.uk/government/publications/creative-industries-mapping-documents-2001
[24] http://www.teraconsultants.fr/medias/uploads/pdf/Publications/2014/2014-Oct-European-Creative-Industry-GDP-Jobs-full-Report-ENG.pdf
[25] http://rin.ifpi.org/rin Income from subscription services increased by 33.4% in 2014.
[26] http://www.europeandigitalmedia.org/uploads/Press/documents/EDiMA-CCIA_Technology%20is%20Culture.pdf
[27] http://ftp.jrc.es/EURdoc/JRC69435.pdf
[28] http://ftp.jrc.es/EURdoc/JRC77932.pdf
[29] Currently, the OECD definition of "Media and Content" includes certain classes of the ISIC rev.4 divisions 58, 59, 60, and 63. However, to encompass a broader range of activities, the following NACE (rev. 2) divisions should be considered: 32, 46, 47, 58, 59, 60, 63, 71, 72, 73, 74, 77, 90, 91

- Share of copyright-intensive sectors in GDP and employment;
- Growth of the creative industries sectors measured as a percentage change of value added at current prices and expressed in Purchasing Power Standard;
- Ratio of the productivity level in the creative industries with respect to the entire economy;
- Productivity growth in the creative industries;
- Size and nominal growth of creative markets.

Sources: Eurostat (Structural Business Statistics, National Accounts, Community Innovation Survey)

Finally, the digital shift would not have happened were it not for the continuous evolution of the quality, speed, and throughput of fixed and wireless networks.

2. Connectivity

The availability of high-speed and affordable network infrastructure is a necessary precondition for accessing online goods and services in the Digital Single Market. Therefore, systematic monitoring of broadband markets from the supply, as well as demand side should be continued.

The primary information sources are the Communications Committee (COCOM) questionnaires to National Regulatory Authorities and the Eurostat surveys. In addition, several indicators (such as prices and coverage indicators) will be collected through recurring studies.

The following indicators are envisaged:

- Total revenues of the electronic telecommunications sector (COCOM);
- Total investment in networks by the electronic telecommunications sector (COCOM);
- Broadband **coverage** indicators for nine fixed and mobile technologies, speed categories, as well as overall fixed and Next Generation Access (NGA) coverage (% of homes covered, recurring study).
  Indicators include:
    - standard fixed broadband coverage (% households);
    - NGA coverage (% households);
    - Urban/rural divide.

- Broadband **subscriptions** by technology and speed (number of subscriptions and share of subscriptions, COCOM and Eurostat).

  Indicators include:

    - Households subscribing to fixed broadband connections (% households, Eurostat);
    - mobile broadband take-up (subscriptions/100 persons, NRA, COCOM);
    - Fast broadband subscriptions (% of all subscriptions, NRA, COCOM);

- o Share of DSL connections (% of all subscriptions, NRA, COCOM).
- % of SIM cards dedicated to M2M communication (to be developed).
- Competition in the telecom sector in broadband for Internet data exchange, mobile and voice (market share data for various segments, COCOM).
- Wholesale broadband access lines (COCOM).
- Telecom traffic data for broadband, mobile and voice (**traffic volumes**, COCOM).
- Wholesale and retail **prices** (COCOM):
  - o Mobile and fixed termination rates (COCOM);
  - o Local Loop Unbundling prices (COCOM);
  - o Fixed broadband retail prices for 32 consumptions baskets (recurring BIAC study):
    - ▪ E.g. Price of fixed broadband subscription (as % of individual gross income, recurring study);
  - o Mobile prices for 15 consumption baskets (recurring BIAC study).
- Indicators on the consumer aspect including **customer satisfaction, operator switching and bundling** (COCOM and E-Communications Eurobarometer Survey). The ad hoc monitoring[30] of the effective speed will be discontinued and future data will be collected from the regulatory authorities[31] and studies[32];
- Problems encountered by enterprises with broadband connections (coverage, speed, quality of connection) (EC studies).
- Percentage of the assigned spectrum out of the target to be harmonized at the EU level (EC internal data);

Furthermore, on the demand side, the number of <u>enterprises</u> having access to the Internet is measured as follows:

- % of enterprises with broadband access (fixed or mobile); speed of fixed subscriptions;

- % of enterprises providing portable devices for a mobile connection to the Internet to persons employed; % of persons employed using a portable device provided by the enterprise allowing for a mobile Internet connection for business purposes (also, as a % of persons employed using the Internet).

Source: Eurostat

Additionally, the following data is collected on the use of Internet:
- % of households using a broadband Internet connection at home (fixed or mobile);
- % of individuals using mobile devices to access the Internet away from home or work.

Source: Eurostat

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[30] http://ec.europa.eu/digital-agenda/en/news/quality-broadband-services-eu-samknows-study-internet-speeds-second-report
[31] Under the recent agreement on the Telecoms Single Market package, as of 30 April 2016, operators will need to be more transparent. They will have to inform customers of fixed internet access about the minimum, normally available, maximum and advertised internet speeds they can expect to get; in mobile networks, operators will have to inform of the estimated maximum and advertised speed. http://europa.eu/rapid/press-release_IP-15-5265_en.htm
[32] A new EC study on broadband mapping will try to define a methodology to collect data by using sources like Mlab, Akamai and Ookla Speedtest, also ensuring some representative sampling.

Simultaneously, there are still large groups of individuals, who despite the availability of high speed internet connections are not taking advantage of these opportunities. The reasons behind these phenomena are also to be investigated, by addressing the following:

- **Reasons for not having Internet access** at home or not using mobile Internet services (Eurostat).

Moreover, to better contextualise the reasons, these should be explored at both household and individual level, taking into account the availability of connections and devices on which Internet is accessed. By doing so, issues of affordability and inequality resulting from non-access could be examined.

Moreover, the possibility of procuring data on the size of the **markets** for specific telecommunications products from third parties, as well as the inclusion of the share of **household expenditure** spent on telecommunications services in the budget surveys, could shed more light on the contextual factors inhibiting the uptake of Internet and associated services.

Finally, the European Commission will continue to monitor progress towards the achievement of the broadband targets in the context of the Europe 2020 strategy, namely:

- Next Generation Networks (NGN) (30 Mbps or more) coverage for all by 2020, and
- 50% of households having 100 Mbps subscriptions or higher (this indicator is not actually available and will need the definition of a new appropriate data source).

To address **regional disparities** in the availability and accessibility of the Internet, the abovementioned indicators (where feasible), should be available at NUTS2 and NUTS3 level.

While availability and accessibility of the Internet to European citizens, businesses, and governments is of utmost importance, this access should be free and open to all to ensure the fundamental rights of individuals as users of the Internet are respected. Furthermore, the evolution and use of the Internet should be governed according to a set of common rules and principles agreed by all stakeholders. The European Commission has outlined this vision in its Communication on **Internet Governance**[33]. Furthermore, qualitative efforts to monitor policy developments in this area have been made by establishing a Global Internet Policy Observatory[34], which is expected to identify/develop the relevant indicators (i.e. about IPv6 deployment or Net Neutrality enforcement).

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[33] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0072&from=EN
[34] http://ec.europa.eu/digital-agenda/en/global-internet-policy-observatory-gipo

3. Integration of Digital Technology

3.1. General Trends in Digitisation of Business

ICT are almost unanimously considered as a general purpose technologies that bring additional innovations and organizational changes to the enterprises and sectors that adopt it, in an analogous way to the changes brought on by the introduction of electricity in the production processes. It is therefore more and more difficult to attach the label of digital economy to some specific sectors, be it either the ICT producing sectors or the ICT consuming sectors, since more and more companies in all sectors of the economy are investing in ICT. With such investments and complementary ones in organizational changes and training, they are also revolutionising their business models and transforming value chains. Furthermore, the adoption of new digital solutions leads to technological substitution that, in turn, challenges established processes in the economy and society at large. These also pose considerable implications for the environment, as the digital footprint of the ICT sector[35] increases.

The digitisation of the enterprises in the economy can be characterised along the following dimensions:

- Inputs in terms of Connectivity and Digital Skills;
- Internal Processes; and
- Engagement with Partners and Customers.

a) Connectivity and Skills

As mentioned earlier, connectivity is an important pre-condition for the participation in the digital economy, and access to the Internet on and off site is becoming crucial. At the same time, digitisation mandates the recruitment of individuals that possess the necessary skills to utilise the respective technologies.

In 2014, 97% of enterprises used computers, and 94.5% of enterprises had a connection to either fixed or mobile broadband according to the Eurostat Survey on the ICT Usage and E-Commerce in Enterprises[36]. While these figures point to a very positive general development in the up-take of broadband by enterprises, a considerable share of enterprises in certain regions in Europe still do not have an Internet connection of high quality and speed. Thus, connectivity will continue to be monitored through the Eurostat Survey on the ICT Usage and E-Commerce in Enterprises (for more details, see section on Connectivity).

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[35] In 2013, the European Commission published a Pilot Study on methodologies for measuring the carbon footprint of the ICT sector, http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=1710.
[36] Eurostat Survey on the ICT Usage and E-Commerce in Enterprises http://ec.europa.eu/eurostat/web/information-society/data/comprehensive-database

In terms of the workforce, nearly 20% of enterprises employed **ICT specialists** and nearly 9% of enterprises provided training to develop ICT related skills of these specialists, whereas 18% of enterprises provided **ICT-related training** to other employees. At the same time, some 8% of enterprises recruited or tried to recruit ICT specialists, and nearly 40% of these reported **hard-to-fill vacancies** requiring specialist skills in the area[36] (for a more detailed discussion on the monitoring needs and the proposed indicators, see the section on Human Capital).

b) Internal Processes

The take up of ICT for business as a general trend has been measured in previous monitoring frameworks, by surveying the **automation of selected business processes**. The use of specific technologies for managing internal processes in European enterprises has been growing, as 31% of enterprises had used Electronic Resource Planning (ERP) software in-house in 2014, in contrast to 22.5% two years previously. 30% of enterprises, on the other hand, had used some form of Customer Relationship Management (CRM) software, and one tenth of enterprises had used RFID technologies[36]. As the adoption of these technologies is further set to grow, the proposed indicators to be measured are:

- % of enterprises whose internal business processes are automatically linked (e.g. through the use of **ERP**);

- Adoption of **mobile technologies** for organisation of work within the enterprise

- % of enterprises using software *applications for managing information about clients*, like **CRM**

- % enterprises using **RFID** technologies by purpose (person or product identification).

Source: Eurostat

One of the recent trends in the digitisation of businesses has been the use of **cloud computing** services, where the enterprise relies on ICT services provided over the Internet. 18.6% of enterprises in Europe have bought cloud computing services in 2014[36]. The usage of this and other digital technologies will be also monitored in the future:

- % enterprises buying cloud computing services used over the Internet;
- Types of cloud computing services bought;
- Factors limiting the enterprise from using cloud computing services;
- Delivery mode of cloud computing services (public or private cloud).

Source: Eurostat

In addition to cloud computing, other emerging technologies include **3D printing**, industrial and service **robots**[37], and developments in the areas broadly known as the **Internet of Things** (IoT), **Big Data Analytics** and **dematerialisation** of documents management. As the abovementioned technologies and practices become more commonplace in European enterprises, it is envisaged that new and more sophisticated automated processes will emerge. Some of these are already foreseen or implemented, especially in the manufacturing sector, and although some are not yet widely adopted, their rate of diffusion can be quite rapid. Moreover, the Commission is supporting several initiatives in the area of modernising and digitising the manufacturing sector (notably, the Factories of the Future Public-Private Partnership), as well as monitoring the outcomes of these e.g. in the area of Innovation for Manufacturing SMEs (I4MS) Initiative[38].

Indeed, the emerging paradigm for digitised manufacturing, Industry 4.0, is based on widespread utilisation of these emerging technologies at three levels: more electronics embedded in products, digitisation of the production processes, changes in the business models (from an higher service component added to goods to a complete redefinition of value chains). However, some new technologies are general enough to warrant monitoring penetration across all sectors of the economy. Hence, the below mentioned indicators are currently not collected, but proposed for development following the conceptualisation of definitions and the identification of appropriate data sources:

- % enterprises using 3D printing in various stages of the production process (design, manufacturing);
- % enterprises using industrial or professional service robots in various stages of the production process (assembly, warehouse, delivery, assistance);
- % enterprises using CAD and **virtual reality** tools in various stages of the production process (design, manufacturing) or in training;
- % enterprises employing cyber-physical systems (sensors-actuators, M2M communications), connected or not the Internet, in the production processes and/or integrated in their final products (see section on Internet of Things below).

Internet of Things

Increasingly, devices of all sorts have been equipped with sensors and actuators, connected to the Internet, allowing them to monitor their status or the environment, to receive orders or even to take autonomous action based on available information. This is the Internet of Things which is gaining ground also in the factory (Industry 4.0) and which will contribute to deep advances in productivity

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[37] as defined by ISO 8373:2012 and in the IFR – International federation of robotics Reports.
[38] https://ec.europa.eu/digital-agenda/en/news/innovation-manufacturing-smes-i4ms-initiative-enhancing-digital-transformation-european

(also combined with Big Data analytics, see below). Indicators will be needed to monitor such a trend in terms of:

- number and type of Cyber-physical systems (sensors-actuators, embedded micro-sensors, M2M communication) connected to the Internet;
- their usage in production, by consumers and in households, or by the public sector;
- number of M2M SIM cards (indicator to be developed).

Big Data analytics

The sheer amount of data, including business data, generated by online platforms represents a valuable resource in the digital economy so much so that it has evolved in a viable sector[39]. The gradual diffusion of the Internet of Things will shift the availability of data by some order of magnitude. The exploitation of this "big data"[40] enables companies in all industrial sectors to gain a competitive advantage over their competitors. Questions on Big Data Analytics are already foreseen for the enterprise survey of 2016 on a voluntary basis and cover the following aspects:

- % enterprises analysing Big Data by source/type of data (enterprise's own data from smart devices or sensors, data gathered from geolocation data from the use of portable devices, generated from social media, from other sources);
- % enterprises, where big data is analysed by own employees or by external service providers;
Source: Eurostat

While considerable efforts have been made to define and structure issues surrounding the collection and use of "big data", further investigation is needed in such areas as the use of "big data" by intermediaries, as well as the demand for "big data" and analytical services to garner the insights such data might bring. A study[41] on the development of the **European data market** is currently being undertaken at the request of the European Commission, testing the feasibility of new indicators in that domain.

Common methodological work should be done with statistical institutes to update the mix of indicators used to monitor ICT technologies adopted for changing internal business processes,

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[39] http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=6242

[40] Big data are generated from activities that are carried out electronically and from machine-to-machine communications (e.g. data produced from social media activities, from production processes, etc.)
Big data typically have characteristics such as:
- Significant volume referring to vast amounts of data generated over time.
- Variety referring to the different format of complex data, either structured or unstructured (e.g. text, video, images, voice, docs, sensor data, activity logs, click streams, coordinates, etc.).
- Velocity referring to the high speed at which data is generated, becomes available and changes over time.
Big data analysis refers to the use of techniques, technologies and software tools for analysing big data extracted from your own enterprise's data sources or other data sources.

[41] http://datalandscape.eu/

develop <u>special modules</u> and new indicators about the speed and intensity of the business effort to innovate using such technologies.

c) Engagement with Customers, Suppliers and Third Parties

Digitisation of the economy has also meant a change in the way enterprises engage with their customers, suppliers, and the wider public in general. In 2014, 74% of enterprises had a **webpage**, 36% of enterprises used **social media** (as opposed to 30% in the previous year), and a quarter of enterprises paid to **advertise online**.

Significantly fewer companies in Europe, however, had sent or received **electronic invoices** (29%), and only 17% of enterprises have shared **supply chain** management information electronically in the same period. Naturally, the incidence of the abovementioned practices is higher among large enterprises.

Enterprises relying on more traditional forms of information exchange i.e. those not suitable for automatic processing electronically are at the risk of falling behind their competitors and foregoing potential cost savings in the digital economy. Hence, the uptake of electronic business is a phenomenon that needs to be monitored further and along the following lines:

- % of enterprises sharing supply chain management information electronically;
- % of enterprises sending and/or receiving eInvoices;
- % of enterprises having a website with eCommerce functions;
- % of enterprises using social media by purpose.

Source: Eurostat

The pre-conditions to digitizing European businesses, in terms of the availability of infrastructure and connectivity are present in most European regions. However, the up-take of established and new technologies in the digitisation of internal processes, and electronic management of business relations with customers and suppliers is still infrequent.

Automation of internal processes and electronic interactions with Customers, Suppliers and Third Parties should also be evaluated through the development of overall summary measures of digital intensity in the business sector. DESI component 4a[42] and other derived variables from Eurostat

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[42] http://digital-agenda-data.eu/charts/desi-components#chart={%22indicator%22:%22DESI_4A_BD%22,%22breakdown-group%22:%22DESI_4A_BD%22,%22unit-measure%22:%22pc_DESI_4A_BD%22,%22time-period%22:%222015%22}

survey on ICT usage in enterprises should be developed to assess relevant changes by economic sectors at EU and country level, particularly for SMEs.

3.2.   eCommerce

Improved access to digital goods and services is the first pillar of the Digital Single Market Strategy and the policy aim is to make cross-border commerce easier, especially for small and medium enterprises. The moderate up-take of new and automated technologies for business processes and customer management is also reflected in the engagement of enterprises in eCommerce. The share of European enterprises offering their goods and services online is modest. Only 15% of European companies sold online in 2013[43] – 9% of enterprises sold to other enterprises or public authorities, whereas 10% sold to private consumers via the web.

Nearly 14% of enterprises received orders via their website, whereas Electronic Data Interchange (EDI) type sales, where requests are processed automatically, were less frequently used as less than 7% of enterprises had received orders by means of EDI-type messages[36]. Currently, two of the abovementioned types of sales are accounted for; in addition, the proliferation in the use of tablets and smartphones, for example, has given rise to sales being realised not only through websites but also through "apps", which have been accounted for in web sales. Moreover, the growing popularity of intermediaries and commercial platforms has redefined the way buyers and sellers interact within the digital market.

Internet intermediaries "bring together or facilitate transactions between third parties on the Internet. They give access to, host, transmit and index content, products and services originated by third parties on the Internet or provide Internet-based services to third parties"[44]. **eCommerce platforms** are classed as one of several types of intermediary[45] and are gaining prominence and power as facilitators of online trade.

A recent Flash Eurobarometer survey on Companies Engaged in Online Activities[46] (2015) asked a sample of European enterprises about their experience selling or purchasing online, addressing *inter alia* any barriers encountered in the digital market.

Four fifth of all enterprises selling online used their own website or app, whereas slightly over one third (35%) used a small intermediary commercial platform, and one third (33%) used a large commercial platform for their products or services. The majority of online sales took place within

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[43] This figure includes sales via a website or via Electronic Data Interchange (EDI) type messages, representing at least 1% of enterprise's turnover
[44] http://www.oecd.org/internet/ieconomy/44949023.pdf
[45] Other types include: Internet Access and Service Providers (ISPs), data processing and web hosting providers, internet search engines and portals, social networking platforms.
[46] Flash Eurobarometer 413, 2015. http://ec.europa.eu/public_opinion/flash/fl_413_en.pdf

the borders of one country, only 10% were cross-border EU sales, and a further 4% of sales were to countries outside of the EU. Moreover, a worrisome 58% of companies that offered goods and services online in their own country were adamant that they will most likely not sell their products and services online to other EU countries in the future.

Those who tried to offer their goods or services online in another Member State, had encountered the following problems: high delivery costs, high cost of cross-border dispute resolution, high cost of returns, complexity and cost of compliance with foreign taxation or legislation.

The share of enterprises engaged in eCommerce, the volume of online trade, the intermediaries (if any) used, and cross-border activities are all contributing to the assessment of the prevalence and conditions for eCommerce in Europe.

Thus, the evolution of **eCommerce in European enterprises** still needs surveying through the following indicators:

- % of enterprises receiving orders for products placed via a website or apps, by type of web platform (own website or intermediary marketplace platform) ;

- % of enterprises placing orders for products via a website or apps;

- Turnover resulting from orders received that were placed via a website or apps/, including:
  - Turnover from sales to private consumers (B2C),
  - Turnover from sales to other enterprises (B2B) and to public authorities (B2G);
- % of enterprises receiving orders for products placed via EDI-type messages;
- % of enterprises placing orders for products via EDI-type messages;
- Weight of eCommerce, and crossborder eCommerce, in total retail sales
- % of enterprises using own website or apps for selling online;
- % of enterprises using intermediaries (platforms) for selling online;
- Means of payment accepted for sales via a website;

- % of enterprises receiving orders for products, broken down by origin of order (National, EU, World)

- % of enterprises placing orders for products, broken down by origin of product/sender

- Obstacles for selling products via a website or apps and cross-border.

Source: Eurostat

Alternative approaches and sources for assessing the volume and turnover for eCommerce segments should be tested and explored (i.e. data from credit cards transactions). Reliable sources for estimating the share of eCommerce in the GDP should be identified.

Having reviewed the supply side of eCommerce, the demand side also needs to be investigated. Over the last seven years, the number of individuals shopping online has steadily grown. In 2014, half of all Europeans (50%) had ordered goods and services online, and 16% had bought online

content. Less than half of all individuals purchased goods and services from national providers (44%) and 15% had bought them from sellers in other EU countries[47]. In terms of confidence in cross-border purchases, 61% of European consumers were confident purchasing goods and services online from retailers in their home country, whereas a lower percentage of consumers (38%) were confident about purchasing from retailers in another Member State (European Commission's Consumer Conditions Scoreboard 2015 – forthcoming[48]).

The most frequent goods and services purchased for private use were: clothing and sports goods (30% of individuals), travel and holiday accommodation (27%), household goods (21%), tickets for events (20%), books, magazines, and newspapers (including e-books) (19%)[47].

Statistics on the **use of eCommerce by individuals** in terms of purchasing goods or services online, knowledge about the incidence, frequency, type of goods or services, origin of purchase, as well as amounts spent and difficulties encountered provide a good source of data for identifying the barriers for the Digital Single Market. The data obtained (see below) is and will continue to play a key role in informing policy-makers of the need to legislate for increased fair access to goods, services, and content:

- % of individuals purchasing goods, services, or content over the Internet;
- Types of goods, services, or content bought or ordered;
- Origin of sellers (i.e. national, EU, rest of the world), possibly investigating separately the cases of physical goods, of services and of digital content;
- Payment method for goods, services, or content bought or ordered for private use over the Internet, including the different forms of mobile payments ;
- Number of online purchases for private use over the Internet;
- Amount spent on online purchases;

The existing indicators could be enriched if they were aligned with the Household Budget Survey data or if the Household Budget Surveys would include more detail about purchases online and offline (as shown by experience in Poland). The origin of sellers in cross-border transactions could be analysed (e.g. via qualitative studies) to better define and track this phenomenon. The European Commission will analyse this issue further.

Thus far, a valuable source of the abovementioned data has been the Eurostat Survey on the Usage of ICT in Households and by Individuals; however more diversified information is needed on the scope of cross-border purchases (of goods, services, and content) through the Internet (including the delineation of "online" and "offline" steps in the transaction), and the contextual factors that deter individuals from purchasing online (especially, from abroad) i.e.:

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[47] Eurostat Survey on ICT Usage in Households and by Individuals
http://ec.europa.eu/eurostat/web/information-society/data/comprehensive-database
[48] Flash Eurobarometer 397, "Consumer attitudes towards cross-border trade and consumer protection", 2014

- Problems encountered when buying or ordering goods, services, or content over the Internet, especially from abroad;

Reasons for not buying or ordering goods or services over the Internet

Source: Eurostat

Some additional information on cross-border purchases (e.g. incidence of non-delivery of items) can be gained from the biennial Consumer Conditions Scoreboard[49], which is based on data garnered from surveys on consumers' attitudes towards cross-border trade and consumer protection. Methodologically, these surveys are considered statistically representative; however, due to relatively small sample sizes at the country level, one has to be cautious in drawing conclusions from cross-country comparisons.

From the results of these surveys it can be gathered that the increase in online shopping across Europe has been accompanied by an increase in the problems faced by consumers, in particular delays of delivery and the non-delivery of goods (both domestically and cross-border); moreover, cross-border purchases – both within and from outside the EU – account for a disproportionately high amount of problems. Such incidents undermine consumer trust , with consumers persistently being considerably more reticent about buying online cross-border than domestically: they also make retailers weary of offering their goods and services to customers in other EU countries.

One of the **barriers** identified **in the Single Digital Market** is geo-blocking i.e. the practice of blocking or limiting certain access or content based on the country of origin of the user[50]. While justified in certain cases (such as for legal reasons or reasons of copyright – see Section on Consumption of Online Content), the practice is also used as a market segmentation tool. One can distinguish two main variants of geo-blocking:

- geo-blocking, i.e. denial to access the website, simple refusal to sell or automatic re-routing (to a different country website), and
- geo-filtering, i.e. unjustified diversifying of sale conditions.

The location of the user itself is determined by various technological means.

As previously mentioned, geo-blocking and/or geo-filtering is one of several tools used by companies to segment markets along national borders (territorial restrictions), which in turn leads to market fragmentation and limits consumer choice. Hence, to assess the extent of this problem and to monitor geo-blocking and geo-filtering, a number of initiatives are envisaged. Firstly, the Commission has launched a Competition Sector Inquiry, which will investigate the application of

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[49] http://ec.europa.eu/consumers/consumer_evidence/consumer_scoreboards/survey_consumers_retailers/index_en.htm

[50] In the 2015 survey of online consumers on DSM obstacles (2015 DSM survey - forthcoming Sept. 2015), of those respondents who reported on their most recent problem(s) when making/attempting to make an online cross-border purchase (for tangible goods and offline services) from another EU Member State, 6% indicated that foreign sellers refused to sell to them because of their country of residence, 5% indicated that they were not able to access the seller's website because they were redirected to the seller's website in their own country, and 6% indicated that the foreign seller charged them a higher price than in the seller's country.

competition law in eCommerce. Moreover, a study[51] utilising the mystery shopping methodology will provide further information on supply side barriers to the digital market[52], in particular the prevalence, patterns and economic impact of geo-blocking practices in the DSM. Additional avenues for statistically investigating this phenomenon could be surveying enterprises about their use of technologies for traffic management, especially, re-routing of incoming traffic, as well as examining the use of virtual private networks (VPN) by individuals for gaining access to geographically restricted content.

Another recent, yet somewhat undefined, phenomenon has been the emergence of what is termed the **sharing economy**. The sharing economy (also known as the collaborative economy or peer-to-peer business) is a way of providing services and exchanging under-utilised assets between individual (peer), where these are brought together through an online intermediary, most commonly an Internet platform. In five years the simple percentage of individuals using internet to sell goods or services online has doubled, from 10% in 2009 to 19% in 2014. The sharing economy must be distinguished from other types of exchange, such as business-to-consumer transactions (rental or sales), consumer-to-consumer sales or provision of services. Needless to say, these new business models are changing the eCommerce landscape, revenue streams, and also consumer behaviour.

Exploratory studies are foreseen on the sharing economy[53] and to provide **a taxonomy of platforms** and their role and functioning as an intermediary, while future work could include items on the use of platforms by enterprises and/or individuals, not only as market places for eCommerce, as a special module part of the Eurostat surveys.

Concurrently, platforms provide a number of regulatory challenges, as there is uncertainty over the application of the rights and responsibilities of the individual parties (suppliers, users, and intermediaries) in these transactions (i.e. crowdwork platforms used to outsource tasks to a large number of self-employed workers). Last but not least, platforms generate a wealth of data about their customers, which is analysed and subsequently used for marketing purposes, raising issues of trust in these intermediaries, security of transactions, and the privacy and protection of personal data.

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[51] Undertaken jointly by DG JUST, CNECT and JRC
[52] https://ec.europa.eu/jrc/sites/default/files/JRC92294_Supply%20side%20barriers%20to%20ecommerce.pdf
[53] DG JUST study, currently in tendering

3.3. Trust, Security, Data Protection and Privacy

Currently, 97% of households have fixed broadband coverage (IHS and Valdani, Vikari & Associati 2013), and 81% of households in Europe have access to the Internet[47]. The latter has been continuously growing for the past seven years. However, in addition to these networks being accessible and fit for purpose of delivering high quality services, they also need to be sufficiently secure, trustworthy, and respect the privacy of the consumer. Hence, there is a need to monitor the confidence of European citizens and enterprises in the digital market.

Cybersecurity is an area that has been measured sporadically. Three successive Eurobarometer surveys have been conducted on the topic of cybersecurity (European Commission, 2012, 2013[54], 2015[55]). Most of the questions posed to respondents in 2012 have been repeated in consecutive waves, providing a glimpse into the evolution of problems associated with cybersecurity. To date, when using the Internet for things like Internet banking or shopping online, Internet **users' concerns** over misuse of personal data and security of payments have fluctuated around the 40% mark (i.e. over this period around 40% of Internet users were worried about the former, and roughly 38% about the latter). Around one fifth of Internet users have no concerns whatsoever, when it comes to using the Internet for things like Internet banking or shopping online.

The experience of being a victim of cybercrime varies according to severity; however, current surveys have only measured the incidence of the most common and current types of cybercrime. With the advent of technology, the typology and occurrence of these might change.

To date, slightly less than one third of internet users in Europe have received so-called "scam" emails or phone calls. This is also the most frequently experienced cybercrime, followed by having one's email or social media account "hacked" (12% of Internet users), online fraud in terms of goods not delivered, counterfeit, or goods not delivered as advertised (12%), credit or debit card fraud (8%) and identity theft (7%). Finally, 66% of internet users have discovered malicious software on their device[55].

Despite the fairly low percentage of Internet users directly affected by cybercrime (12% or less in case of "hacking" and fraud), the absolute number of individuals represented by this percentage i.e. around 41 million – is significant. Moreover, around two-thirds of Internet users are concerned about being the victim of identity theft, bank card or online banking fraud, malicious software, and having their account "hacked".

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[54] http://ec.europa.eu/public_opinion/archives/ebs/ebs_404_en.pdf
http://ec.europa.eu/public_opinion/archives/ebs/ebs_390_en.pdf
[55] http://ec.europa.eu/public_opinion/archives/ebs/ebs_423_en.pdf

Methodologically, the results of the abovementioned Eurobarometer surveys are generally considered reliable, yet are based on relatively small country-level samples. Moreover, as most questions pertain to perceptions of what is a fairly technical subject, there is some risk of misinterpretation of questions by the respondents, leading to results that are not representative. Thus, traditional survey methods should be combined with other sources, such as technical monitoring of security incidents, coupled with interviews of the persons taking part in the monitoring. Finally, measurement of security and privacy issues as a challenge has also been recognised by other international organisations, notably, the OECD (OECD 2014[56]). Hence, there is room for improvement in the conceptualisation and delineation of these phenomena.

Several cybersecurity related questions have been developed for the Eurostat Surveys on ICT Usage for 2015 and 2016. In particular, questions on security incidents will allow checking the evolution compared to the 2010 figures. Additional indicators have been introduced on knowledge about cookies, and about protecting oneself online:

- Experience of security related incidents through using the Internet for private purposes in the last 12 months;
- Security concerns limiting individuals from doing certain activities via the Internet for private purposes in the last 12 months;
- Capacity of citizens to successfully implement security measures;
- Enterprises having an ICT security policy in place;
- Enterprises capability to report security breaches and existence of updated security plans.
Source: Eurostat

Security concerns have also been added as possible responses to questions pertaining to non-use of the Internet, e-Government, or cloud services. Namely, 2% of all households do not subscribe to the Internet because of privacy and security concerns (however, these households do not consider this to be the only reason). This percentage has remained stable throughout the period of 2010-2014. At the same time, 12% of individuals, who had to submit forms to public authorities, did not do so over the Internet as a result of concerns about protection and security of personal data. Finally, 13% of all individuals did not use cloud services because they were concerned about security or privacy[47].

Privacy and Protection of Personal Data

However, cybersecurity is not only an end-user concern. Governments and businesses are also affected by gaps in digital security, which can lead to considerable economic losses. A lack of trust of internet users over the use of their personal data by governments and companies would inevitably impede the development of eCommerce and advanced online services.

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[56] OECD, 2014. Measuring the Digital Economy. http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/measuring-the-digital-economy_9789264221796-en#page1

The EU is committed to the highest standards of protection of personal data and privacy and to providing enforceable rights for its citizens and authorities. A comprehensive reform of EU data protection law is in progress, to take into account also the rapid technological developments. The e-Privacy Directive may also need to be reassessed once the general EU data protection rules are agreed.

The current Benchmarking framework measures concerns about personal data in a special module of the Eurostat survey on ICT Usage in Households and by Individuals of 2016 with the following questions:

- Type of personal data provided over the internet in the past 12 months;
- Type of activities carried out to manage access to personal data over previous 12 months;
- Concerns/knowledge of individuals about cookies and personalised advertising;
- Use of anti-tracking software by individuals.
- Enterprises using personal data for behavioural advertising
Source: Eurostat

With the advent of large volumes of data being created and stored by businesses and public administrations on different platforms, as well as discussions on interoperability and cross-border sharing of sensitive data (such as patient records and personal details), issues of cybersecurity and privacy will continue to be prominent and revised special modules could be developed for both Eurostat surveys. Some more information is needed on the practice of profiling individuals or sharing personal data with third parties by internet services or other businesses on the basis of sensitive personal data (such as those revealing racial or ethnic origin, political opinions, religious or other beliefs or data concerning health or sexual life), because of the risk of discrimination practices. The cost of security incidents to enterprises and its implications for risk management practices and the economy at large is another area yet unexplored.

4. Use of Internet

The previous sections have largely focused on the use of Internet by individuals and enterprises for the purposes of eCommerce, whereas this section explores the other activities that individuals engage in online.

4.1. Diversification of Internet Use

The number of people regularly using the Internet is augmenting, as is the number of activities that are carried out online. The number of individuals in the EU, who have used the Internet in the last 3

months, has increased from 71% to 78% between 2011 and 2014, whereas the number of regular internet users (those, who use it at least once a week) has increased from 67% to 75% in the same period[47].

Despite this increasing convergence in use, geographical and socio-economic disparities remain in parts of Europe. Therefore, it is important to continue to survey how often citizens use Internet and what are the primary activities that they carry out online. This also enables benchmarking against non-EU countries as data gathered through the European Union Survey on ICT Usage in Households and Individuals is used by other international organisations such as the International Telecommunications Union (ITU) and the Organisation of Economic Cooperation and Development (OECD). Finally, information on online activities is relevant for the identification of those areas in which Internet use can be made safer and easier.

Regular usage of the Internet by individuals should continue to be monitored through the following indicators:

- % of individuals using the Internet at least once a week;
- % of individuals using the Internet every day or almost every day;
- % of individuals never having used the Internet.
Source: Eurostat

Some analysis to determine who the novice Internet users are, from which socio-economic groups they come from, and which factors have encouraged their going online/Internet use, should also be carried out.

In parallel, the mediums of access to the Internet are changing, and more and more Internet is used "on the go". Thus, the device on which Internet is accessed is playing a larger role, and also has implications for the way in which content is presented (in particular, mobile content through apps).

The following indicators gather contextual and structural information on the channels of access and consumption of online content, monitor the harmonisation/convergence of devices, as well as trends towards the use of mobile devices:

- % of individuals accessing the Internet on various devices;
- % of individuals accessing the Internet away from home or work on mobile devices.
Source: Eurostat

The respective devices currently surveyed are desktops, laptops or notebooks, tablets, mobile or smartphones, other mobile devices (media or games players, e-book readers, smart watches), and Smart TVs. With the evolution of technologies and especially interconnectedness of technologies (also labelled the Internet of Things) it is expected that this list of devices will evolve. Hence, a special module on the development of the Internet of Things is envisaged.

Finally, more and more activities are offered online and European citizens increasingly use the Internet to communicate, access information, or manage their finances (for the relevant list of indicators, see Annex II):

Furthermore, the number of activities is diversifying, and surveying trends in Internet usage would be of policy-relevance. Based on the different activities carried out over the Internet, an indicator on the diversification of Internet use (comprising 12 different activities) was computed between 2009 and 2014.

The Internet is a source of vast information, and people use it extensively to make informed choices, for example, 64% of individuals in Europe have used the Internet to gather information about goods and services, and 52% have read newspapers and magazines online, thereby paving the way to new modes of consumption. As for the consumption of online content, 38% of individuals have played or downloaded games, images, films or music, often for free. At the same time, 16% of all individuals have bought online content[47] .

What can be observed from the abovementioned figures is the predominance of consumption of information over concrete goods and services; however, the augmentation of online purchases and increased confidence in these sales channels and online banking in general (close to half (44%) of Europeans now use online banking), mandates further observation of this trend. The Internet is also increasingly replacing standard means of communication as 28.6% of individuals have used it to make telephone or video calls over the Internet[47].

Finally, attention should remain on online activities linked to active citizenship, such as participation in political debates, use of collective awareness platforms, voting or engagement in online civic initiatives.

Increasingly, individuals also use Internet as a storage space by utilising cloud computing services. The 2014 Eurostat Survey on ICT Usage in Households and by Individuals included a special module on the use of cloud services. Currently, one fifth of individuals use storage space on the Internet and nearly 30% share documents, pictures or other files via their personal website or social networking sites. The monitoring of the usage of storage space on the Internet is foreseen for 2015 and 2016 already, and will continue in the future surveys.

Another area requiring innovative monitoring is time spent on online activities. Use should be made of already existing time budget surveys, which should be analysed and possibly further improved. Moreover, the active rating of and feedback on goods, services, and content given online deserves further investigation.

4.2.   Consumption of Online Content

A shift has been observed in the way people consume online content. Changes in technology have resulted in a shift in consumer behaviour from linear viewing to consuming content anywhere, anytime, on any device (AWATAD), and this use will become more widespread well beyond the simple purchase of commercial services facilitated by the single digital market,. While in the past the physical infrastructure (i.e. an Internet connection) and the content have normally been supplied by the same provider, increasingly this is not necessarily the case, as new content providers emerge, offering "over-the-top" (OTT) services via the Internet. According to a recent study by the European Audiovisual Observatory (2015)[57], in 2009, three quarters of consumer spend on video on demand (VoD) was on traditional networks, such as cable service providers, in 2013, consumer spend on OTT services had surpassed the spend on TV VoD, showing a compound annual growth rate of nearly 60% over the five year period. Furthermore, for the first time in history, the share of global revenue from digital sales of music (46%) was on par with that from physical sales, largely fuelled by music subscription services[58].

In order to keep abreast of this phenomenon of convergence, and to ensure the necessary level of protection of minors and promotion of content, this shift in the consumption and use of content needs to be monitored.

Some in-roads to gauge the convergence of traditional broadcasting and broadcasting over the Internet have already been made in the Eurostat survey on ICT Usage in Households and by Individuals. Some historical data about the distinction in the mode of delivery (i.e. by post or online) of purchases of films or music bought over the Internet are available and allow to assess to what extent content was bought and consumed online. The results of the 2014 survey show that 14% of individuals had purchased films and music over the Internet, and 9% of individuals had downloaded or accessed music or films online[47], meaning a 60% consumed some content online (was 40% in 2007).

In 2016, the inclusion of other questionnaire items is foreseen, namely, the different activities carried out via a Smart TV, simultaneously introducing the distinction between streamed TV content (either live or catch-up), video content (on demand or from sharing services), Internet browsing, and usage of "apps". Furthermore, several items on the use of Internet for entertainment purposes such as streaming music and TV have been introduced in the 2016 survey and will prove important to solidify evidence on the level of convergence in Europe.

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[57] http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=9273
[58] http://www.ifpi.org/downloads/Digital-Music-Report-2015.pdf

An additional source of data for analysing the consumer behaviour in this area has been the IHS TV Media Intelligence database, and data collected and studies undertaken by the European Audiovisual Observatory.

The current indicators used to assess the consumption of online content are:

- % of individuals reading news online;
- % of individuals playing or downloading games;
- % of individuals listening to music (e.g. web radio, music streaming);
- % of individuals watching internet streamed TV (live or catch-up) from TV broadcasters;
- % of individuals watching video on demand from commercial services;
- % of individuals watching video content from sharing services;
- % of households that subscribe to Video on Demand (Source: IHS);
- % of individuals uploading self-created content (text, photos, music, videos, software etc.) to any website to be shared;
- % of individuals creating websites or blogs;
- % of individuals using SmartTV for various activities (watching live TV, VoD, Internet browsing, or using apps).

Source: Eurostat

However, in the context of a Digital Single Market, it is not sufficient to assess to which extent Internet users consume content online. It is also necessary to monitor where that content is obtained from, whether it is obtained in a legal fashion, and whether there are obstacles preventing users from obtaining their desired content (in particular, obstacles related to geographical restrictions).

According to a recent Special Eurobarometer E-Communications and Telecom Single Market Household Survey (2014)[59], 24% of households subscribed to the Internet had experienced some sort of blocking of online content or applications on their home connection. This mainly occurred while attempting to access online content: 37% of households experienced blocking while streaming videos, 22% were prevented from watching live events, and 21% - from streaming music. A similar share of households (25%) reported being unable to access content on their mobile phone. Similarly, blocking was experienced most frequently while streaming videos (41%), streaming audio (23%), uploading content on social networks, blogs, and forums (23%), and watching live events (21%).

Blocking occurs most frequently when trying to access cross-border content, largely due to copyright restrictions, territorial restrictions in licensing agreements, but also – commercial practices of online service providers.

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[59] http://ec.europa.eu/public_opinion/archives/ebs/ebs_414_en.pdf

To that end, in order to better understand user behaviour, to pinpoint which are the pressing issues in need of intervention, and to assess the effects of measures put in place to deal with such issues, a comprehensive data collection exercise should be envisioned to develop indicators in the following:

- Demand for accessing content from other countries (e.g. % individuals using VPN to bypass geographical restrictions).

4.3.   Children's internet use

The protection of minors from inappropriate content online has been a policy concern at the European level for some time. While the European Consumer Agenda[60] identify children[61] as a particularly vulnerable group, and the buying and use of online content by children as a particular area of concern, the European Parliament (2011/2272(INI)) has voiced particular concern about the impact on children of intrusive online advertising practices. However, gathering reliable data on the consumption of content of minors is a methodological challenge in itself, given the strict ethical parameters of any such study[62].

An ad hoc study, funded by the European Commission (Livingstone et al. 2012) has followed children's activities online and found that 85% of 9-16 year-olds use the Internet for schoolwork, 83% use it to play games, 76% watch video clips, and 62% engage in instant messaging. 59% of youngsters have a profile on a social networking site.

Concerning inappropriate content, 12% of the children were bothered or upset by something they saw on the Internet; 14% encountered content of a sexual nature, but only one in three were bothered by this. Moreover, 21% or 11-16 year-olds have been exposed to potentially harmful user-generated content, such as hate (12%), pro-anorexia (10%), self-harm (7%), drug-taking (7%), or suicide (5%) ((Livingstone et al. 2012). Children are particularly vulnerable to online marketing practices and exposure to inappropriate content online, little information is available on the exposure of children to such practices and few measures to protect children online exist. Because of this lack of data it may be worthwhile to start monitoring children's online activities and exposure to inappropriate content more systematically[63].

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[60] *"A European Consumer Agenda - Boosting confidence and growth",* COM(2012) 225 final -
http://ec.europa.eu/consumers/strategy/docs/consumer_agenda_2012_en.pdf
[61] Following the United Nations Convention on the Rights of the Child (UNCRC) Article 1, we use the term children for anyone below the age of 18 years - http://www.unicef.org/crc/files/Rights_overview.pdf
[62] Two relevant ad hoc studies are currently ongoing. One study, commissioned by DG JUST, focusses on the impact of marketing through social media, online games and mobile applications on children's behaviour. Preliminary results indicate that embedded marketing online have a direct and subliminal effect on children's behaviour. This effect is particularly strong for young children (6 – 8 years). Furthermore, the findings indicate that parent's find it hard to regulate the commercial online activities of their children and that they expect other actors, such as businesses and governments, to take action to protect children online.
The other study, commissioned by DG CNECT, focusses on the exposure of minors to alcohol advertising on linear and non-linear audio-visual media services and other online services.
Both studies are expected to be finalised in the end of 2015.
[63] Further to the above mentioned categories of illegal content, should also be covered racist hate speech and terrorism-related offences.

4.4. *Internet use & working conditions*

The effects of internet usage at work or for working deserve some special attention. The Eurostat survey on ICT usage in enterprises provides already some important information on the number of workers requested to **work with computers or portable devices** connected to the internet, as well as the existing possibility to have a remote connection to the enterprise IT tools. This is changing the working conditions and **mobility patters**, creating opportunities for **telework** and raising new problems as for example the usage of information about the geo-localisation of workers. Data are needed on the penetration of such changing practices and opportunities in all types of working environments: micro-SME-large enterprises, self-employment (with a particular reference to crowdwork platforms), and in the public sector. A special module should be developed and proposed to all employed persons, which are in the scope of the Survey on ICT Usage in Households and by Individuals or via the Labour force survey.

5. Human Capital

In order to have a thriving Digital Economy and a Digital Single Market, it is of utmost importance that firms and individuals (as consumers, employees/workers or learners etc.) have at their disposal sufficient digital skills to make the most of the economic and societal advantages it presents. A mismatch between demand and supply would typically affect labour market policies, possibly educational policies, and may even go as far as affecting migration policies.

While being relatively small, the **ICT specialists'** segment of employment is rather impactful for the building up the European competitiveness potential through its contribution to production and use of digital technologies. Overall, labour market dynamics of ICT specialists are characterised by rapid and persistent employment growth, showing resilience to the economic downturns. Important aspects that need monitoring are: the general employment trends of ICT specialists, and the evolution of the group's composition in terms of occupations, gender, age field and level of education. Moreover, it is important to analyse different aspects of the demand and supply forces that impact the ICT specialists' labour dynamics. Some of these aspects are captured by the statistics on difficulties firms have in hiring ICT specialists and ways they mitigate lacking digital skills (such as by offering employees ICT training or outsourcing functions requiring ICT specialists). Other important indicators include those related to the numbers of students entering (higher) education and graduating with diplomas in the fields of STEM (Science, Technology, and Mathematics) and specifically in ICT. As there is a strong gender bias in the education, training and employment of STEM graduates, and especially ICT specialists, it is important to collect information on gender related aspects. As such, the following indicators are needed:

- % of persons employed with ICT specialist skills (by gender);
- % of enterprises employing ICT specialists;
- % of enterprises training their ICT specialists;

- % of enterprises providing training to employees to develop ICT related skills;
- % of enterprises trying to recruit or recruiting ICT specialists;
- % of enterprises finding it difficult to fill vacancies for ICT specialists.
- % of enterprises outsourcing various relevant IT functions requiring ICT specialists

Source: Eurostat (Labour Force Survey, Survey on ICT Usage and e-Commerce in Enterprises)

In addition, further work is needed in assessing generic ICT user skills in the workplace. To this end the OECD has made inroads with its Programme for the International Assessment of Adult Competencies (PIAAC) survey[64], which could serve as a springboard for the development of a new classification of ICT user skills.

A complementary initiative in the area has been a recent study by the European Commission[65], which has developed the specification and implemented a web crawler (a software application browsing the World Wide Web in a systematic manner) for gathering information on vacancies for ICT professionals. The application was successfully piloted using one country as a test case, and it is planned to extend this approach in order to gather data across all EU Member States.

As digital technologies spread throughout the economy to all sectors and an increasing number of jobs, digital skills are becoming an essential element of employability. Therefore, it is also necessary to collect data on the **digital skills of the workforce as a whole**. For the purpose of assessing the digital competences of EU citizens, the European Commission has developed a Digital Skills Index (DSI), which it first piloted on the 2012 micro data of the European Union Survey on Internet Usage in Households and by Individuals (Eurostat). As the DSI is a composite indicator constructed using various internet and computer use indicators from the said survey, the continued collection of these indicators is essential for its calculation and the continued assessment of the digital skills of the EU workforce (and citizens as a whole). It aims to assess the various digital skills of individuals, who have used the Internet in the last three months. Finally, as this indicator can be broken down by various background variables, it can also be calculated for the labour force thus allowing an assessment of the digital skills for the EU workforce, and be complementary to further investigation of skills shortages.

These indicators (for a full list of indicators see Annex III) are grouped into four dimensions:
- Information Skills;
- Communication Skills;
- Problem-solving Skills;
- Software Skills for Content Manipulation.

More detailed information of digital skills demand and supply and the factors affecting it will be collected on an ad hoc basis through dedicated studies, such as the recently started study on "ICT for work: Digital Skills in the Workplace".

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[64] http://www.oecd.org/site/piaac/surveyofadultskills.htm
[65] MOVIP Study http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=KK0415105

Beyond the workforce, it is important to ascertain the level and development of **digital skills of European citizens** as a whole who, as consumers, are essential to a thriving Digital Single Market and who can only benefit from the digital economy and society if they can access and use digital technologies effectively. In this regard, the above mention DSI and the Internet and computer use indicators on which it is based are needed to assess the digital skills of men and women. Furthermore, as the pilot DSI only covered four of the five digital competence domains identified by the European Commission's Digital Competence Framework, going forward it will be necessary to develop, and collect data for, indicators for the missing domain of "Safety". This could be the outcome of special modules on security and privacy. Other important indicators not included in the DSI include indicators on the use and non-use of the Internet, the reasons for not having an internet connection at home (which includes lacking digital skills) and the breakdowns of these indicators by socio-economic background variables. This would also enable the assessment according to the already established disadvantage factors (i.e. individuals comprising the age group 55-74, individuals with low educational attainment, and unemployed, inactive or retired individuals), which are to be continued.

As the learning of digital skills and digital skills for learning are increasingly important it is envisaged to carry out ad hoc studies covering this domain. A recent example is the study "Survey of Schools: ICT in Education"[66]. Possible future studies could look at higher, vocational and/or informal education/learning.

6. Digital Public Services

The increasing sophistication of online public services[67] has led to a multiplication of the ways in which public administrations interact with their citizens, as well as with business, of which smart phone apps and presence on social media are only two notable examples. Therefore, the measurement of citizens' electronic interaction with public administrations should be updated taking into account these developments.

Current measurement of demand side, coming from Eurostat survey of ICT Usage in Households and by Individuals accounts for the following:

- % of citizens obtaining information from (public administrations') websites;
- % of citizens downloading official forms from public administrations through the Internet;
- % of citizens submitting completed forms to public administrations through the Internet;
- % of citizens using online public services (derived variable as union of the three above);
- Reasons for not submitting completed forms through the Internet
Source: Eurostat

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[66] http://ec.europa.eu/digital-agenda/en/survey-schools-ict-education
[67] In this context, online public services comprise primarily technical solutions deployed in the areas of eGovernment, health services, and inclusion.

Clearly, the current indicators are generic to encompass and account for the various ways of interaction with public authorities to date, but as new technologies and forms of interaction with public authorities, as well as legislation (the eIDAS Regulation[68]) to ensure the security of these transactions become available, there is room for new indicators measuring these modes of **online public service delivery** (e.g. smart phone apps), **proactive public services** (e.g. pre-filled tax declarations or eligibility to eProcurement verified by administration on existing registers without the need to submit evidence) **collaborative production of services**, and **eParticipation**. Measurement of demand side (specific services take-up, as i.e. the % of fiscal declarations introduced online) could be also done through other sources like administrative data (e.g. public eProcurement platforms).

For what concerns measurement of the supply side, the priorities of the new e-Government Action Plan 2016-2020 should be considered. This Action Plan will include:

a) making mandatory interconnection of business registers a reality by 2017;
b) launching in 2016 an initiative with the engagement of Member States to demonstrate and pilot the 'Once-Only' principle for businesses;
c) working towards a 'Single Digital Gateway' to create a seamless, user friendly information system for citizens and business; and
d) accelerating Member States' transition towards full e-procurement and interoperable e-signatures.

Interoperability and ensuing seamless interconnection and integration of services, even at the European level, is therefore becoming the new standard benchmark on which to measure performance.

Currently, the supply side of eGovernment is measured through an ad-hoc recurring study (the eGovernment Benchmark Report[69]), and in view of the new eGovernment Action Plan 2016-2020 monitoring and measurement will continue.

The current eGovernment Benchmarking study uses the mystery shopping methodology to assess different characteristics of online public services, grouped into 7 groups of services related to a unique user's need (life events).

The current top level benchmark indicators for the supply side are the following:

- **User Centricity.** It indicates to what extent (information about) a service is provided online and how this is perceived (in terms of user-friendliness).

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[68] Regulation No 910/2014 of the Euorpean Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0910&from=EN to enter into force on 1st July 2016

[69] http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5811

- **Transparency.** It indicates to what extent governments are transparent regarding: a) their own responsibilities and performance, b) the process of service delivery and c) personal data involved.
- **Cross border mobility.** It indicates to what extent EU citizens can use online services in another country.
- **Key enablers**. It indicates the extent to which 5 technical pre-conditions are available online. These are: Electronic Identification (eID), Electronic documents (eDocuments), Authentic Sources[70], Elecronic Safe (eSafe), Single Sign On (SSO).

Possible developments of the current framework may include exploitation of administrative data about services provided to businesses (e.g. eTendering via eProcurement platforms or submission of VAT declarations online) and more precise information on the interoperability of key enablers. Another development could include a more detailed assessment of the Authentic Sources key enabler for businesses to see to what extent the Once Only principle is implemented in the measured life events. **eSignature** could be added to the list of the key enablers, and survey data could be used to monitor the take-up by enterprises and individuals. Finally, user satisfaction with digital public services is an important consideration in the take-up of said services; thus, questions pertaining to user satisfaction (as done in the 2013 special e-government module of the ICT Usage Survey on Households and by Individuals) could be repeated.

Another area, where there has been ongoing deployment of online public services is the healthcare sector. However, the progress in modernising healthcare across Europe has been uneven and the European Commission has taken an active role in promoting **eHealth** through the eHealth Action Plan 2012-2020[71], which foresees the achievement of the following operational objectives:

- Achieving wider interoperability of eHealth services;
- Supporting research, development and innovation in eHealth and wellbeing to address the lack of availability of user-friendly tools and services;
- Facilitating uptake and ensuring wider deployment;
- Promoting policy dialogue and international cooperation on eHealth at global level.

According to a study requested by the European Commission, the introduction of eHealth solutions, such as ePrescription and Electronic Health Records (EHR), in public healthcare systems could lead to considerable efficiency gains in the long term[72].

The subject of health has been only marginally addressed by the Eurostat survey on ICT Usage in Households and by Individuals via the following:

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[70] Authentic Sources are base registries used by governments to automatically validate or fetch data relating to citizens or businesses. It facilitates pre-filling of online forms and the implementation of the 'once-only principle' that implies governments re-use data to deliver services automatically (without the user having to do anything). Source: http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=5812
[71] http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=4188
[72] http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=2923

- % of individuals making an appointment with a practitioner via a website (e.g. of a hospital or a health care centre) (2014, 2016);
- % of individuals seeking health-related information (2015, 2016);
- % of individuals buying or ordering medicine over the Internet (2014, 2015, 2016).

Source: Eurostat

In addition, two surveys on the use of ICT by General Practitioners (conducted in 2007[73] and 2013[74]), and two surveys on the use of ICT in acute hospitals (conducted in 2010[75] and 2012[76]) have been carried out. A replication of the survey on the use of ICT by GPs is foreseen for 2016, whereas composite indicators for eHealth Deployment and for eHealth Availability and Use in hospitals have been developed on the basis of the survey of hospitals. These have been used to benchmark eHealth services across the various member states[77]. Possible future developments could include the monitoring of:

- Consultations offered at a distance;
- Access to the personal electronic health record.

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[73] http://bookshop.europa.eu/en/benchmarking-ict-use-among-general-practitioners-in-europe-pbKK0114648/downloads/KK-01-14-648-EN-N/KK0114648ENN_002.pdf?FileName=KK0114648ENN_002.pdf&SKU=KK0114648ENN_PDF&CatalogueNumber=KK-01-14-648-EN-N
[74] https://ec.europa.eu/digital-agenda/en/news/benchmarking-deployment-ehealth-among-general-practitioners-2013-smart-20110033
[75] https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/ehealth_benchmarking_3_final_report.pdf
[76] http://ftp.jrc.es/EURdoc/JRC85852.pdf
[77] http://is.jrc.ec.europa.eu/pages/TFS/EHS.html

Alternative Data Collection Mechanisms

Increasingly, traditional statistics are complemented by alternative data collection and analysis mechanisms, or such methods are incorporated into the production of Official Statistics. In this regard, a number of pilot initiatives have been launched to test these new approaches and techniques, with a view to supplement traditional statistics by establishing alternative ways to collect policy indicators.

A number of initiatives in the field have been already launched:

- The ICT vacancies study using web crawling (MOVIP-VICTORY SMART 2014/0045);
- The IPv6 indicator on the Digital Agenda Scoreboard.

And other ideas need to be further explored, like the following:

- development of apps to determine and monitor mobile broadband speed/quality across the EU, as the one existing for the Netherlands[78];
- crawling of eGovernment websites to analyse their web accessibility[79];
- up-to-date, transparent and interoperable business registers integrating administrative sources, websites crawling and other big data sources;
- harmonization of administrative data from online public services (e.g. eProcurement platforms)
- indicators on net neutrality using tools such as SamKnows meters,
- use of Big Data for small area estimators, namely, to obtain reliable data at the sub-regional level (NUTS2 and 3 or lower)[80].

Furthermore, it is clear that the data revolution, which makes data cheaper, should also ensure that policy makers and citizens have better access to quality information. Hence, establishing the necessary infrastructure for accessing such information, especially for official statistics, must be an integral part of the framework.

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[78]https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/FINAL%20REPORT%20Dialogic%202010.30%20Internet%20as%20a%20Source%20of%20Statistical%20Data%20(with%20visual%20ID)_0.pdf

[79] The initiatives of W3C http://www.w3.org/standards/webdesign/accessibility concerning the standards for accessing the web. There are as well the WCAG Web Content Accessibility Guidelines for which certain metrics have been developed in addition to the many web accessibility studies. The evaluation of the websites (concerning accessibility) can in principle be automated by software known as "web crawlers". This software accesses the websites and evaluates the accessibility standards or in most cases the violation of accessibility standards. A list can be found in http://www.w3.org/WAI/ER/tools/ as well as in many other places over the internet. In the 2009 e-Government Benchmarking Report was measured if the national portals were accessible to people with disabilities (DG CNECT).

[80] Examples of pilots include http://www.cros-portal.eu/sites/default/files/10A01_208_0.pdf

Annexes

ANNEX I: Summary of Proposed Key Indicators for Benchmarking collected through Eurostat ICT surveys

	Indicator (those marked with an * asterisk need to be properly developed or revised)	Source	Periodicity	Used for Composite Indices
	Connectivity			
	% households using a fixed broadband Internet connection at home	Eurostat HH	Annual	DESI
	% of enterprises using a fixed broadband Internet connection, by speed	Eurostat ENT	Annual or Biennial	
	% of individuals using mobile devices to access the Internet away from home or work	Eurostat HH	Annual or Biennial	
	Reasons for not having access to the Internet	Eurostat HH	Biennial	
	% of enterprises providing portable devices to persons employed for a mobile connection to the Internet for business purposes	Eurostat ENT	Annual	
	% of persons employed using a portable device (provided by the enterprise) for a mobile Internet connection for business purposes	Eurostat ENT	Annual	
	Integration of Digital Technology			
	% of enterprises whose internal business processes are automatically linked (e.g. through the use of ERP);	Eurostat ENT	Biennial	DESI
	% of enterprises using software applications for managing information about clients (e.g. CRM)	Eurostat ENT	Biennial	
	Adoption of mobile technologies by degree of sophistication *	Eurostat ENT	Triennial	
	% enterprises using RFID technologies, by purpose (person or product identification)	Eurostat ENT	Bi- or Triennial	DESI
	% enterprises buying cloud computing services used over the Internet, by type of services	Eurostat ENT	Biennial	DESI
	% enterprises using 3D printing in various stages of the production process (design, manufacturing) *	Eurostat ENT or CIS	Bi- or Triennial	
	% enterprises using industrial or professional personal robots in various stages of the production process (assembly, warehouse, delivery, assistance) *	Eurostat ENT or CIS	Bi- or Triennial	
	% enterprises using CAD or virtual reality tools in various stages of the production	Eurostat ENT	Bi- or Triennial	

process (design, manufacturing) or in training *	or CIS		
% enterprises employing cyber-physical systems (sensors-actuators, M2M communications) connected or not to the Internet *	Eurostat ENT or CIS	Bi- or Triennial	
% enterprises analysing big data, by type of source	Eurostat ENT	Bi- or Triennial	
big data analytics by internal/external provider	Eurostat ENT	Bi- or Triennial	
% of enterprises sharing supply chain management information electronically	Eurostat ENT	Bi- or Triennial	
% of enterprises sending and/or receiving eInvoices	Eurostat ENT	Biennial	DESI
% of enterprises using social media, by purpose	Eurostat ENT	Biennial	DESI
eCommerce			
% of enterprises having a website with eCommerce functions	Eurostat ENT	Annual or Biennial	
% enterprises receiving orders for products, placed via website/apps or EDI-type messages	Eurostat ENT	Annual	DESI
Turnover resulting from orders received via electronic networks, by channel website/EDI and by type of customer i.e. B2C, B2G, B2B if through websites or apps	Eurostat ENT	Annual	DESI
enterprises receiving orders for products via websites or apps, by type of web platform (own website or intermediary platforms)	Eurostat ENT	Annual or Biennial	
enterprises receiving orders for products broken down by origin of order (National, EU, World)	Eurostat ENT	Biennial	DESI
Obstacles to selling products online, in general and cross-border	Eurostat ENT	Annual or Biennial	
% of individuals purchasing goods, services, or content over the Internet	Eurostat HH	Annual	DESI, DSI
Types of goods, services, or content bought or ordered for private use over the Internet in the last 12 months	Eurostat HH	Annual	
Origin of sellers (i.e. national, EU, rest of the world) of goods, services or content bought or ordered for private use over the Internet	Eurostat HH	Annual or Biennial	
Payment method for goods, services or content bought or ordered for private use over the Internet *	Eurostat HH	Biennial	
Number of online purchases and amount spent on buying or ordering goods, services, or content over the Internet	Eurostat HH	Annual	
Problems encountered when buying or ordering goods, services, or content over the	Eurostat HH	Annual or Biennial	

	Internet			
	Reasons for not buying or ordering any goods or services over the Internet	Eurostat HH	Annual or Biennial	
	Trust, Security and Privacy			
	Experience of security related incidents through using the Internet	Eurostat HH	Triennial	
	Security concerns limiting individuals from doing certain activities via the Internet for private purposes	Eurostat HH	Triennial	
	Types of activities carried out to manage access to personal data and implement security measures (i.e. use of anti-tracking software by individuals) *	Eurostat HH	Triennial	
	Concerns/knowledge of individuals about cookies and personalised advertising	Eurostat HH	Triennial	
	% of enterprises having an up to date ICT security policy	Eurostat ENT	Triennial	
	Experience of security related incidents in enterprises (including report of security breaches) *	Eurostat ENT	Triennial	
	Enterprises using behavioural advertising	Eurostat ENT	Triennial	
	Use of Internet			
	individuals using the Internet, by frequency (at least once a week, almost every day, never)	Eurostat HH	Annual	DESI
	individuals using mobile devices to access the Internet away from home or work, by network used (mobile phone subscription or WiFi)	Eurostat HH	Annual or Biennial	
	Devices used by individuals for accessing the Internet, at home or away from home*	Eurostat HH	Biennial	
	% of individuals using the Internet for sending/receiving e-mails	Eurostat HH	Annual	DSI
	% of individuals using the Internet for telephoning (via webcam), video calls over the Internet	Eurostat HH	Annual	DESI, DSI
	% of individuals using the Internet for participating in social networks	Eurostat HH	Annual	DESI, DSI
	% of individuals using the Internet for listening to music (e.g. web radio, music streaming)	Eurostat HH	Biennial	DESI
	% of individuals using the Internet for watching Internet streamed TV (live or catch-up) from TV broadcasters*	Eurostat HH	Biennial	
	% of individuals using the Internet for watching Video on Demand from commercial services *	Eurostat HH	Biennial	DESI
	% of individuals watching video content from sharing services*	Eurostat HH	Biennial	DESI

	Eurostat HH		
% individuals accessing content from other countries (e.g. for free, subscribing, using VPN to bypass geographical restrictions, etc.) *	Eurostat HH or other sources		
% of individuals purchasing e-books	Eurostat HH	Biennial	
% of individuals using the Internet for playing or downloading games*	Eurostat HH	Biennial	DESI
% of individuals using the Internet for reading / downloading online newspapers / news magazines	Eurostat HH	Biennial	DESI
% of individuals using the Internet for seeking health-related information (on injuries, diseases, nutrition)	Eurostat HH	Biennial	DSI
% of individuals using the Internet for looking for information about goods or services	Eurostat HH	Annual or Biennial	DSI
% of individuals using the Internet for posting opinions for discussing civic and political issues on websites (e.g. blogs, social networks, etc)	Eurostat HH	Biennial	
% of individuals using the Internet for taking part in consultations, voting and opinion polls on-line on political issues	Eurostat HH	Biennial	
% of individuals using the Internet for uploading self-created content (text, photos, music, videos, software etc.) to any website to be shared *[81]	Eurostat HH	Biennial	DSI
% of individuals using the Internet for doing an online course	Eurostat HH	Biennial	DSI
% of individuals using online learning resources (online courses, material other than a complete online course, educational websites/portals)	Eurostat HH	Biennial	DSI
% of individuals using the Internet for making an appointment with a practitioner via a website	Eurostat HH	Biennial	
% of individuals using the Internet for Internet Banking	Eurostat HH	Annual	DESI, DSI
% of individuals using the Internet for selling of goods or services	Eurostat HH	Biennial	DSI
% of individuals using peer-to-peer web-services to sell/rent/exchange goods or services, both as a supplier or as a consumer *	Eurostat HH	Biennial	
% of individuals looking for a job or sending a job application	Eurostat HH	Triennial	
% of individuals using storage space on the Internet (cloud computing services)[82]	Eurostat HH	Annual	DSI

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[81] To be better coordinated with the indicator about using the Internet for creating websites or blogs

[82] Relevant also for the trust, security and privacy domain

	Human Capital			
	persons employed with ICT specialist skills/occupation	Eurostat LFS	Annual	
	% of enterprises employing ICT specialists	Eurostat ENT	Biennial	
	Enterprises trying to recruit or recruiting ICT specialists, in case finding it difficult to fill vacancies	Eurostat ENT	Biennial	
	Enterprises training their personnel (ICT specialists and/or other persons employed)	Eurostat ENT	Biennial	
	Enterprises outsourcing key IT functions or performing them with own employees	Eurostat ENT	Biennial	
	% of individuals with digital skills (low, basic, above basic), overall and by competence area	Eurostat HH	Annual or Biennial	DSI
	Individuals performing selected Hardware and Software related activities, to assess digital skills	Eurostat HH	Biennial	DSI
	Digital Public Services			
	% of citizens using online public services (i.e. obtaining information from websites, submitting forms online) *	Eurostat HH	Annual	DESI, DSI
	Reasons for not submitting completed forms through the Internet *	Eurostat HH	Annual	

ANNEX II: Main recurrent sources for the key indicators

Category of statistics producers/providers	Data description	Frequency of the collection
Produced for the DG by an external contractor	Broadband Coverage in Europe. Urban and rural areas and population which have the possibility to subscribe and access internet under various technologies and speeds conditions, as offered by Internet service providers and telecom operators.	annually
Produced for the DG by an external contractor	Broadband internet access cost (BIAC). A recurrent study on retail prices for a variety of broadband offerings including standalone and bundled services for eight speed categories (a basket of 32 fixed broadband and 15 Mobile offerings).	annually
Produced for the DG by an external contractor	eCommunication Eurobarometer: A consumer survey conducted on a yearly basis since 2005 using the Eurobarometer tools. To measure the diffusion of eCommunications services in households and the attitude of households and individuals towards new services, and in particular in the areas of fixed and mobile Internet access, VoIP, Digital TV, bundles, transparency of information and control of expenditure, affordability, quality of services, switching, consumer sensitivity to speed, Single Market-related aspects, consumer experience in access to online applications and content.	annually
Produced for the DG by an external contractor	2nd Survey of Schools: ICT in Education - SMART 2014/0020 Call for tender launched in 2015 and field work expected beginning of 2016.	a-periodic

Produced for the DG by an external contractor	Benchmarking Deployment of eHealth among General Practitioners - SMART 2015/0065 Besides basic ICT information and infrastructures, the key pillars of eHealth that have been measured include: Electronic Health Record (EHR), Health Information Exchange (HIE), TeleHealth, and Personal Health Record (PHR).	a-periodic
Produced for the DG by an external contractor	eGovernment Benchmark study - SMART number: 2014/0040 The study provides insight into the state-of-play of the implementation of digital public services in Europe in 33 participating countries, including all of the EU28. The assessment is done by Mystery Shoppers, who measure the quality and quantity of online public services by acting as a user. Under review is a set of seven life events. Each life event is measured once every two years.	annually
Produced for the DG by an external contractor	VICTORY A pilot study crawling web vacancies to analyse the demand for ICT specialists and the type of skills required	weekly
Produced for the DG by an external contractor	European Data Market Study - SMART 2013/0063 Study intended to develop indicators about the new data economy to be described in terms of data enterprises, data workers, etc. Large use of models to estimate the new indicators. Baseline years 2014 and 2015. First results to be published early 2016 and continued.	annually
Commissioned by the DG and produced by an agency	PREDICT The project is a source of information on ICT R&D investments in the EU, also benchmarking them against those of the EU's main global competitors. PREDICT combines in a unique way three complementary perspectives: national statistics (covering both private and public R&D expenditures), company data, and technology-based indicators. It relies on the latest available official statistics delivered by Member States,	annually

	Eurostat and the OECD. This data still contains gaps and where this is the case, rigorous cross-checking and estimating methods have been applied by JRC-IPTS to provide the study with the necessary set of data	
Data produced directly by the DG	"Cocom" questionnaire to Telecom Regulatory Authorities. A survey on European broadband markets including the number of subscriptions of fixed and mobile broadband, data on competition, broadband speeds as well as Next Generation Access technologies.	bi-annually
Data produced directly by the DG	Amount of spectrum assigned by Member States for wireless mobile broadband communications (WBB) within the ranges harmonised by European Union decisions. Continuous monitoring through a database of national assignment decisions.	quarterly
Data produced directly by the DG	Inventory of the patents and publications of FP7 projects in the field of ICT. The inventory includes data on 295 patents and 18,158 publications resulting from FP7 funded projects in the field of ICT (ICT theme within Cooperation Programme and eInfrastructures within Capacities Programme). To be continued under H2020 monitoring mechanisms.	annually

ANNEX III: *Variables used for the Digital Skills Indicator 2015*

Domains/Competence Areas
1. Information Skills
Copied or moved files or folders
Saved files on Internet storage space
Obtained information from public authorities/services' websites
Finding information about goods and services
Seeking health-related information
2. Communication Skills
Sending/receiving emails
Participating in social networks
Telephoning/video calls over the internet
Uploading self-created content to any website to be shared
3. Problem Solving Skills
A – Problem solving
Transferring files between computers or devices
Installing software and applications (apps)
Changing settings of any software, including operating system or security programs
B – Familiarity with online services (former: technological responses to needs)
Online purchases
Selling online
Used online learning resources
Internet banking
4. Software Skills for Content Manipulation (former: Content Creation Skills)
A – Basic
Used word processing software
Used spreadsheet software
Used software to edit photos, video or audio files
B – Above basic
Created presentation or document integrating text, pictures, tables or charts
Used advanced functions of spreadsheet software to organise and analyse data (sorting, filtering, using formulas, creating charts)
Have written code in programming language

Overall Digital Skills Assessment scale

Individuals with "*no skills*" should be as follows:

- those who never used the internet

- those who used the internet more than 12 months ago

- Four "none" (no items ticked in all four domains), and

Individuals with "*low*" level of skills (individuals with heavy weaknesses):

- One or more "none" in 3 domains (no items ticked in one to three domains)

Individuals with a "*basic*" level of skills (individuals with some weaknesses):

- one or more "basic" (but no "none")

Individuals with "*above basic*" level of skills (individuals without clear weaknesses):

- "above basic" in all the 4 domains

Annex IV: Composition of the Digital Economy and Society Index (DESI)

1a1 Fixed BB Coverage	**Notation:** DESI_1A1_FBBC **Definition:** Standard fixed broadband coverage, normalised indicator	Study on broadband coverage
1a2 Fixed BB Take-up	**Notation:** DESI_1A2_FBBTU **Definition:** Households that have a fixed Broadband connection, normalised indicator	Eurostat - ICT Households survey
1b1 Mobile BB Take-up	**Notation:** DESI_1B1_MBBTU **Definition:** Mobile broadband take-up, normalised indicator	Communications Committee survey
1b2 Spectrum	**Notation:** DESI_1B2_SPEC **Definition:** Percentage of assigned spectrum out of the target to be harmonised at EU level, normalised indicator	European Commission Services
1c1 NGA Coverage	**Notation:** DESI_1C1_NGAC **Definition:** Households covered by NGA broadband, normalised indicator	Study on broadband coverage
1c2 Subscriptions to Fast BB	**Notation:** DESI_1C2_SFBB **Definition:** Share of fixed broadband subscriptions >= 30 Mbps, normalised indicator	Communications Committee survey
1d1 Fixed BB Price	**Notation:** DESI_1D1_FBBP **Definition:** Monthly cost of the least expensive fixed broadband subscription with speed of 12 to 30 Mbps, normalised indicator	Broadband Internet Access Cost (BIAC) annual studies
2a1 Internet Users	**Notation:** DESI_2A1_IU **Definition:** Individuals whose frequency of Internet access is at least once a week, normalised indicator	Eurostat - ICT Households survey
2a2 Basic Digital Skills	**Notation:** DESI_2A2_BDS **Definition:** Individuals with basic or above basic digital skills, normalised indicator	Pilot of new Digital Skills Indicators
2b1 ICT Specialists	**Notation:** DESI_2B1_ICTSPEC **Definition:** Persons Employed with ICT Specialist Skills, normalised indicator	Eurostat - Labour force survey
2b2 STEM Graduates	**Notation:** DESI_2B2_STEMG **Definition:** Science and technology graduates, normalised indicator	Eurostat education statistics

3a1 News	**Notation:** DESI_3A1_NEWS **Definition:** Individuals who used the Internet to read online news sites, newspapers or news magazines, normalised indicator	Eurostat - ICT Households survey
3a2 Music, Videos and Games	**Notation:** DESI_3A2_MVG **Definition:** Individuals who used the Internet to play or download games, images, films or music, normalised indicator	Eurostat - ICT Households survey
3a3 Video on Demand	**Notation:** DESI_3A3_VOD **Definition:** Percentage of households subcribing to any form of Video on Demand, normalised indicator	IHS TV Media Intelligence
3b1 Video Calls	**Notation:** DESI_3B1_VIDCALL **Definition:** Individuals who used the Internet to make telephone or video calls, normalised indicator	Eurostat - ICT Households survey
3b2 Social Networks	**Notation:** DESI_3B2_SOCNET **Definition:** Individuals used the Internet to participate in social networks (create user profile, post messages or other contributions to facebook, twitter, etc.), normalised indicator	Eurostat - ICT Households survey
3c1 Banking	**Notation:** DESI_3C1_BANK **Definition:** Individuals who used the Internet to use online banking, normalised indicator	Eurostat - ICT Households survey
3c2 Shopping	**Notation:** DESI_3C2_SHOP **Definition:** Individuals who ordered goods or services online, normalised indicator	Eurostat - ICT Households survey
4a1 Electronic Information Sharing	**Notation:** DESI_4A1_EIS **Definition:** Enterprises who have ERP software package to share information between different functional areas, normalised indicator	Eurostat - ICT Enterprises survey
4a2 RFID	**Notation:** DESI_4A2_RFID **Definition:** Enterprises using Radio Frequency Identification (RFID) technologies for after sales product identification or as part of the production and service delivery, normalised indicator	Eurostat - ICT Enterprises survey
4a3 Social Media	**Notation:** DESI_4A3_SOCMED **Definition:** Enterprises that use two or more types of social media, normalised indicator	Eurostat - ICT Enterprises survey
4a4 eInvoices	**Notation:** DESI_4A4_EINV **Definition:** Enterprises sending e-invoices suitable for automatic processing, normalised indicator	Eurostat - ICT Enterprises survey
4a5 Cloud	**Notation:** DESI_4A5_CLOUD	Eurostat - ICT

	Definition: Buy Cloud Computing services of medium-high sophistication, normalised indicator	Enterprises survey
4b1 SMEs Selling Online	**Notation:** DESI_4B1_SMESO **Definition:** Enterprises selling online (at least 1% of turnover), normalised indicator	Eurostat - ICT Enterprises survey
4b2 eCommerce Turnover	**Notation:** DESI_4B2_ECOMTURN **Definition:** Enterprises' total turnover from e-commerce, normalised indicator	Eurostat - ICT Enterprises survey
4b3 Selling Online Cross-border	**Notation:** DESI_4B3_SELLCB **Definition:** Enterprises that did electronic sales to other EU countries, normalised indicator	Eurostat - ICT Enterprises survey
5a1 eGovernment Users	**Notation:** DESI_5A1_EGOVU **Definition:** Individuals sending filled forms to public authorities, over the internet, last 12 months, normalised indicator	Eurostat - ICT Households survey
5a2 Pre-filled Forms	**Notation:** DESI_5A2_PREFFORM **Definition:** Amount of data that is pre-filled in Public Services' online forms (Authentic sources Key Enabler indicator of eGovernment benchmark), normalised indicator	eGovernment Benchmark
5a3 Online Service Completion	**Notation:** DESI_5A3_OSERCOMP **Definition:** Share of the steps in a Public Service life event that can be completed online (Online availability sub-indicator for User centricity of the eGovernment benchmark), normalised indicator	eGovernment Benchmark
5a4 Open Data	**Notation:** DESI_5A4_OPENDATA **Definition:** Score in the European PSI Scoreboard measuring the status of Open Data and PSI re-use throughout the EU, normalised indicator	ePSI Scoreboard
5b1 Medical Data Exchange	**Notation:** DESI_5B1_MDATAEXCH **Definition:** GPs using electronic networks to exchange medical data with other health care providers and professionals, normalised indicator	eHealth Studies
5b2 ePrescription	**Notation:** DESI_5B2_EPRESC **Definition:** GPs using electronic networks to transfer prescriptions to pharmacists, normalised indicator	eHealth Studies