THE 2013 PREDICT REPORT:
An Analysis of ICT R&D in the EU and Beyond

Authors: Matilde Mas and Juan Fernández de Guevara Radoselovics (University of Valencia-Ivie)
Editors: Ibrahim K. Rohman, Giuditta De Prato and Paul Desruelle (JRC-IPTS)

2014
Abstract
The 2013 PREDICT report provides an overview of the importance of the EU ICT sector and its R&D performance. The report gives detailed information on the progress made by the ICT sector in both ICT manufacturing and ICT services. The analysis has been carried out by comparing EU Member States with non-EU economies that are currently leading the world economy, including both developed and emerging economies. The report found that the share of the EU ICT sector in total value added, business enterprise expenditure on R&D (BERD), R&D personnel and R&D researchers had reduced over the period 2006-2010, while its share in terms of employment remained stable. The EU ICT services sector performed better than the ICT manufacturing sector since the former showed more positive results in the observed variables than the economy as a whole. Finally, the US kept the lead in all variables — but especially in labour productivity and BERD intensity— widening the gap with the EU.
Acknowledgements

The authors acknowledge the valuable comments and suggestions made by the editors of this report: Ibrahim K. Rohman, Giuditta De Prato and Paul Desruelle. The authors also thank the contributions of the Ivie team Eva Benages, Laura Hernández, Juan Pérez and Juan Carlos Robledo. We also gratefully acknowledge Susana Sabater for thorough checking and editing of the text.
Table of Contents

Acknowledgements .................................................................................................................. 1
List of Figures .......................................................................................................................... 3
List of Tables .......................................................................................................................... 5
Executive Summary ............................................................................................................... 6
Introduction ............................................................................................................................ 9
  Methodological note .............................................................................................................. 9
1. Overview of the EU ICT Sector and its R&D .................................................................. 10
  1.1 ICT sector value added ................................................................................................. 10
  1.2 ICT sector employment and labour productivity ......................................................... 13
  1.3 ICT sector business expenditure on R&D (ICT BERD) ................................................ 17
  1.4 ICT sector R&D personnel ......................................................................................... 21
  1.5 Comparison of indicators and data summary ............................................................... 23
2. Analysis by ICT Sub-sector ............................................................................................... 25
  2.1 ICT sector value added ................................................................................................. 25
  2.2 ICT sector employment and labour productivity ......................................................... 27
  2.3 ICT sector business expenditure on R&D (ICT BERD) ................................................ 29
  2.4 ICT sector R&D personnel ......................................................................................... 32
  2.5 Comparison of indicators and data summary ............................................................... 34
3. Analysis by Member State ................................................................................................. 37
  3.1 ICT sector value added ................................................................................................. 37
  3.2 ICT sector employment and labour productivity ......................................................... 39
  3.3 ICT sector business expenditure on R&D (ICT BERD) ................................................ 43
  3.4 ICT sector R&D personnel ......................................................................................... 46
  3.5 Comparison of indicators and data summary ............................................................... 49
4. Comparison with Other Economies .................................................................................... 52
  4.1 ICT sector value added ................................................................................................. 52
  4.2 ICT sector employment and labour productivity ......................................................... 56
  4.3 ICT sector business expenditure on R&D (ICT BERD) ................................................ 61
  4.4 ICT sector R&D personnel ......................................................................................... 66
  4.5 Comparison of indicators and data summary ............................................................... 69
List of Abbreviations Used .................................................................................................... 71
List of Definitions .................................................................................................................. 72
List of Figures

Figure 1—a: ICT value added share of total value added.
Figure 1—b: ICT value added and GDP real annual growth rates ......................................................... 10
Figure 1—c: Distribution of VA shares for ICT manufacturing and ICT services
Figure 1—d: Annual real growth rates of ICT manufacturing and ICT services value added ...................... 11
Figure 1—e: ICT value added share of GDP and comparison with non-ICT economic activities.
  a) Manufacturing; b) Services ........................................................................................................ 12
Figure 1—f: ICT sector employment share of total employment.
Figure 1—g: ICT sector employment and total employment annual growth rates. ....................................... 13
Figure 1—h: Distribution of employment shares for ICT manufacturing and ICT services.
Figure 1—i: Annual growth rates of ICT manufacturing and ICT services employment .................................. 14
Figure 1—j: ICT sector employment share on total employment and comparison with non-ICT economic activities.  a) Manufacturing b) Services .............................................................................. 15
Figure 1—k: ICT labour productivity
Figure 1—l: ICT labour productivity and total productivity annual real growth rates. .................................. 16
Figure 1—m: ICT labour productivity. Manufacturing and services.
Figure 1—n: ICT labour productivity annual real growth rates. Manufacturing and Services ....................... 17
Figure 1—o: Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP).
Figure 1—p: ICT BERD and non-ICT BERD annual real growth rates .................................................... 18
Figure 1—q: ICT manufacturing and ICT services BERD. Share of total ICT BERD
Figure 1—r: ICT manufacturing and ICT services BERD annual real growth rates ........................................ 19
Figure 1—s: ICT BERD share of ICT value added.
Figure 1—t: ICT BERD annual real growth rates ..................................................................................... 19
Figure 1—u: ICT BERD share of total BERD and comparison with non-ICT economic activities. ............... 20
Figure 1—v: Employment Shares: ICT R&D personnel/total ICT sector, ICT R&D researchers/ICT R&D
Figure 1—w: Annual growth rates of ICT sector employment, ICT R&D personnel and researchers ............. 21
Figure 1—x: Share of ICT manufacturing R&D personnel and ICT services R&D personnel.
Figure 1—y: Annual growth rates of ICT manufacturing R&D personnel and ICT services R&D personnel 22
Figure 1—z: ICT R&D personnel share of total R&D personnel and comparison with non-ICT economic activities. European Union (2006–2010) ................................................................. 23
Figure 1—aa: Comparison of ICT manufacturing and services for value added, employment, R&D personnel
  and BERD. European Union (2010) .................................................................................................... 24
Figure 2—a: ICT VA share of GDP by sub-sector (2009, 2010) ................................................................. 26
Figure 2—b: Comparison of ICT manufacturing and services: distribution of VA among the biggest
  Member State contributors (2010) ........................................................................................................ 26
Figure 2—c: ICT sector employment share of total employment by sub-sector (based on head counts;
  2009, 2010) ...................................................................................................................................... 28
Figure 2—d: Comparison of ICT manufacturing and services: distribution of ICT sector employment among
  the biggest Member State contributors (2010) ....................................................................................... 28
Figure 2—e: ICT Labour productivity by sub-sector (thousand constant [base year 2005] EUR per person;
  2009, 2010) ..................................................................................................................................... 29
Figure 2—f: ICT BERD share in total BERD by sub-sector (2009, 2010) ..................................................... 30
Figure 2—g: Comparison of ICT manufacturing and services: distribution of ICT BERD among the biggest
  Member State contributors (2010) ......................................................................................................... 31
Figure 2—h: ICT BERD intensity (ICT BERD/ICT VA) by sub-sector (2009, 2010) .................................... 32
Figure 2—9: ICT R&D personnel share of total ICT sector employment by sub-sector (based on FTE; 2009, 2010) ........................................................................................................................................................................33

Figure 2—10: Comparison of ICT manufacturing and services: distribution of ICT R&D personnel among the biggest Member State contributors (2010) ........................................................................................................................................................................34

Figure 2—11: Comparison of value added, employment, BERD, and R&D personnel by ICT sub-sectors (2010) ........................................................................................................................................................................................................35

Figure 3—1: ICT VA share of GDP by Member State (2009, 2010) .........................................................................................................................................................................................................................37

Figure 3—2: Distribution of VA shares for ICT manufacturing and ICT services by Member State (2010). 38

Figure 3—3: Distribution of ICT VA among Member States (2010) .........................................................................................................................................................................................................................39

Figure 3—4: ICT sector employment share of total employment by Member State (% of head counts; 2009, 2010) .........................................................................................................................................................................................................................40

Figure 3—5: Distribution of employment shares between ICT manufacturing and ICT services by Member State (% of head counts, 2010) .........................................................................................................................................................................................................................41

Figure 3—6: Distribution of ICT sector employment among Member States (head counts, 2010). 42

Figure 3—7: ICT labour productivity by Member State (thousands of EUR PPS [Purchase Power Standard] per person, 2010) .........................................................................................................................................................................................................................43

Figure 3—8: ICT BERD share of total BERD by Member State (2009, 2010) .........................................................................................................................................................................................................................44

Figure 3—9: Distribution of ICT BERD between ICT manufacturing and ICT services by Member State (2010) .........................................................................................................................................................................................................................44

Figure 3—10: Distribution of ICT BERD among Member States (2010) .........................................................................................................................................................................................................................45

Figure 3—11: ICT BERD intensity (ICT BERD/ICT VA) by Member State (2010) .........................................................................................................................................................................................................................46

Figure 3—12: ICT R&D personnel share of total ICT sector employment by Member State (based on FTE; 2009, 2010) .........................................................................................................................................................................................................................47

Figure 3—13: ICT manufacturing/services distribution of countries’ shares (based on FTE, 2010) 48

Figure 3—14: Distribution of ICT R&D personnel among Member States (based on FTE, 2010) 49

Figure 3—15: Comparison of ICT value added, employment, BERD and R&D personnel by Member State (2010) .........................................................................................................................................................................................................................50

Figure 4—1: ICT VA share of GDP for the European Union and other economies (2009, 2010) 53

Figure 4—2: Distribution of ICT value added among the European Union and other economies (2009, 2010) .........................................................................................................................................................................................................................53

Figure 4—3: Distribution of ICT value added by manufacturing and services sub-sectors for the European Union and other economies (2010) .........................................................................................................................................................................................................................54

Figure 4—4: ICT value added share of GDP and comparison with non-ICT economic activities. European Union and other economies (2010) .........................................................................................................................................................................................................................55

Figure 4—5: ICT sector employment share of total employment for the European Union and other economies (2009, 2010) .........................................................................................................................................................................................................................55

Figure 4—6: Distribution of ICT sector employment among the European Union and other economies (2009, 2010) .........................................................................................................................................................................................................................57

Figure 4—7: Distribution of ICT sector employment by manufacturing and services sub-sectors for the European Union and other economies (2010) .........................................................................................................................................................................................................................58

Figure 4—8: Share of ICT sector employment in total employment and comparison with non-ICT economic activities. European Union and other economies (2010) .........................................................................................................................................................................................................................59

Figure 4—9: ICT labour productivity for the European Union and other economies (thousand EUR PPS per person; 2009, 2010) a) ICT total; b) ICT manufacturing; c) ICT services .........................................................................................................................................................................................................................60

Figure 4—10: Share of ICT and non-ICT BERD for the European Union and other economies (2010) 62
Figure 4—11: *Distribution of ICT BERD among the European Union and other economies (2009, 2010)* .......................................................... 63
Figure 4—12: *Distribution of ICT BERD by manufacturing and services sub-sectors for the European Union and other economies (2010)* .......................................................... 63
Figure 4—13: *ICT BERD share of total BERD and comparison with non-ICT economic activities. European Union and other economies (2010)* .......................................................... 64
Figure 4—14: *Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP). European Union and other economies (2009, 2010)* .......................................................... 65
Figure 4—15: *Contribution of ICT sub-sectors to ICT BERD intensity (ICT BERD/ICT GVA). European Union and other economies (2010)* .......................................................... 66
Figure 4—16: *ICT R&D personnel (FTE) share of total ICT sector employment for the European Union and other economies (2009, 2010)* .......................................................... 67
Figure 4—17: *Distribution of ICT R&D personnel (FTE) among the European Union and other economies (2009, 2010)* .......................................................... 67
Figure 4—18: *Share of ICT and non-ICT R&D personnel (FTE) for the European Union and other economies (2010)* .......................................................... 68
Figure 4—19: *Distribution of ICT R&D personnel (FTE) by manufacturing and services for the European Union and other economies (2010)* .......................................................... 68
Figure 4—20: *Comparison of ICT sector value added, employment, R&D personnel and BERD for other economies and the EU (2010)* .......................................................... 69

List of Tables

Table 1—1: *Summary table of ICT indicators by broad sectors. European Union (2010)* .......................................................... 24
Table 2—1: *Summary table of ICT indicators by sub-sectors. European Union (2010)* .......................................................... 36
Table 3—1: *Summary table of ICT indicators by European country. European Union (2010)* .......................................................... 51
Table 4—1: *Summary table of ICT indicators for the European Union and other economies (2010)* .......................................................... 70
Executive Summary

Introduction

The 2013 PREDICT report provides a detailed quantitative analysis of the state of the Information and Communication Technologies (ICT) sector and its Research and Development (R&D) in the European Union and beyond.

This analysis was carried out by the Valencian Institute of Economic Research (Ivie) and the Information Society Unit of the Institute for Prospective Technological Studies (JRC-IPTS) under the Prospective Insights on R&D in ICT (PREDICT) project. PREDICT is being run by JRC-IPTS for the Directorate General for Communications Networks, Content and Technology (DG CONNECT) of the European Commission.

This is the sixth in a series of annually published reports, and it is the second web-based edition. Like the previous reports, this one is based on the latest data available from official sources such as Eurostat (Statistical Office of the European Communities) and the Organisation for Economic Co-operation and Development (OECD)\(^1\). The 2013 PREDICT covers the period 2006–2010, and as such includes analysis of the consequences for the European Union (EU) ICT sector and its R&D of the deep recession that began at the end of 2007 in the United States (US), but had its first most severe downturn in the EU in 2009. The analysis first provides an overview of the importance of the EU ICT sector and its R&D. It then gives detailed information, by ICT manufacturing and service sub-sectors and by EU Member State, and in comparison with other non-EU economies that are currently taking the lead in the world economy, including both developed and emerging economies.

The report confirms the trends observed in previous PREDICT analyses; however the availability of more recent data allows for a focus on the ICT sector and its R&D in the pre- and post- crisis period. The main observations made in this year’s report are the following:

- The EU ICT sector saw a reduction in its share in total value added, business expenditure on R&D (BERD), R&D personnel and R&D researchers over the period 2006–2010, while its share in terms of employment remained stable.
- The EU ICT services sector performed better than the ICT manufacturing sector since the former showed more positive results than the economy as a whole in all the analysed

\(^1\) This is the second year in which the PREDICT analysis has followed the NACE Rev 2 definition of the ICT sector (See: OECD Information Economy–Sector definitions based on the International Standard Industry Classification (ISIC 4), Annex 1, p.15, available at: [http://www.oecd.org/science/scienceandtechnologypolicy/38217340.pdf](http://www.oecd.org/science/scienceandtechnologypolicy/38217340.pdf)). Since the adoption in 2006 of this new definition of the ICT sector, it must now be applied by all Member States when reporting ICT sector data, starting with year 2008. More details on methodology are provided in Mas, Robledo and Pérez (2012): ICT sector definition transition from NACE Rev. 1.1 to NACE Rev. 2: A methodological note, Ivie. Following the NACE Rev 2 definition, the ICT sector is composed of the following sub-sectors:

- ICT manufacturing
  - 261 Manufacture of electronic components and boards
  - 262 Manufacture of computers and peripheral equipment
  - 263 Manufacture of communication equipment
  - 264 Manufacture of consumer electronics
  - 268 Manufacture of magnetic and optical media

- ICT services
  - 4651 Wholesale of computers, computer peripheral equipment and software
  - 4652 Wholesale of electronic and telecommunications equipment and parts
  - 5820 Software publishing
  - 61 Telecommunications
  - 62 Computer programming, consultancy and related activities
  - 631 Data processing, hosting and related activities; web portals
  - 951 Repair of computers and communication equipment
variables. More specifically, it experienced an almost nil employment reduction and a positive rate of growth in the BERD variable for the whole considered period.

- The US kept the lead in all variables—but especially in two of them, ICT sector labour productivity and BERD intensity—widening the gap with the EU.

The ICT sector after the downturn

The EU ICT sector value added (VA) showed a stable share of gross domestic product (GDP) of 4.11% in years 2006 and 2007, before the onset of the crisis. In the following three years it experienced a slight but steady decrease, falling to 4.03% in 2010. The opposite trend was seen in ICT sector employment which, at least initially, resisted more successfully than total employment. In 2010 it represented 2.68% of total EU employment, a slightly higher share than in 2006 (2.62%).

The combined movements of VA and employment left EU labour productivity in the ICT sector practically unchanged over the 2006-2010 period. However the advantage of ICT over total labour productivity fell from 56.86% in 2006 to 50.70% in 2010, as ICT sector employment proved to be more resilient.

The ICT sub-sectors with the highest weight in GDP and employment in the EU—Telecommunications and Computer programming—belong to the ICT service sector. The former experienced a reduction in 2010 in terms of both variables but increased its labour productivity, which is also the highest of all the ICT sub-sectors.

Overall, the available information indicates that the EU ICT sector lost momentum from 2008 to 2010, the last year analysed.

R&D in the ICT sector

The ICT sector is one of the most research-intensive sectors in the EU economy. BERD intensity—defined as the BERD/GDP ratio—was 1.24% of GDP in 2010 while ICT BERD intensity (ICT BERD/ICT VA) reached 5.24%. That is, it was 4.22 times higher than total BERD intensity. Thus, the ICT sector is a key contributor to the EU’s target to reach 3% of GDP invested in R&D by 2020 based on the target set by the Europe 2020 growth strategy.

The total economy, and also ICT manufacturing sectors, have an important role to play within total Business Enterprise Expenditure on R&D (BERD). While manufacturing represents around 14% of VA and employment, its weight in terms of BERD is much higher at around 65%. A similar—although less pronounced—pattern can be seen in ICT service sectors. Their share in terms of BERD is around 9.66% while the corresponding figures for VA and employment are around 3.66% and 2.30%, respectively. Thus, ICT sub-sectors—especially manufacturing—absorb a much higher proportion of business R&D (BERD) than their weight in the economy.

The two ICT sub-sectors with the highest BERD share of total BERD are Computer programming, belonging to the ICT service sector, and Manufacturing of communication equipment, belonging to ICT manufacturing. Of the selected non-ICT manufacturing sectors with close relations to ICT and/or R&D, the highest shares in total BERD correspond to Manufacture of motor vehicles, trailers and semi-trailers, and Manufacture of machinery and equipment.

The available information indicates that the ICT sector has also been losing share in terms of BERD over time. However, a positive sign for the ICT sector is that the ICT R&D personnel share of total ICT sector employment—which remained fairly stable during the years of expansion—increased from 2008 onwards, reaching its maximum in 2010, due to the positive performance of the ICT service sectors. The share of ICT R&D researchers of all ICT R&D personnel also remained positive after 2008. Both results confirm that the most highly qualified employees have resisted the crisis better than those with lower qualifications, at least until 2010.

The main conclusion is that the ICT sector has lowered during the most recent period in terms of BERD mainly due to the poor performance of the ICT manufacturing sectors but not in terms of R&D personnel and researchers.
The strength of the EU ICT service sector

The crisis hit the EU's ICT manufacturing sector more severely than its services sector. The ICT manufacturing sector share of total ICT VA came down from 12.16% in 2006 to 8.57% in 2009. The positive news is that in 2010 it experienced a sharp recovery, bringing its share up to 9.37% of total ICT VA. The news for employment was not so encouraging: ICT manufacturing employment share dropped 3.5 percentage points from 17.73% in 2006 to 14.13% in 2010.

The strength of the ICT service sector is also confirmed by the BERD variable. The ICT service sector has shown a small but continuous increase in its share of total BERD, from 9.06% in 2006 to 9.66% in 2010, in contrast to ICT manufacturing BERD, whose share fell from 10.02% in 2006 to 7.39% in 2010. Furthermore, unlike most of the variables, BERD in the ICT service sector at no time fell into negative growth rate values during the period 2006-2010. The lowest rate of growth achieved was 1.99% between 2008 and 2009, while the ICT manufacturing sector experienced negative growth rates in all the years analysed, and specially negative (~15.07%) between 2008 and 2009.

Thus, the weakness shown by the EU ICT sector during the first years of crisis is due to weakness in the ICT manufacturing sector rather than in the service sector, which has maintained its strength stable even under very adverse circumstances.

The ICT sector in Member State (MS) countries

In 2010 ICT value added was highly concentrated in the five largest EU countries: Germany (16.74%), France (16.60%), the United Kingdom (UK) (16.43%), Italy (11.60%) and Spain (7.43%). These five countries together generated 68.80% of total EU ICT VA, and 64.88% of total ICT sector employment.

The picture for ICT BERD at national level is rather different from that of employment or VA. Germany had the highest share (21.09%) of total ICT BERD for the European Union in 2010, followed by France (17.38%), UK (11.45%), Finland (10.89%) and Italy (8.37%). The differences between the VA and BERD shares originate in the sectoral specialization between manufacturing and services: the higher the share of manufacturing, the higher the share in terms of BERD, and also in terms of R&D personnel. This is the case of Finland, whose share in terms of VA was a low 1.86%, compared with 10.89% for BERD. But it is not the case for countries that host the production of ICT goods –such as Hungary or Ireland– since in those cases R&D is usually carried out in the home country. In 2010 Finland had the highest BERD intensity in the ICT sector (ICT BERD/ICT VA), followed by the other two Nordic countries, Sweden and Denmark. Finland also had the highest share of ICT R&D personnel of the total ICT sector employment and, together with Sweden, was the country with the highest share of ICT manufacturing personnel. Thus, the Nordic countries, especially Finland and Sweden, have a weight in ICT R&D that goes well beyond their economic size.

Asian countries and the US: world leaders in 2009 and 2010

China, Taiwan and Korea –three countries highly specialized in ICT manufacturing– continued to consolidate their positions in the global ICT market. India, Brazil, and Australia also increased their share in the global marketplace between 2009 and 2010. Of the remaining major players, the EU and Japan reduced their figures while the US improved its well-recognized leadership. China took the lead due to both its specialisation in manufacturing and its economic size, while the strength of Taiwan and Korea, two small size countries, was based on their ICT manufacturing specialization.

The main lessons to be learnt from the international perspective is that having a large ICT manufacturing sector –like China, Taiwan and Korea– is an important lever for growth, especially when it is combined with important resources devoted to R&D, both in terms of expenditures and of qualified personnel. The strength of the US, as compared with the EU, lies in its high productivity levels, the defence of its ICT manufacturing sector, and high R&D resources committed to improve its competitiveness in the world markets.
Introduction

The 2013 PREDICT Report: “An Analysis of ICT R&D in the EU and beyond” provides a detailed analysis of the state of Information and Communication Technologies (ICT) Research and Development (R&D) activities in the European Union. This is the sixth edition of a series that is published annually. As in the 2012 edition, the 2013 edition has also been published in an online version available at: http://is.jrc.ec.europa.eu/pages/ISG/PREDICT.html.

This edition is based on the latest data available from official sources, such as Eurostat and OECD. It covers the years 2006 to 2010, a period marked by a deep financial and economic crisis.

This analysis was carried out by the Valencian Institute of Economic Research (Ivie) and the Information Society Unit of the Institute for Prospective Technological Studies (JRC-IPTS) under the Prospective Insights on R&D in ICT (PREDICT) project, a research project analysing R&D in ICT in Europe. PREDICT is being run by JRC-IPTS for the Directorate General for Communications Networks, Content and Technology (DG CONNECT) of the European Commission.

The PREDICT analysis provided here is structured as follows:

- An initial overview of the importance of the EU ICT sector and of its R&D.
- Detailed information by ICT manufacturing and services sub-sectors, by EU Member State, and compared with twelve leading ICT countries from the five continents. Data and analyses are provided according to the following categories: Size of the ICT sector in terms of its share of GDP, ICT sector employment and labour productivity, ICT business expenditure on R&D (ICT BERD), and ICT R&D personnel.

Methodological note

The data and analyses provided here are based on data from National Accounts and R&D statistics. PREDICT analyses follow the NACE Rev 2 definition of the ICT sector\(^2\). Since the adoption in 2006 of this new definition of the ICT sector, it must now be applied by all Member States when reporting ICT sector data, starting with year 2008.\(^3\) Data was downloaded between July and October 2013 covering the period up to 2010.


\(^3\) More details on methodology are provided in Mas, Robledo and Pérez (2012), ICT sector definition transition from NACE Rev. 1.1 to NACE Rev. 2: A methodological note, Ivie.
1. Overview of the EU ICT Sector and its R&D

This chapter provides an overview of the importance of the EU ICT sector and its R&D by presenting the main indicators for period 2006-2010, offering a general perspective which will be analysed in depth in the following three chapters.

1.1 ICT sector value added

EU ICT value added (VA) amounted to 481.50 billion euros in 2006. Four years later it had increased by 14.57 billion euros, reaching a value of 496.07 billion euros. The EU ICT sector VA represents around 4.1% of total GDP. Figure 1–1-a shows a slight reduction in this share from 4.11% in 2006 to 4.03% in 2010 during the most recent years of economic recession. Figure 1–1-b shows a very similar annual growth rate in both variables, especially in the first part of the period. Between 2006 and 2007, ICT VA and GDP both grew at a similar rate of 3.19% in real terms. However, during the first year of recession ICT VA growth rate fell to -0.26% and GDP to 0.37%. Both variables experienced a drop (-4.5%) in 2009, to recover again in 2010.

Figure 1–1:

a: ICT value added share of total value added. European Union (2006-2010)

![ICT Value Added Share of Total Value Added](image)

ICT VA: 4.11% 4.11% 4.08% 4.08% 4.03%

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

ICT VA is concentrated in the ICT services sectors as Figure 1–2-a illustrates. ICT manufacturing’s VA represents around 11% of total ICT value added. However a distinct feature is that it has been losing share since the beginning of the recession. While in 2006 ICT manufacturing VA represented 12.16% of total VA, in 2010 this share had decreased by almost three percentage points, to 9.37%. This result indicates that ICT manufacturing has suffered more from the downturn of economic activity than ICT services, as confirmed by Figure 1–2-b. ICT manufacturing experienced a contraction of its VA of -12.41% in 2008 and -23.23% in 2009. However, it recovered in 2010 when it grew at a rate of 10.33%. Compared to these figures, the pattern of growth in ICT services VA was much more stable, decreasing only by -2.23% in the most severe drop which took place in 2009.

---

All growth rates are computed in real terms using the implicit GDP deflator (chained volume estimates or fixed-base volume estimates, depending on countries).
The value added generated by the whole manufacturing sector (including ICT and non ICT industries) represents around 14% of total GDP in the EU. Figure 1–3-a shows how this percentage is split among ICT and some selected non-ICT sub-sectors that in some way have a closer relation with ICT and/or R&D. ICT manufacturing sectors represented 0.5%-0.3% of total GDP. Other sectors with an important relation with ICT and/or R&D also have a small share of GDP, with Manufacture of machinery and equipment having the highest share (around 2%).
Figure 1—3: ICT value added share of GDP and comparison with non-ICT economic activities. European Union (2006-2010)

a) Manufacturing

<table>
<thead>
<tr>
<th>Year</th>
<th>Value Added</th>
<th>ICT</th>
<th>Rest of non-ICT manufacturing industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>8.85%</td>
<td>8.81%</td>
<td>1.21%</td>
</tr>
<tr>
<td>2007</td>
<td>8.81%</td>
<td>8.53%</td>
<td>1.21%</td>
</tr>
<tr>
<td>2008</td>
<td>8.53%</td>
<td>7.94%</td>
<td>1.14%</td>
</tr>
<tr>
<td>2009</td>
<td>7.94%</td>
<td>7.99%</td>
<td>1.14%</td>
</tr>
<tr>
<td>2010</td>
<td>7.99%</td>
<td>7.99%</td>
<td>1.14%</td>
</tr>
</tbody>
</table>

- Manufacture of other transport equipment
- Manufacture of motor vehicles, trailers and semi-trailers
- Manufacture of machinery and equipment
- Manufacture of pharmaceuticals, medicinal chemical and botanical products
- Manufacture of chemicals and chemical products
- ICT total manufacturing industries

b) Services

<table>
<thead>
<tr>
<th>Year</th>
<th>Value Added</th>
<th>ICT</th>
<th>Rest of non-ICT service industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>6.11%</td>
<td>4.52%</td>
<td>3.59%</td>
</tr>
<tr>
<td>2007</td>
<td>6.00%</td>
<td>4.47%</td>
<td>3.69%</td>
</tr>
<tr>
<td>2008</td>
<td>5.73%</td>
<td>4.53%</td>
<td>3.73%</td>
</tr>
<tr>
<td>2009</td>
<td>5.66%</td>
<td>4.83%</td>
<td>3.62%</td>
</tr>
<tr>
<td>2010</td>
<td>6.63%</td>
<td>4.76%</td>
<td>3.64%</td>
</tr>
</tbody>
</table>

- Manufacture of other transport equipment
- Manufacture of motor vehicles, trailers and semi-trailers
- Manufacture of machinery and equipment
- Manufacture of pharmaceuticals, medicinal chemical and botanical products
- Manufacture of chemicals and chemical products
- ICT total manufacturing industries
- Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction are not included in either manufacturing or services industries.

Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction are not included in either manufacturing or services industries.

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 1—3-b provides similar information but related to the services VA share of GDP. Services VA represents around 65% of total GDP in the EU. ICT services sectors account for 3.6%. Wholesale and retail trade, repair of motor vehicles and motorcycles (9.76%), Human health and social work activities (6.63%) and Professional, scientific and technical activities (5.21%) are the non-ICT services sectors with the highest shares of GDP. Overall, the information confirms that services sectors are more closely related to ICT R&D than manufacturing sectors. Now, the share of the group termed “rest of non-ICT services industries” – which gathers the non-ICT sectors with lower presence of R&D- is lower than that of manufacturing, representing around one third of total service VA share. At the same time, the share of ICT sectors is higher in service sectors than in manufacturing.
1.2 ICT sector employment and labour productivity

1.2.1 ICT sector employment

Total ICT sector employment in the EU amounted to almost 6 million people in 2006 and almost the same figure in 2010, with a positive variation of 163 thousand workers. The ICT share of total EU employment is lower than that of VA, around 2.7%. This percentage has also remained fairly stable over the five years analysed, oscillating very slightly between 2.62% in 2006 and 2.71% in 2008 as indicated in Figure 1–4-a. In contrast to the case of VA, ICT sector employment share increased during the first years of the recession that started in 2008, falling since this year. Figure 1–4-b illustrates the pattern for the annual rate of growth of ICT sector and total employment in the EU. In 2007 ICT sector employment grew at an annual rate of over 3%, almost doubling total employment growth. ICT sector employment did not suffer the deceleration that ICT VA experienced in 2008, the first year of recession, since it continued to grow at an annual rate of 3.3%, tripling total employment growth. By contrast, the fall in the rate of growth of ICT sector employment in the following two years was more severe than for the total economy. In 2010, the last year for which information is available, ICT sector employment continued to contract but at a slower rate.

Figure 1–4:

a: ICT sector employment share of total employment. European Union (2006-2010)


Source: Eurostat, elaborated by Ivie and JRC-IPTS.

The share of ICT manufacturing employment on total ICT sector employment is higher than its share in terms of VA. Figure 1–5-a indicates that, as in the case of VA, this share fell throughout the period from 17.73% in 2006 to 14.13% in 2010. It is interesting to note, in Figure 1–5-b, that employment in the ICT service sectors did not suffer the adverse effect of the economic crisis to the same extent as ICT manufacturing employment or total employment. In fact, while manufacturing experienced a drop of -13.89% in 2009, ICT service employment only contracted by -0.07%.
Figure 1—5:

a: Distribution of employment shares for ICT manufacturing and ICT services. European Union (2006-2010)

<table>
<thead>
<tr>
<th>Year</th>
<th>ICT manufacturing</th>
<th>ICT services</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>17.73%</td>
<td>82.27%</td>
</tr>
<tr>
<td>2007</td>
<td>17.93%</td>
<td>82.07%</td>
</tr>
<tr>
<td>2008</td>
<td>16.77%</td>
<td>83.23%</td>
</tr>
<tr>
<td>2009</td>
<td>14.80%</td>
<td>85.20%</td>
</tr>
<tr>
<td>2010</td>
<td>14.13%</td>
<td>85.87%</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Year</th>
<th>ICT manufacturing</th>
<th>ICT services</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>4.37%</td>
<td>4.74%</td>
</tr>
<tr>
<td>2008</td>
<td>2.93%</td>
<td>-0.07%</td>
</tr>
<tr>
<td>2009</td>
<td>-3.36%</td>
<td>-0.41%</td>
</tr>
<tr>
<td>2010</td>
<td>-11.89%</td>
<td>-5.63%</td>
</tr>
</tbody>
</table>

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 1–6-a shows that employment in the EU manufacturing sectors represents around 14%–16% of total employment, a slightly higher share than the 13%–15% for VA (see Figure 1–3-a). Employment in ICT manufacturing sectors represents around 0.5% of total employment, a percentage similar to that of VA. Manufacture of machinery and equipment has the highest share (2.04%), as already seen in terms of VA. The non-ICT sub-sectors that are not closely related to ICT and/or R&D (“rest of non-ICT manufacturing industries” in Figure 1–6-a) represent more than half of total manufacturing employment. As before, the sectors with the highest share are Wholesale and retail trade, repair or motor vehicles and motorcycles (14.48%) and Human health and social work activities (9.81%).
1.2.2 ICT sector labour productivity

Labour productivity in the ICT sector amounted to around 83 thousand euros per person in 2010, 50% higher than total labour productivity (Figure 1–7–a). Before the onset of the economic crisis, labour productivity in the ICT sector grew at a lower rate than in the total economy. In the last year for which data are available, 2010, both variables had recovered a similar rate above 2% (Figure 1–7–b), basically due to the recovery of VA growth together with the fall in employment.


Figure 1—7:


<table>
<thead>
<tr>
<th>Year</th>
<th>ICT labour productivity</th>
<th>Total labour productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>81.04</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>81.03</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>78.25</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>76.58</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>78.18</td>
<td></td>
</tr>
</tbody>
</table>

b: ICT labour productivity and total productivity annual real growth rates. European Union (2006-2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 1–8-a shows that labour productivity is higher in the ICT services sector than in manufacturing. In 2010, labour productivity in manufacturing amounted to around 55 thousand euros per person, while in services the corresponding figure was 60% higher at 87.65 thousand euros. Figure 1–8-b reports the time profile for labour productivity throughout the period 2006–2010. ICT services labour productivity presented a very similar pattern to total ICT labour productivity due to its high share in the aggregate. It was positive in 2007, the last year of expansion. In the first two years of recession, 2008 and 2009, ICT labour productivity experienced a drop, especially intense in the ICT manufacturing sector and in 2009 when its annual contraction was -10.85%. In 2010, it experienced an increase, growing at an annual rate of 16.91%, due to the combination of a manufacturing VA growth of 10.33% (Figure 1–2-b) and a drop of -5.63% in manufacturing employment (Figure 1–5-b). Taken all together, labour productivity in the EU presented a much more cyclical pattern in ICT manufacturing than in ICT services sectors.
1.3 ICT sector business expenditure on R&D (ICT BERD)

ICT BERD amounted to 26.21 billion euros in the EU in 2006. In 2010, it had decreased by 211.91 million euros. The weight of BERD on GDP – or BERD intensity (BERD/GDP) – was around 1.25% over the period. Figure 1–9–a shows how this percentage was split between ICT and non-ICT sector. While ICT VA represented around 4% of total VA, and ICT sector employment around 2.5%, ICT BERD had a higher share of total BERD, around 18%. However, these last years have seen a continuous fall in the ICT BERD share from 19.09% in 2006 to 17.05% in 2010. This reduction is the consequence of the lower rate of growth of ICT BERD than total BERD, together with a more severe contraction in 2009, when ICT BERD experienced a -5.05% annual rate of variation while the fall in non-ICT BERD was less pronounced, -1.44% (Figure 1–9–b).
ICT manufacturing has a higher share in terms of BERD than VA or employment. As Figure 1–10–a shows, ICT BERD in manufacturing has a share on total ICT BERD of around 50%. However, it is important to note that this share has gone down quite sharply, from 52.52% to 43.33%, in just five years. This reduction is the result of a continuous decline of ICT manufacturing BERD in absolute terms, as illustrated in Figure 1–10–b by the negative rates of growth shown throughout the period. This pattern contrasts sharply with the trend in ICT BERD services, which even in the worst year of the crisis, 2009, presented a positive growth rate of 3.44%.

Figure 1–11–a shows that the ratio of ICT BERD to ICT VA—termed ICT BERD intensity—remained fairly stable at around 5.30% over the period 2006–2010, which is 4.4 times higher than the same ratio for the total economy (see Figure 1–9). In 2006 it reached a maximum of 5.44% and in 2007 and 2010, a minimum of 5.24%. The range of fluctuation is therefore practically negligible. Real growth rates, shown in Figure 1–11–b, reveal that in 2007 ICT BERD moved at an annual rate of -0.56%, almost four percentage points lower than ICT VA (3.19%). In 2008 the gap was smaller, but in 2009 the drop in ICT BERD was more severe (-5.05%) than in ICT VA (-4.48%). For 2010, both ICT BERD and VA gained momentum, and recovered positive values. The combination of these movements is what explains the relatively mild oscillations shown on the left hand side of Figure 1–11.

Source: Eurostat, elaborated by Ivie and JRC-IPTS.
Figure 1—10:

a: ICT manufacturing and ICT services BERD. Share of total ICT BERD. European Union (2006-2010)


Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 1—11:


Source: Eurostat, elaborated by Ivie and JRC-IPTS.
Figure 1–12 shows how total BERD is split among selected economic sectors. Figure 1–12-a provides the information for total manufacturing share as well as the share of the same selected sectors previously analysed. The first thing to note is that while manufacturing represents around 12% in terms of VA (Figure 1–2) and 16% in terms of employment, it accounts for around 65% in terms of BERD in 2010. However, it must be highlighted that, as with most variables, it also lost share over the period. On the other hand, ICT manufacturing sectors represent around 8.6% of total BERD, while their weight in terms of VA and employment is a scant 0.5%. Again, it should be noted that this share also fell over the period, from 10.02% in 2006 to 7.39% in 2010. The two manufacturing sectors with the highest BERD share are Manufacture of motor vehicles, trailers and semi-trailers (14%), which gained share over the period, and Manufacturing of machinery and equipment, whose share fell.

**Figure 1–12: ICT BERD share of total BERD and comparison with non-ICT economic activities. European Union (2006-2010)**

(a) Manufacturing

(b) Services

Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction are not included in either manufacturing or services industries.

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 1–12-b provides the same information but referring to services, which represent around 32% of total BERD in the EU. ICT services sectors account for around 9.3% of total BERD but reflect an upward trend, which contrasts with the downward trend shown by manufacturing. Besides ICT, the non-ICT sector with the highest, and continuously increasing, share on total BERD is Professional, scientific and technical activities, which rose from 14.50% in 2006 to 18.20% in 2010. In the interpretation of the low shares corresponding to Human health and social work activities, together with Education, it is important to bear in mind that the BERD variable refers strictly to the business sector and not to the non-market economy, which has a significant weight in those two activities.
Finally, it is interesting to note that, in contrast to the case of VA (Figure 1–3) and employment (Figure 1–6), the selected sectors absorb almost all BERD leaving practically no room for the other non-ICT sub-sectors (termed “rest of non-ICT industries”).

1.4 ICT sector R&D personnel

In 2006, R&D personnel in the EU ICT sector amounted to 236 thousand workers and in 2010, 257 thousand, reflecting an increase of 21 thousand. At the same time, in 2006 the number of researchers in the ICT sector was 150.73 thousand, rising to 161.42 thousand in 2010, representing an increase of 10.70 thousand researchers in these two years. Figure 1–13-a indicates that R&D personnel in the ICT sector accounts for around 4% of total ICT sector employment in the EU (see the right hand side for the scale of this variable). This share increased from 4.05% in 2006 to 4.30% in 2010. The sharpest growth was seen in this last year. On the other hand, Figure 1–13-a also shows the share of ICT R&D researchers on ICT personnel (scale on the left hand side). This ratio has fluctuated around a range of 62%-64%. The highest share, 63.98%, occurred in 2006, while a minimum was reached in 2008 (62.58%), from which it recovered in the two following years, rising to 62.85% in 2010.

In the ICT sector, employment grew at a faster pace (3.24%) than R&D personnel (2.08%) or R&D researchers (0.95%) between 2006 and 2008 as Figure 1–13-b indicates. With the onset of the recession, ICT sector employment contracted by -2.39%, while ICT R&D personnel (-0.85%) and researchers (-0.77%) defended their positions more successfully. In 2010, while general ICT sector employment continued to fall, R&D personnel (5.52%) and researchers (5.89%) witnessed an upturn.

Figure 1—13:  

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

5 The statistics available for all the countries provides the data for personnel in full-time equivalent (FTE) terms while employment is measured in terms of headcounts.
Figure 1–14-a shows how R&D personnel is split between ICT manufacturing and services sectors. Again, it is interesting to note that ICT manufacturing has declined in almost all variables. While ICT R&D personnel in manufacturing represented 48.0% of total ICT R&D personnel in 2006, five years later this figure had fallen by almost 18 percentage points to 30.5%. The reason for this decline can be seen in the annual real growth rates plotted in Figure 1–14-b. The striking fact is that while R&D personnel in the ICT services sectors retained positive annual growth rates, even in the years of deep recession, the same cannot be said for ICT manufacturing sectors, where the annual rate of variation has always been negative.

Figure 1–14:

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Finally, Figure 1–15 shows the share of R&D personnel of the total for ICT and non-ICT sector, differentiated according to manufacturing and services. As with BERD, the share of R&D personnel in manufacturing is higher than in VA or employment (Figure 1–15-a), but it showed a downward tendency. ICT R&D personnel in manufacturing accounted for around 7.5% of total personnel but with the opposite profile since it fell from 9.50% in 2006 to 6.01% in 2010. As for BERD, the two manufacturing sectors with the highest share of R&D personnel are Manufacture of machinery and equipment and Manufacture of motor vehicles, trailers and semi-trailers, both of which lost share over the period.

R&D personnel in the services sector showed an upward trend that was very pronounced in the two sectors with the highest weight: ICT services R&D personnel share on total went up from 10.40% in 2006 to 13.69% in 2010, and Professional, scientific and technical activities rose from 14.82% in 2006 to 18.23% in 2010. Thus, as with almost all variables, the services sector has shown remarkable resilience even in the most difficult years of the economic recession.
Figure 1—15: ICT R&D personnel share of total R&D personnel and comparison with non-ICT economic activities. European Union (2006-2010)

a) Manufacturing

Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction are not included in either manufacturing or services industries.

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

1.5 Comparison of indicators and data summary

Figure 1–16 provides a comparison of the ICT manufacturing and ICT services sectors distribution of the four main indicators analysed in this section –value added, employment, BERD and R&D personnel– for the European Union in 2010. The data summary for those variables is provided in Table 1–1. The main results of this comparison can be summarized as follows:

- ICT VA and ICT sector employment are concentrated in the ICT services sectors, especially in ICT VA, representing 90.63% of total ICT VA and 85.68% of total ICT sector employment.

- ICT manufacturing has a higher share in terms of BERD and R&D personnel than VA or employment. ICT BERD in manufacturing represents 43.33% of total ICT BERD, while the share of ICT manufacturing R&D personnel on total amounted to 30.49%.
Figure 1—16: Comparison of ICT manufacturing and services for value added, employment, R&D personnel and BERD. European Union (2010)

Table 1—1 summarizes the main variables reviewed in this chapter.

Table 1—1: Summary table of ICT indicators by broad sectors. European Union (2010)

<table>
<thead>
<tr>
<th></th>
<th>Value added</th>
<th>Employment</th>
<th>BERD</th>
<th>R&amp;D personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Millions of current EUR)</td>
<td>(thousand persons employed)</td>
<td>(Millions of current EUR)</td>
<td>(thousand full-time equivalent)</td>
</tr>
<tr>
<td>ICT total</td>
<td>46,475.33</td>
<td>844.12</td>
<td>11,262.23</td>
<td>78.31</td>
</tr>
<tr>
<td>ICT total services</td>
<td>449,594.77</td>
<td>5,129.27</td>
<td>14,730.91</td>
<td>178.51</td>
</tr>
<tr>
<td><strong>ICT total</strong></td>
<td><strong>496,070.10</strong></td>
<td><strong>5,973.39</strong></td>
<td><strong>25,993.15</strong></td>
<td><strong>256.82</strong></td>
</tr>
</tbody>
</table>

Source: Eurostat, elaborated by Ivie and JRC-IPTS.
2. Analysis by ICT Sub-sector

2.1 ICT sector value added

ICT sector value added (VA) amounted to 496.07 billion euros in 2010. This represented a share of 4.03% of EU GDP, a share that has reduced slightly over the last few years. ICT services contributed by far the largest share of ICT VA (90.63%, or around 450 billion euros in 2010), accounting for 3.66% of EU GDP, while ICT manufacturing VA contributed 9.37% of ICT VA (46.48 billion euros), totalling 0.38% of GDP.

Figure 2–1 plots the ICT VA share of GDP by ICT sub-sectors. By far, the two largest ICT services sub-sectors in the EU are Computer programming, consultancy and related activities, which generated a VA of around 180 billion euros in 2010 (1.47% of EU GDP) and Telecommunications, producing a VA of 175.85 billion euros in 2010 (1.47% of EU GDP). These two sub-sectors represented almost 72% of the total VA produced by the ICT sector in 2010. ICT trade activities – Wholesale of computers, computer peripheral equipment and software and Wholesale of electronic and telecommunications equipment and parts– generated a VA of 45.95 billion euros in 2010, or 0.37% of EU GDP. In 2010, the value added created in ICT manufacturing was more than the VA produced in ICT trade services. From 2009 to 2010, the value added generated by ICT services increased by 10.4 billion euros (a 2.36% increase).

The two largest ICT manufacturing sub-sectors in the EU are Manufacturing of electronic components and boards and Manufacturing of communication equipment. Their cumulative contribution to EU GDP was, however, only 0.28% in 2010. From 2009 to 2010, value added produced by ICT manufacturing increased by 5.3 billion euros (12.93%). The largest increase was in Manufacturing of electronic components and boards (19.75%).

Box 1: List of NACE Rev. 2 ICT sub-sectors:

<table>
<thead>
<tr>
<th>Nace Rev. 2</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>261-264, 268</td>
<td>ICT total manufacturing industries</td>
</tr>
<tr>
<td>261</td>
<td>Manufacture of electronic components and boards</td>
</tr>
<tr>
<td>262</td>
<td>Manufacture of computers and peripheral equipment</td>
</tr>
<tr>
<td>263</td>
<td>Manufacture of communication equipment</td>
</tr>
<tr>
<td>264</td>
<td>Manufacture of consumer electronics</td>
</tr>
<tr>
<td>268</td>
<td>Manufacture of magnetic and optical media</td>
</tr>
<tr>
<td>465, 582, 61, 62, 631, 951</td>
<td>ICT total services</td>
</tr>
<tr>
<td>465</td>
<td>ICT trade industries</td>
</tr>
<tr>
<td>4651</td>
<td>Wholesale of computers, computer peripheral equipment and software</td>
</tr>
<tr>
<td>4652</td>
<td>Wholesale of electronic and telecommunications equipment and parts</td>
</tr>
<tr>
<td>5820, 61, 62, 631, 951</td>
<td>ICT services industries</td>
</tr>
<tr>
<td>5820</td>
<td>Software publishing</td>
</tr>
<tr>
<td>61</td>
<td>Telecommunications</td>
</tr>
<tr>
<td>62</td>
<td>Computer programming, consultancy and related activities</td>
</tr>
<tr>
<td>631</td>
<td>Data processing, hosting and related activities; web portals</td>
</tr>
<tr>
<td>951</td>
<td>Repair of computers and communication equipment</td>
</tr>
</tbody>
</table>
Figure 2—1: ICT VA share of GDP by sub-sector (2009, 2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2—2: Comparison of ICT manufacturing and services: distribution of VA among the biggest Member State contributors (2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2–2 provides a comparison of ICT manufacturing and services sub-sectors in terms of Member State contributions to ICT VA in 2010. On the one hand, Germany dominated ICT manufacturing (contributing 24.18% of EU ICT manufacturing VA), followed by Italy and the UK (contributing around 12%), France and Sweden, which contributed similar shares of 7–9%. On the other hand, the ICT services sub-sector was dominated by a group of four countries (France, the UK, Germany and Italy) that represented 62.08% of the total EU ICT services VA. The biggest differences in Member States’ contributions can be seen in Germany (24.18% in manufacturing vs.
15.99% in services), Sweden (8.71% vs. 3.27%), Finland (6.23% vs. 1.42%), France (6.73% vs. 17.61%), the UK (11.85% vs. 16.90%) and Spain (2.94% vs. 7.88%). The twelve new Member States contributed more to ICT VA in ICT manufacturing (12.32%) than in ICT services (7.00%).

2.2 ICT sector employment and labour productivity

2.2.1 ICT sector employment

In 2010, almost 6 million people worked in the EU ICT sector, representing 2.68% of total employment. ICT sector employment is highly concentrated in ICT services: 5.1 million people worked in ICT services (85.87%) whereas 0.8 million worked in ICT manufacturing (14.13%). Overall ICT sector employment decreased by 1.2% –in absolute terms, 71.50 thousand people– from 2009 to 2010. This figure comprised 50.30 thousand people in manufacturing (-5.63%) and 21.20 thousand in services (only -0.41%, in spite of the economic crisis). The decrease in employment in ICT manufacturing was therefore higher than in ICT services in both relative and absolute terms.

Figure 2–3 plots the ICT sector employment share of total employment by ICT sub-sectors. As in the case for VA, ICT sector employment in the EU is concentrated in just two service sectors, Computer programming, consultancy and related activities, with 2.75 million people (1.23% of total employment), and Telecommunications with 1.03 million people (0.46% of total employment). In 2010, these two sub-sectors represented 63.33% of total ICT sector employment. In the same year, ICT trade services employed 0.58 million people (0.26% of total employment).

In ICT manufacturing, most employment is provided by two sub-sectors: Manufacturing of electronic components and boards employs 0.38 million people (0.17% of total employment) and Manufacturing of communication equipment employs 0.25 million people (0.11% of total employment).

From 2009 to 2010, ICT services employment remained constant in Computer programming, consultancy and related activities and decreased by 3.6% in Telecommunications. Employment decreased by 3.4% in Data processing, hosting and related activities; web portals to 0.42 million people in 2010. In ICT manufacturing, employment decreased by 20% in Manufacturing of magnetic media and by 11% in Manufacturing of communication equipment.
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

**Figure 2—3: ICT sector employment share of total employment by sub-sector (based on head counts, 2009, 2010)**

![ICT sector employment share of total employment by sub-sector (based on head counts, 2009, 2010)](image)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

**Figure 2—4: Comparison of ICT manufacturing and services: distribution of ICT sector employment among the biggest Member State contributors (2010)**

![Comparison of ICT manufacturing and services: distribution of ICT sector employment among the biggest Member State contributors (2010)](image)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2–4 provides a comparison of employment in the ICT manufacturing and services sub-sectors by MS in 2010. The most striking observation is the contribution of the new Member States. These 12 countries together employed 30.23% of all employees from the EU ICT manufacturing sub-sector, significantly above the 21.52% employed by Germany. In services, however, their contribution was only half that value (14.31%). In terms of single-country contributions, Germany dominated both ICT manufacturing and services (providing 18–22% of EU ICT sector employment). France, Italy and the UK together contributed 27% and 42% to total EU ICT manufacturing and services employment, respectively. Compared to other indicators analysed, the differences between individual country shares (manufacturing vs. services) remained quite stable.
2.2.2 ICT sector labour productivity

In 2010, labour productivity per person in ICT manufacturing in the EU was 55.06 thousand euros, while the figure for ICT services was 87.65 thousand euros. The highest labour productivity was achieved in Telecommunications, rising to more than 170.5 thousand euros (see Figure 2–5). Between 2009 and 2010, ICT labour productivity in the EU grew up by 2.10% in real terms. This increase was more intense in ICT manufacturing (on average 17%) than in services (0.42%). The biggest rise was recorded in Manufacture of consumer electronics, 22.31%, while the biggest drop was in Manufacture of magnetic and optical media, which fell by almost 16%.

Figure 2–5: ICT Labour productivity by sub-sector (thousand constant [base year 2005] EUR per person; 2009, 2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.3 ICT sector business expenditure on R&D (ICT BERD)

Analysing ICT business expenditure on R&D (ICT BERD) across ICT sub-sectors provides a quite different perspective to the picture resulting from a comparison of value added or employment (see Figure 2–6).

In 2010, ICT BERD amounted to 26 billion euros, 2.46% more than in 2009 (25.37 billion euros). This amount was divided almost equally between manufacturing (11.26 billion euros) and services (14.73 billion euros).

In 2010, more than half ICT manufacturing BERD (56.51%) was invested in Manufacturing of communication equipment (6.34 billion euros, or 4.17% of total BERD in the EU economy), and 30.72% in Manufacturing of electronic components and boards (3.5 billion euros). More than half ICT services BERD (59.44%) was invested in Computer programming, consultancy and related activities (8.34 billion euros), and 28.67% in Telecommunications (4.02 billion euros).
Figure 2—6: ICT BERD share in total BERD by sub-sector (2009, 2010)

From 2009 to 2010, ICT BERD invested in ICT manufacturing remained stable in nominal terms, which meant a reduction in real terms of -2.48%. Manufacturing of magnetic and optical media experienced the biggest drop in nominal terms (almost 38%). In ICT services, however, it increased by 0.65 billion euros (a 2.19% increase in real terms), mostly in Computer programming, consultancy and related activities (by 0.60 billion euros) and Data processing, hosting and related activities; web portals, by 3.50% in real terms.

Figure 2—7 provides a comparison of the ICT manufacturing and services sub-sectors in terms of Member States’ contributions to ICT BERD in 2010. ICT manufacturing was dominated by Germany (25.40% of EU ICT manufacturing BERD) and Finland (21.88%). Sweden and France then followed with 14.71% and 13.98%, respectively. These four countries represented 76% of the total EU ICT manufacturing BERD. However, when ICT services BERD is considered, Finland and Sweden contributed only 2.49% and 2.81% each, in sharp contrast to their contribution to ICT manufacturing BERD, which was 36.60% in total. In contrast, France and Germany held leading positions also in services (19.97% and 17.79%, followed by the UK with 17.64%). The UK and Spain are among the Member States with larger ICT BERD contributions in services than in manufacturing: Spain (1.19% in manufacturing vs. 6.16% in services) and the UK (3.35% vs. 17.64%).
The ICT sector is one of the most R&D-intensive sectors in the EU economy. In 2010, ICT BERD made up 17.05% of total BERD, while ICT VA represented only 4.03% of GDP. In the same year, ICT BERD intensity, measured by the ratio of ICT BERD to ICT VA, was, at 5.40%, very close to its 2009 value of 5.27%.

In 2010, although ICT manufacturing sub-sectors produced only 9.37% of ICT value added, they accounted for 43.33% of ICT BERD. ICT manufacturing sub-sectors are thus much more R&D intensive than ICT services sub-sectors. In fact, ICT BERD intensity is 7.39 times higher in ICT manufacturing (24.23%) than in ICT services (3.28%).

Figure 2–8 provides a comparison of BERD intensity among ICT sub-sectors. ICT BERD intensity (measured by the ratio of ICT BERD to ICT VA) was particularly high, especially in one manufacturing sub-sector: 40.18% in Manufacturing of communication equipment. From 2009 to 2010, ICT manufacturing BERD decreased by -2.48% in real terms, and ICT manufacturing VA increased by 10.33% in real terms. This difference resulted in a decrease in ICT BERD intensity from 27.42% in 2009 to 24.23% in 2010.

In ICT services in 2010, more than half ICT services BERD (56.59%) was invested in Computer programming, consultancy and related activities (8.34 billion euros), and 27.29% in Telecommunications (4.02 billion euros). In these two sub-sectors, ICT BERD intensity was significantly lower than in most ICT manufacturing sub-sectors: 4.62% in Computer programming, consultancy and related activities and 2.29% in Telecommunications.

From 2009 to 2010, ICT services BERD increased by 2.19% in real terms and the ICT BERD intensity (ICT BERD/ICT VA) remained stable between 3.21% and 3.28%. ICT BERD increased mostly in Computer programming, consultancy and related activities (by 5.31% in real terms) and decreased in Telecommunications by 7.19% in real terms.
**2.4 ICT sector R&D personnel**

ICT R&D personnel (including both researchers and R&D supporting staff) made up 4.30% of total ICT sector employment in the EU. In 2010, 9.28% of employees in the EU ICT manufacturing sub-sectors were R&D personnel, whereas the figure for ICT services was only 3.48%. According to Figure 2—9, the ICT sub-sectors with the highest share of R&D personnel were Manufacture of communication equipment and Software publishing (15.75% and 10.63%, respectively). In contrast, the ICT sub-sectors with the lowest shares of R&D personnel were ICT trade industries, Manufacture of magnetic media, Data processing, hosting and related activities; web portals and Repair of computers and communication equipment—each employing less than 2%.

**Source:** Eurostat, elaborated by Ivie and JRC-IPTS.
There were around 257 thousand R&D employees working in the EU ICT sector in 2010, 5.52% more than in 2009. This is the result of a 3.42% decrease in ICT manufacturing R&D employment (from around 81.10 thousand employees in 2009 to 78.30 thousand in 2010) offset by a 9.99% increase in ICT services employment (from 162.30 thousand employees in 2009 to 178.50 thousand in 2010). The drop in ICT manufacturing personnel occurred mainly in the Manufacture of consumer electronics sub-sector, while the largest increase in ICT services personnel occurred in Repair of computers and communication equipment. Similar trends are observed in the numbers of ICT researchers.

Figure 2–10 provides a comparison between the share of ICT R&D personnel employed in the ICT manufacturing sub-sector and the ICT services sub-sector by Member State in 2010. On the one hand, similarly to previous indicators, Germany has the highest share: 32.31% of EU ICT manufacturing R&D personnel worked in Germany, followed by 16.84% in France and 12.65% in Finland. These three countries alone account for almost 62% of the total EU ICT manufacturing R&D personnel. On the other hand, in ICT services, only 12.57% of ICT R&D personnel are employed in Germany and 2.22% in Finland. France has the highest share (19.39%), closely followed by the UK (16.57%). A large difference in ICT R&D personnel employment figures can also be observed in Spain (2.79% in manufacturing vs. 8.29% in services).
Figure 2—10: Comparison of ICT manufacturing and services: distribution of ICT R&D personnel among the biggest Member State contributors (2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.5 Comparison of indicators and data summary

Figure 2–11 provides a comparison by ICT sub-sectors of the four main indicators –value added, employment, BERD and R&D personnel– for 2010. The main results of this comparison can be summarized as follows:

- The Computer programming, consultancy and related activities sub-sector consistently scored highest in all four indicators, with shares between 32% and 46%.

- Manufacturing of communication equipment was a highly R&D-intensive sub-sector. While it produced only 3.19% of the total ICT VA in 2010 and employed only 4.15% of the total ICT workers, it invested 24.49% of the total ICT BERD and employed 15.21% of ICT R&D personnel. Similar characteristics can be seen also in Manufacture of electronic components and boards.

- A different situation is observed in the Telecommunications sub-sector. On the one hand, this sub-sector produced 35.45% of the total EU ICT VA. On the other hand, it represented only half this share in terms of ICT sector employment (17.25%), ICT BERD (15.47%) and ICT R&D personnel (14.74%). A similar pattern was seen in ICT trade industries, with 9.26% of the total ICT value added, and only 2.72% of the total ICT BERD.
Table 2—1 shows the data for the main variables analysed in this chapter.

Source: Eurostat, elaborated by Ivie and JRC-IPTS.
<table>
<thead>
<tr>
<th>NACE Rev. 2</th>
<th>Description</th>
<th>Value added (Millions of current EUR)</th>
<th>Employment (thousand persons employed)</th>
<th>BERD (Millions of current EUR)</th>
<th>R&amp;D personnel (thousand full-time equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>261-264, 268, 268</td>
<td>ICT total manufacturing industries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>261</td>
<td>Manufacture of electronic components and boards</td>
<td>46,475.33</td>
<td>844.12</td>
<td>11,262.23</td>
<td>78.31</td>
</tr>
<tr>
<td>262</td>
<td>Manufacture of computers and peripheral equipment</td>
<td>19,081.02</td>
<td>381.45</td>
<td>3,460.03</td>
<td>27.17</td>
</tr>
<tr>
<td>263</td>
<td>Manufacture of communication equipment</td>
<td>6,083.38</td>
<td>117.15</td>
<td>973.60</td>
<td>8.65</td>
</tr>
<tr>
<td>264</td>
<td>Manufacture of consumer electronics</td>
<td>15,839.16</td>
<td>248.05</td>
<td>6,364.74</td>
<td>39.07</td>
</tr>
<tr>
<td>268</td>
<td>Manufacture of magnetic and optical media</td>
<td>5,393.16</td>
<td>94.99</td>
<td>459.87</td>
<td>3.38</td>
</tr>
<tr>
<td>465, 582, 61, 62, 631, 951</td>
<td>ICT total services</td>
<td>78.61</td>
<td>2.48</td>
<td>4.00</td>
<td>0.03</td>
</tr>
<tr>
<td>465</td>
<td>ICT trade industries</td>
<td>449,594.7</td>
<td>5,129.27</td>
<td>14,730.91</td>
<td>178.51</td>
</tr>
<tr>
<td>4651</td>
<td>Wholesale of computers, computer peripheral equipment and software</td>
<td>45,952.45</td>
<td>581.63</td>
<td>706.83</td>
<td>7.91</td>
</tr>
<tr>
<td>4652</td>
<td>Wholesale of electronic and telecommunications equipment and parts</td>
<td>28,613.29</td>
<td>361.48</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5820, 61, 62, 631, 951</td>
<td>ICT services industries</td>
<td>17,339.16</td>
<td>220.15</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5820</td>
<td>Software publishing</td>
<td>403,642.3</td>
<td>4,547.64</td>
<td>14,024.08</td>
<td>170.61</td>
</tr>
<tr>
<td>5820</td>
<td>Software publishing</td>
<td>14,871.01</td>
<td>132.49</td>
<td>1,199.21</td>
<td>14.08</td>
</tr>
<tr>
<td>61</td>
<td>Telecommunications</td>
<td>1,030.50</td>
<td>4020.79</td>
<td>37.85</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Computer programming, consultancy and related activities</td>
<td>175,854.1</td>
<td>1,030.50</td>
<td>1,199.21</td>
<td>37.85</td>
</tr>
<tr>
<td>631</td>
<td>Data processing, hosting and related activities; web portals</td>
<td>180,550.5</td>
<td>2,752.56</td>
<td>37.85</td>
<td>110.83</td>
</tr>
<tr>
<td>951</td>
<td>Repair of computers and communication equipment</td>
<td>22,914.23</td>
<td>418.62</td>
<td>452.87</td>
<td>7.53</td>
</tr>
<tr>
<td>951</td>
<td>Repair of computers and communication equipment</td>
<td>9,452.40</td>
<td>213.47</td>
<td>14.72</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Note: There is no data available for BERD and R&D personnel in the Statistics on Research and Development (Eurostat) for the ICT trade industries sub-sectors (NACE 4651, NACE 4652).
3. Analysis by Member State

3.1 ICT sector value added

ICT sector VA in the EU amounted to 496 billion euros in 2010. This represented a share of 4.03% of EU GDP that has reduced slightly over the last few years.

From the individual country perspective, in 2010 the share of ICT sector ranged from 9.32% of total VA for Ireland down to 3.03% for Austria and 2.99% for Poland (see Figure 3-1). Ireland maintained the leading position with an increase in the ICT sector share in VA from 8.70% to 9.32%. In 2010, Malta and Luxembourg came next with a share 3 percentage points lower (6.30% and 6.29%, respectively). Five other countries had shares above or around 5% (Sweden, Finland, Bulgaria, Hungary and Estonia) and twelve countries had shares below the EU level (4%). It is notable that while eight of the twelve most recent EU members (“newer Member States”) have ratios of ICT VA to GDP above the EU level, these ratios for eight of the fifteen older Member States are below the EU average.

**Figure 3—1: ICT VA share of GDP by Member State (2009, 2010)**

In almost all countries the ICT sector VA share of GDP remained fairly stable from 2009 to 2010. In Malta, ICT sector VA rose in this period by 0.70 percentage points and in Ireland by 0.63 percentage points. On the other hand, Cyprus, Slovenia, the Netherlands and Sweden experienced moderate increases between 2009 and 2010 of around 0.2 percentage points, whereas Hungary and Poland saw falls of 0.40 and 0.35 percentage points, respectively. Here, however, it should be stressed that these falls and increases are relative to GDP. In some of these countries, the change in the ICT VA/GDP ratio may be due to a change in GDP rather than in ICT VA. Nevertheless, almost all EU Member States (except Greece, Hungary, Spain, Latvia, Lithuania and Austria) experienced

---

6 Greece, Luxembourg and especially Malta lack official data, therefore we recommend taking the results with caution. The missing data not covered with sources mentioned above has been estimated using NACE Rev. 1.1 data, correspondence table between NACE Rev. 1.1 and NACE Rev. 2, European averages ICT shares, and turnover/GVA ratio.

7 Due to measurement problems in Greece, Luxembourg and Malta, caution is recommended when interpreting results.
rises in the nominal values of ICT VA. At the EU level, ICT services contributed by far the largest share of ICT VA (90.63% in 2010), while ICT manufacturing VA contributed only 9.37%.

Figure 3—2 shows the distribution of VA shares for ICT manufacturing and ICT services by country in 2010. The three most ICT manufacturing-oriented countries in the EU are Malta (its ICT manufacturing industries produced 36.74% of total ICT VA), Finland (30.92%) and Hungary (26.35%). Other countries with ICT manufacturing sectors that produced relatively high percentages of ICT VA were Romania (25.40%), Sweden (21.33%), Slovakia (19.42%), Estonia (17.90%) and Ireland (16.97%).

Clearly, in terms of VA, the ICT sector of every EU Member State is dominated by ICT services. In 2010, the ICT services sectors of eight countries produced over 95% of total ICT sector VA: Cyprus (99.89%), Luxembourg (99.80%), Greece (99.36%), Bulgaria (97.25%), Spain (96.33%), France (96.25%), Latvia (95.98%) and the Netherlands (95.68%).

Figure 3—3 provides a comparison of contributions by Member State to EU ICT VA in 2010. It comes as no surprise that the largest EU economies contributed the most – Germany (16.74%), France (16.60%), the United Kingdom (16.43%), Italy (11.60%) and Spain (7.43%). Together, these five countries produced 68.80% of total EU ICT VA. The Netherlands followed with 5.35%. Overall, the twelve newer Member States contributed 7.70% to total EU GDP in 2010, a figure similar to their ICT sector contribution of 7.49% to EU ICT VA. In 2010, the six EU economies that are most specialized in ICT (Ireland, Malta, Luxembourg, Sweden and Finland – see Figure 3—1) together produced only 9.19% of the EU ICT VA, i.e., less than the share of Italy.

Source: Eurostat, elaborated by Ivie and JRC-IPTS.
3.2 ICT sector employment and labour productivity

3.2.1 ICT sector employment

In 2010, almost 6 million people worked in the EU ICT sector, representing 2.68% of employment in the EU. This percentage was almost identical in 2009.

Figure 3–4 compares the ICT sector employment shares of total employment by Member State (based on head counts). As with ICT value added in GDP, the leading country in 2009 and 2010 was Ireland with a share of almost 5% in both years (4.75% in 2009 and 4.92% in 2010). Only Finland exceeded a 4% share (around 4.3% in both years 2009 and 2010). At the other end of the scale, six countries –Bulgaria, Cyprus, Lithuania, Portugal, Greece\(^9\) and Romania– had shares below 2% in 2010.

---

\(^9\) As Greece, Luxembourg and especially Malta lack official data, we recommend taking the results with caution. The missing data for ICT sector employment has been estimated using some alternative methods like NACE Rev. 1.1 data, correspondence table between NACE Rev. 1.1 and NACE Rev. 2, and European average ICT shares.
Between 2009 and 2010, the EU ICT sector lost 71.5 thousand workers. The sharpest reductions were in Italy and France with 17 and 16.2 thousand workers, respectively (jointly, 46.49% of the total EU reduction), while the United Kingdom experienced a fall of 14.3 thousand (19.97%), Netherlands 10.3 thousand (14.47%), Romania 9.3 thousand (12.96%) and Slovakia 8.9 thousand (12.46%). Thus, these six countries accounted for 106.36% of the contraction in EU ICT sector employment. Interestingly, in spite of the economic crisis, ICT sector employment increased in some countries, most notably in Poland where almost 14 thousand more workers were employed (according to head counts). Hungary (11.7 thousand workers), Bulgaria (7.7 thousand), Spain (5.7 thousand), Germany (3.2 thousand), Portugal (1.7 thousand) and Lithuania (1.6 thousand) also employed additional ICT workers.

At the EU level in 2010, ICT manufacturing employed 14.13% of the ICT sector workforce. There is considerable variation between Member States in the distribution of labour between the two ICT sub-sectors (manufacturing and services). A large number of newer EU Member States have become important ICT manufacturing countries, and have relatively high employment in ICT manufacturing (see Figure 3–5). This was the case for Hungary (51.26% of ICT sector employment in manufacturing), Malta (40.56%), Estonia (37.16%), Slovakia (29.74%), Romania (21.19%), Slovenia (20.48%), the Czech Republic (20.15%) and Poland (20.06%). Other EU countries with a relatively high share of ICT manufacturing employment were Finland (28.48%) and Ireland (23.92%). On the other hand, countries with the biggest share of ICT services employment in 2010 were Luxembourg (99.82%), Bulgaria (99.66%), Greece (97.53%), Cyprus (97.19%), Latvia (95.04%), and Spain (94.18%).

Source: Eurostat, elaborated by Ivie and JRC-IPTS.
Figure 3—5: Distribution of employment shares between ICT manufacturing and ICT services by Member State (% of head counts, 2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 3–6 compares Member State contributions to EU ICT sector employment in 2010. As can be expected, EU ICT sector employment was concentrated in the five largest EU economies. Germany came first with 18.24% of total ICT sector employment in 2010. The UK was second with 15.83%, followed by France (12.94%), Italy (11.02%), and Spain (6.84%). Thus, 64.88% of EU ICT sector employment is concentrated in these five countries. Other EU countries with fairly high shares of ICT sector employment relative to their economic size are Poland (5.40%) and the Netherlands (4.54%). Three newer Member States, Hungary (2.57%), the Czech Republic (2.51%), and Romania (2.23%) have fairly high contributions, followed by Belgium (1.85%) and Finland (1.80%).
3.2.2 ICT sector labour productivity

Figure 3—7 shows that the EU ICT labour productivity level in 2010 was around 83 thousand euros per person. Luxembourg had the highest level (154.54 thousand euros per person), followed by Ireland (143.83), then Greece (127.90) and Belgium (110.18). All the newer Member States (except Cyprus, Slovakia and Malta) had the lowest levels of ICT labour productivity. It is also interesting to note that ICT services in almost all countries (21 out of 27) had higher labour productivity than the total and, therefore, than ICT manufacturing\textsuperscript{10}. The only exceptions were Luxembourg, Sweden, the United Kingdom, Finland, Romania and Austria.

\textsuperscript{10} The bright blue bubbles in Figure 3–7 indicate the value of ICT labour productivity in the manufacturing sector whereas the light blue bubbles indicate the value of ICT labour productivity in the services sector.
Figure 3—7: ICT labour productivity by Member State (thousands of EUR PPS [Purchase Power Standard] per person, 2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

3.3 ICT sector business expenditure on R&D (ICT BERD)

In 2010, EU ICT business expenditure on R&D (ICT BERD) amounted to 26 billion euros, 2.46% more than in 2009 (25.4 billion euros). This represented 17.05% of the total EU BERD in 2010.

Figure 3–8 presents ICT BERD shares of total BERD by Member State. Of total BERD in the ICT sector in 2010, Greece and Finland spent 62.29% and 58.33%, respectively, i.e., between 23 and 19 percentage points more than the next country, Cyprus (39.00%). Malta, Ireland and Portugal followed with shares between 34.82% and 31.40%. Estonia, Poland, Sweden, Lithuania and Italy, which spent between 20% and 30% of total BERD on ICT, were next. In 2010, the country with by far the lowest share of ICT BERD in total BERD was Slovakia, with 3.62%.

In 2010, six out of the twenty-seven countries had a higher ICT BERD share of total BERD than in 2009. This group consisted of three countries belonging to the former EU15 (Netherlands, Portugal and Greece) and three countries that entered the EU in recent years (Lithuania, Poland and Slovakia). The biggest jump took place in Lithuania, from 9.98% in 2009 to 24.63% in 2010. In Ireland, Luxembourg, Belgium and Germany the share remained stable. In the remaining countries, the ICT BERD share of total BERD dropped. The sharpest drop occurred in Estonia, from 39.95% in 2009 to 27.91% in 2010.

11 As for the other variables, Greece and Luxembourg lack official data, therefore we recommend taking the results with caution. The missing data has been estimated using some alternative methods like NACE Rev.1.1 data and correspondence table between NACE rev. 2 and NACE Rev 1.1 or percentage structure of turnover.
At EU level in 2010, ICT BERD (26 billion euros) was almost equally divided between manufacturing (11.3 billion euros) and services (14.7 billion euros).

Figure 3—9 shows the distribution of ICT BERD between ICT manufacturing and ICT services by Member State in 2010. Only five EU countries reported more ICT BERD in manufacturing than in services. Finland led with a share of 87.05%, followed by Sweden (79.99%) and Austria (64.96%). The remaining two countries in this group were Germany (52.19%) and Slovenia (51.26%).

**Figure 3—9: Distribution of ICT BERD between ICT manufacturing and ICT services by Member State (2010)**

*Source: Eurostat, elaborated by Ivie and JRC-IPTS.*
On the other hand, shares of ICT BERD in services were especially important in Cyprus (100.00%), Bulgaria (99.93%), Luxembourg (99.23%), Portugal (95.88%), Estonia (94.78%), and Romania (93.71%).

In 2010, the largest contributors to EU ICT BERD were Germany and France (21.09% and 17.38%, respectively). These two countries alone contributed for 38.47% of total EU ICT BERD. They were followed, albeit at a certain distance, by the United Kingdom (11.45%) and Finland (10.89%). Although Finland is a small economy in terms of GDP and even in terms of absolute ICT VA, it has the strongest ICT BERD intensity in the EU. These countries were followed by Italy (8.37%) and Sweden (7.97%), again a relatively small country with strong ICT BERD intensity. These six countries together spent 77.15% of total EU ICT BERD in 2010.
**ICT BERD intensity (ICT BERD/ICT VA) by Member State (2010)**

![Figure 3-11](image)

**Source:** Eurostat, elaborated by Ivie and JRC-IPTS.

ICT BERD intensity (defined as the ratio of ICT BERD to ICT value added) in the EU in 2010 amounted to 5.24%. Finland had by far the highest ICT BERD intensity, 30.61 (see Figure 3–11). Sweden and Denmark also had relatively high ICT BERD intensities, but only around a third that of Finland. In the same year, ICT BERD intensity in Sweden amounted to 11.05% and in Denmark, 9.40%. Only four other countries had ICT BERD intensities above the EU level: Austria (7.36%), Portugal (6.96%), Germany (6.59%), and France (5.48%). Some of the newer Member States – Slovakia (0.20%), Bulgaria (0.41%), Romania (0.52%) and Latvia (0.71%) – together with Luxembourg (0.71%), had the lowest levels.

ICT BERD intensity decreased slightly in the EU as a whole between 2009 and 2010 (from 5.28% to 5.24%). The countries where it increased include Lithuania, Poland, the Netherlands, Portugal, Slovenia, Slovakia, Greece, Germany and the Czech Republic. Austria, Italy, Latvia and Bulgaria remained stable, whereas Sweden, Finland, Estonia and Cyprus experienced the highest drops.

### 3.4 ICT sector R&D personnel

In 2010, ICT R&D personnel (including both researchers and R&D supporting staff) made up 4.30% of total ICT sector employment in the EU. This represents a slight increase from 2009 (of 0.27 percentage points).

Figure 3–12 presents ICT R&D personnel shares of total ICT sector employment by Member State. During the analysed period (2009–2010), Finland led the EU Member States with a share of around 13% in both years. At a distance of more than 3 percentage points was Greece\(^\text{12}\) with a 9.62% share in 2010, followed by Denmark (8.23%) and France (6.20%). Nine other countries scored above the EU level (4.30% in 2010). The lowest ranking countries were mostly newer Member States (the Czech Republic 2.99%, Hungary 2.00%, Poland 1.94%, Lithuania 1.90%, Cyprus 1.68%,

---

\(^{12}\) Again, Greece and Luxembourg lack official data also for this variable, therefore we recommend taking the results with caution. The missing data has been estimated using some alternative methods like NACE Rev. 1.1 data and correspondence table between NACE rev. 2 and NACE Rev 1.1 or percentage structure of Highly Qualified employment.
Latvia 1.24%, Romania 0.94% and Bulgaria 0.67%), but also several important ICT R&D players like the Netherlands (4.03%), the United Kingdom (3.53%), Italy (3.51%) and Luxembourg (2.37%).

Figure 3–13 provides a comparison of the distribution of ICT R&D personnel between manufacturing and services by Member State. In countries like Finland, Sweden, Slovenia and Germany, the manufacturing sector plays a major role in terms of ICT R&D personnel. In all four of these countries more than 50% of their ICT R&D employees were working in ICT manufacturing in 2010. In Finland, this ratio was as high as 71.40%. At the EU level, however, more than two thirds of ICT R&D jobs were in services in 2010. In fact in 2010, 23 EU countries had more ICT R&D jobs in services than in manufacturing, with over 90% shares in Romania, Poland, Estonia, Denmark, Portugal, Bulgaria, Lithuania, Greece, Cyprus and Luxembourg.

Figure 3—12: ICT R&D personnel share of total ICT sector employment by Member State (based on FTE; 2009, 2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.
Figure 3—13: ICT manufacturing/services distribution of countries’ shares (based on FTE, 2010)

Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 3–14 shows the distribution of ICT R&D personnel among Member States. As with other indicators, the largest EU economies took the lead in 2010. France and Germany led the field, each with shares of 18.6% (again based on full-time equivalents), followed by the United Kingdom (12.97%) and Italy (8.97%). These four countries together employed almost 59.14% of ICT R&D workers in the EU in 2010. What is also remarkable is Finland’s relatively high share (5.40%). Among the main contributors, Spain, which employed almost 7% of ICT R&D employees, should also be mentioned. It is also of interest that France, Germany, UK and Italy, individually, employed more ICT R&D workers than the whole group of twelve newer Member States (7.25%). In this group, Poland had the highest share (2.43%).
Figure 3—14: Distribution of ICT R&D personnel among Member States (based on FTE, 2010)

In this section, all four previously analysed indicators are compared in terms of Member State contributions (see Figure 3—15). Overall, due to the importance of their economies or to their particularly large ICT sector or strong ICT BERD intensities, only eight countries play significant roles in both ICT VA generation and ICT BERD in the EU according to this particular selection of indicators. This does not mean that important ICT activities do not take place in other Member States, but that a size effect makes these particular Member States stand out. A finer regional analysis would most certainly identify important ICT regions in other Member States.
**Figure 3—15**: Comparison of ICT value added, employment, BERD and R&D personnel by Member State (2010)

These eight countries are analysed individually in this section. The other countries are grouped into older MS and newer MS categories.

Unsurprisingly, the fact that emerges most clearly is the dominance of four major economies (France, Germany, Italy and the United Kingdom) in all four indicators. There are some exceptions (e.g., Finland in ICT BERD), but these four countries together systematically contributed around 60% in all indicators.

*Source: Eurostat, elaborated by Ivie and JRC-IPTS.*
Other interesting facts (all related to 2010) can be summarized as follows:

- Finland produced 1.86% of total EU ICT value added and employed 1.80% of the total EU ICT sector employees, but invested 10.89% of total EU ICT BERD. Sweden was in a similar position, producing 3.78% and employing 2.91%, but investing 7.97%.

- The twelve newer Member States together produced 7.49% of total EU ICT VA. For this, they needed only 2.46% of total EU ICT BERD but employing 16.46% of the total EU ICT sector workforce. The share of ICT R&D personnel working (7.25%), however, did not correspond to this relatively high 16.46% share.

- The contribution of Germany was very consistent across all four indicators (always between 17% and 28%). Similarly consistent patterns can be seen in Italy (always between 8% and 12%), the United Kingdom (always between 12% and 16%) and in the group of other older Member States (always between 9% and 14%).

Table 3–1 summarizes the main information presented in this chapter.

**Table 3–1: Summary table of ICT indicators by European country. European Union (2010)**

<table>
<thead>
<tr>
<th>ICT total:</th>
<th>Value added (Millions of current EUR)</th>
<th>Employment (thousand persons employed)</th>
<th>BERD (Millions of current EUR)</th>
<th>R&amp;D personnel (thousand full-time equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>9,250.28</td>
<td>107.07</td>
<td>2,831.42</td>
<td>13.87</td>
</tr>
<tr>
<td>France</td>
<td>82,417.30</td>
<td>771.02</td>
<td>4,517.04</td>
<td>47.80</td>
</tr>
<tr>
<td>Germany</td>
<td>83,132.24</td>
<td>1,086.70</td>
<td>5,481.79</td>
<td>47.74</td>
</tr>
<tr>
<td>Italy</td>
<td>57,583.10</td>
<td>656.66</td>
<td>2,176.75</td>
<td>23.03</td>
</tr>
<tr>
<td>Netherlands</td>
<td>26,550.63</td>
<td>270.46</td>
<td>808.59</td>
<td>10.91</td>
</tr>
<tr>
<td>Spain</td>
<td>36,864.03</td>
<td>407.73</td>
<td>1,041.95</td>
<td>16.98</td>
</tr>
<tr>
<td>Sweden</td>
<td>18,753.43</td>
<td>173.62</td>
<td>2,071.34</td>
<td>8.71</td>
</tr>
<tr>
<td>UK</td>
<td>81,592.72</td>
<td>943.04</td>
<td>2,974.96</td>
<td>33.32</td>
</tr>
<tr>
<td>Other old Member States</td>
<td>63,146.36</td>
<td>560.30</td>
<td>3,448.57</td>
<td>35.86</td>
</tr>
<tr>
<td>Newer Member States</td>
<td>37,194.76</td>
<td>980.46</td>
<td>640.73</td>
<td>18.61</td>
</tr>
<tr>
<td><strong>European Union</strong></td>
<td><strong>496,070.10</strong></td>
<td><strong>5,973.39</strong></td>
<td><strong>25,993.14</strong></td>
<td><strong>256.82</strong></td>
</tr>
</tbody>
</table>

*Source: Eurostat, elaborated by Ivie and JRC-IPTS*
4. Comparison with Other Economies

This section places the EU in the international context by comparing its ICT R&D position with the most relevant players in the world economy: United States, Canada, Australia, five Asian countries (Taiwan, Korea, Japan, China and India); three European countries not belonging to the EU (Russia, Norway and Switzerland); and one Latin American country (Brazil). The comparison is made for the two most recent years for which information is available, 2009 and 2010. It uses the *ICT sector Operational Definition*\(^{13}\) in the JRC-IPTS database, following the same structure as previous chapters.

4.1 ICT sector value added

The importance of the ICT sector is very uneven among the countries considered. Figure 4–1 plots the weight of the value added (VA) generated by the ICT sector on total GDP. The message it gives is clear: the five Asian countries, together with the US, have the highest share of ICT in their value added. Of those, the high share of the ICT sector in Taiwan and Korea –especially the former– is outstanding. While ICT VA represented around 3.7% of VA in the EU\(^{14}\) in 2010, it was four times higher in Taiwan, at 12.15%, and in Korea more than double, at 8.18%. These two countries are therefore the most ICT oriented in the world economy. In addition, note that while in those two countries, and also in the US, ICT VA share increased between 2009 and 2010, it slightly decreased in the EU.

The share of one country in the total ICT VA depends on two conditions: 1. its ICT sector VA share on total VA; and 2. its economic size, as measured by total GDP or total employment its ICT sector VA share on total VA. Figure 4–2 shows how total ICT VA is split among the different countries. As expected, due to their economic size, the US enjoys the highest share (32.85%), followed by the EU countries (25.36%), China (11.79%) and Japan (11.02%). Thus, in 2010 these four players together represented 81.01% of total ICT VA produced by the thirteen countries selected for analysis.

---

\(^{13}\) The *Comprehensive definition of ICT sector* is available mainly for EU Member States for the period 2008-2010. It corresponds to the definition given by the OECD in 2007. This definition includes ICT manufacturing industries, ICT trade industries and ICT services industries. Data in accordance with this classification are not available for some non-EU countries. See OECD definition: [http://www.oecd.org/science/sci-tech/38217340.pdf](http://www.oecd.org/science/sci-tech/38217340.pdf). The *Operational definition of ICT sector* allows for an international comparison with non-EU countries over a longer period of time (2006-2010), as some of these countries do not have the necessary disaggregated information to estimate all the ICT sub-sectors included in the comprehensive definition. This definition takes into account the standard distinction between manufacturing and services, but does not include the following sectors: Manufacture of magnetic and optical media (268) and ICT trade industries (465). In addition, ICT services industries are only available for two sub-sectors: Telecommunication (61) and the aggregate Computer and related activities (5820, 62, 631, 951). See Technical report: [http://ftp.jrc.es/EURdoc/JRC77364.pdf](http://ftp.jrc.es/EURdoc/JRC77364.pdf).

\(^{14}\) Recall that in this chapter we are using the *Operational Definition*; some discrepancies may therefore arise between the figures provided in this chapter and in previous ones.
Figure 4—1: ICT VA share of GDP for the European Union and other economies (2009, 2010)

Note: ICT VA was not available for Japan in 2010.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4—2: Distribution of ICT value added among the European Union and other economies (2009, 2010)

Note: 2009 for Japan for both years.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.
Figure 4–3 reports the different ICT sub-sectors’ share of total ICT VA\textsuperscript{15}. Of the five ICT sub-sectors represented in the figure, three stand out for their importance: Manufacture of electronic components and boards; Computer and related activities; and Telecommunications. Both Taiwan and Korea have a very high share of the first sector, Manufacture of electronic components and boards; China has a relatively high share of Manufacture of computers and peripheral equipment and Manufacture of consumer electronics; India and Norway have high shares of Computer and related activities, while Brazil, Russia and Canada present the highest Telecommunications share of the thirteen countries considered. The most striking difference between the EU and the US is the former’s relatively high share in two service sectors, Telecommunications and Computer and related activities, together with the relative low share in Manufacture of electronic components and boards as compared with the US.

**Figure 4—3: Distribution of ICT value added by manufacturing and services sub-sectors for the European Union and other economies (2010)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Telecommunications</th>
<th>Manufacture of communication equipment</th>
<th>Manufacture of computers and peripheral equipment and manufacture of consumer electronics</th>
<th>Manufacture of electronic components and boards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>48.27%</td>
<td>40.52%</td>
<td>40.75%</td>
<td>45.20%</td>
</tr>
<tr>
<td>Brazil</td>
<td>50.75%</td>
<td>48.85%</td>
<td>50.82%</td>
<td>24.25%</td>
</tr>
<tr>
<td>Canada</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>13.12%</td>
</tr>
<tr>
<td>China</td>
<td>50.62%</td>
<td>50.62%</td>
<td>50.62%</td>
<td>26.13%</td>
</tr>
<tr>
<td>EU</td>
<td>36.03%</td>
<td>39.08%</td>
<td>36.03%</td>
<td>35.15%</td>
</tr>
<tr>
<td>India</td>
<td>66.33%</td>
<td>48.45%</td>
<td>66.33%</td>
<td>48.45%</td>
</tr>
<tr>
<td>Japan</td>
<td>16.22%</td>
<td>35.15%</td>
<td>16.22%</td>
<td>35.15%</td>
</tr>
<tr>
<td>Korea</td>
<td>20.20%</td>
<td>18.83%</td>
<td>20.20%</td>
<td>18.83%</td>
</tr>
<tr>
<td>Norway</td>
<td>62.39%</td>
<td>18.83%</td>
<td>62.39%</td>
<td>18.83%</td>
</tr>
<tr>
<td>Russia</td>
<td>66.10%</td>
<td>65.56%</td>
<td>66.10%</td>
<td>65.56%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>5.35%</td>
<td>5.35%</td>
<td>5.35%</td>
<td>5.35%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>4.45%</td>
<td>4.45%</td>
<td>4.45%</td>
<td>4.45%</td>
</tr>
<tr>
<td>United States</td>
<td>10.22%</td>
<td>7.35%</td>
<td>10.22%</td>
<td>7.35%</td>
</tr>
</tbody>
</table>

Note: 2009 for Japan.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4–4 offers a complementary perspective by plotting the ICT and non-ICT activities shares on GDP, differentiating between manufacturing and services industries. As we have already seen (Figure 4–1) ICT sector has a small share of GDP. ICT manufacturing sectors are relevant in terms of VA for only four Asian countries, Taiwan, Korea, Japan and China, while for the remaining countries its presence is almost nil, below 1% (1.1% in the US) of total GDP. For all the countries the highest share of GDP corresponds to non-ICT services industries. This is especially true for the US (75.69%), Japan (66.88%), Switzerland (66.01%) and Canada (62.76%). Non-ICT manufacturing sectors are very relevant in China (30.33%) and also Korea (22.02%), while the sectors that fall under the “Rest” heading (agriculture, mining and quarrying, energy and construction) are relatively more significant in Norway (40.54%), India (34.48%) and Russia (34.25%). A comparison of the EU

\textsuperscript{15} The figure represents five ICT sub-sectors instead of the six for which the database offers information. It combines Manufacture of computers and peripheral equipment with Manufacture of consumer electronics in order to make the information more easily readable.
and the US reveals the main difference as the relatively higher share in the US of non-ICT services and the lower share of the “Rest” component, together with the higher share of the ICT sector already highlighted.

**Figure 4—4:** ICT value added share of GDP and comparison with non-ICT economic activities. European Union and other economies (2010)

Note: 2009 for Japan. Non-ICT service industries include total Trade.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.
4.2 ICT sector employment and labour productivity

4.2.1 ICT sector employment

Figure 4–5 plots the ICT sector employment share on total employment. The picture it reveals is not so different from that for value added. Taiwan, Korea, and Japan are, again, the countries with the highest shares of ICT. The first two countries had (slight) increases in share in 2010 compared to 2009. On the other hand, the EU had a similar share (around 2.4%) to Norway and the United States.

Figure 4—5: ICT sector employment share of total employment for the European Union and other economies (2009, 2010)

Note: 2010 data were not available for Brazil, China, India and Japan.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4–6 shows each country’s contribution to the aggregated employment of the thirteen selected countries.\(^\text{16}\) Now the picture is rather different from that obtained for VA (Figure 4–2). The highest contribution to total ICT sector employment in 2010 corresponded to China (37.10%), followed at a large distance by the EU (15.73%, less than half of China’s contribution), India (12.43%), the United States (10.47%) and Japan (7.15%). The sum of these five shares amounts to 82.89% of ICT sector employment. It is interesting to recall that the share of the ICT sector in the EU represented 25.36% in terms of ICT aggregate VA, but only 15.73% in terms of ICT aggregated employment. For the US the gap is even more striking: 32.85% for VA and 10.47% for employment. On the other hand, the contribution of the different countries to aggregated ICT sector employment remained practically constant between 2009 and 2010, which was not the case for VA (Figure 4–2).

---

\(^\text{16}\) Recall that the information for Brazil, China, India and Japan refers to 2009 instead of 2010.
Figure 4—6: Distribution of ICT sector employment among the European Union and other economies (2009, 2010)

Note: 2009 for Brazil, China, India and Japan for both years.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4–7 plots the shares of the employment in five ICT sub-sectors on total ICT sector employment. The picture it reveals is similar to that provided by Figure 4–3, which gave the same information but in reference to VA rather than employment. As before, three ICT sub-sectors show the highest share: Manufacture of electronic components and boards, which is especially relevant for four Asian countries – Taiwan, Korea, Japan and China – and also for Switzerland. Telecommunications has a high share in total ICT sector employment in almost all countries, but it is especially high in India and Russia. The Computer and related activities sub-sector is very relevant for Norway, Brazil and Australia, while for Taiwan and China the contribution of Manufacture of computers and peripheral equipment and manufacture of consumer electronics is also relevant. The main difference to emerge in a comparison of the EU and the US is the relatively high US share of the Telecommunications sub-sector and the low share of Computer and related activities, together with the higher share of ICT manufacturing already mentioned.
Figure 4—7: Distribution of ICT sector employment by manufacturing and services sub-sectors for the European Union and other economies (2010)

Note: 2009 for Brazil, China, India and Japan.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4–8 shows the distribution of total employment between ICT and non-ICT activities, as well as between manufacturing and services. The image this figure provides is very different from Figure 4–4, which contained similar information but for VA rather than employment. Generally speaking, in developed countries the contribution of non-ICT service industries VA to total GDP is lower than the contribution to total employment. For instance, in the EU the contribution of non-ICT service industries to GDP amounted to 62.17%, while for employment the percentage was 69.46%. A similar difference can be observed in the US with a 75.69% share in GDP, as compared with an 82.24% share in total employment. For less developed countries, and as expected, the contribution of the “Rest” industries (agriculture, mining and quarrying, energy and construction) is higher in terms of employment than in terms of GDP. This is especially true—also as expected—for India and China. The most notable fact when comparing the EU with the US is the higher share of non-ICT services industries and the lower share of non-ICT manufacturing industries in the US.
Figure 4–8: Share of ICT sector employment in total employment and comparison with non-ICT economic activities. European Union and other economies (2010)

Note: 2009 for Brazil, China, India and Japan. Non-ICT service industries include total Trade.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

4.2.2 ICT sector labour productivity

The profiles followed by GDP and employment in the different countries and sectors have their counterpart in the levels of labour productivity achieved, since this variable is the ratio between the two. Figure 4–9 shows the levels of labour productivity in the ICT sector (panel a), ICT manufacturing (panel b) and ICT services (panel c), expressed in thousands of Euros PPS per worker. The picture now is rather different from what we have reported in the previous sections. The United States leads in total ICT sector labour productivity, ICT manufacturing and ICT services. Norway lies in second position –due to its more productive ICT service sector – followed by Canada. India, China, Russia and Brazil can be found at the opposite side of the spectrum; while the three large ICT countries –Taiwan, Korea and Japan– have lower ICT labour productivity levels than the EU average.
Figure 4—9: ICT labour productivity for the European Union and other economies (thousand EUR PPS per person; 2009, 2010)

a) ICT total

b) ICT manufacturing
Figure 4–9: (cont.) ICT labour productivity for the European Union and other economies (thousand EUR PPS per person; 2009, 2010)

c) ICT services

![Chart showing ICT labour productivity for various economies]

Note: 2010 data were not available for Brazil, China, India and Japan.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

4.3 **ICT sector business expenditure on R&DICT BERD**

Business expenditure on R&D (BERD) is very unevenly distributed among ICT and non-ICT sector in the countries considered. As Figure 4–10 shows, in 2010, more than 70% of total BERD (72.93%) in Taiwan was devoted to the ICT sector, 52.59% in Korea and 30.31% in the US. In the EU the share was around half of that of the US (16.58%), and it was even lower in India (15.66%), Brazil (14.66%), Switzerland (12.95%), Australia (10.67%) and Russia (1.32%).

---

17 The figures for China, India and Russia should be interpreted with caution since the available information is scarce and not fully comparable. In the three countries the correspondence between the sector classification and the one followed in the PREDICT methodology is an approximation. Many sectors are estimated as there is not enough available official disaggregation. In China, for sectors 63 and 58 Korean weights are used. In India, for sectors 63 and 58 United Kingdom’s weights are used. In Russia, only GERD data are available, so this structure is applied to total BERD in order to estimate the sub-sectors. Besides, the Russian sector classification uses NACE Rev 1.1 and not NACE 2, so the sectoral correspondence is not exact.
Figure 4—10: Share of ICT and non-ICT BERD for the European Union and other economies (2010)

Note: 2008 for Brazil and Switzerland. Data for India and China should be interpreted with caution.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

ICT BERD is much more concentrated in a small number of countries than value added or employment. According to the information provided in Figure 4–11, almost half of total ICT BERD (44.18%) was made in the United States. The EU follows – but at a large distance – representing 17.51% of the total, close to the 16.50% contribution of Japan, and the even smaller Korean contribution (7.80%). When China (5.61%) and Taiwan (3.41%) are considered, these five countries represent 95.01% of total ICT BERD undertaken by the thirteen countries under consideration. Note also that while the contributions of the US, the EU and Japan decreased between 2009 and 2010, those of Taiwan, Korea and China increased.

Figure 4–12 plots the distribution of ICT BERD between ICT manufacturing and services sub-sectors in 2010. Now all the sub-sectors appear almost equally relevant in one way or another. Manufacture of electronic components and boards is very relevant for Korea, Taiwan, Switzerland, Russia, and to a lesser extent for the US. Manufacture of computers and peripheral equipment, together with Manufacture of consumer electronics, is relevant for Brazil, Taiwan, Japan, China and the United States. Manufacturing of communication equipment has a high share in ICT BERD in the EU, Japan, Canada, and Russia. For Telecommunications the highest shares are reflected for Brazil, Switzerland and Australia. Finally, Computer and related activities have a very high presence in India, Norway and Australia. Overall, ICT BERD is more evenly distributed than ICT VA or ICT sector employment among the ICT sub-sectors. The main differences between the EU and the US is that the latter has a much higher share of Manufacture of electronic components and boards and a lower share in Manufacture of communication equipment and Telecommunications.
Figure 4—11: Distribution of ICT BERD among the European Union and other economies (2009, 2010)

Note: 2008 for Brazil and Switzerland for both years.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4—12: Distribution of ICT BERD by manufacturing and services sub-sectors for the European Union and other economies (2010)

Note: 2008 for Brazil and Switzerland.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

The distribution of ICT BERD by ICT and non-ICT sub-sectors, and between manufacturing and service industries, is shown in Figure 4–13. As already highlighted, BERD in ICT manufacturing industries is very high in Taiwan and Korea and it is relatively higher in Japan and the US than in the other countries. BERD in non-ICT manufacturing industries is very important in all countries, 18

18 Information for Brazil is not available due to lack of data for BERD in the service sector.
except for Russia, but it is especially high in Japan, Switzerland, India and China. When the EU and the US are compared the most notable fact is the lower US share of non-ICT industries –both manufacturing and services– and thus, the higher share of ICT industries.

Figure 4—13: ICT BERD share of total BERD and comparison with non-ICT economic activities. European Union and other economies (2010)

BERD intensity measures the weight of BERD in GDP. Figure 4–14 plots the BERD/GDP ratio for the years 2009 and 2010, distinguishing between ICT and non-ICT sector. The order of the countries remained constant in both years. The highest BERD intensity corresponded to Korea (2.80%) in 2010, and three other countries had BERD/GDP ratios above 2%: Japan (2.49%), Switzerland (2.11%) and Taiwan (2.08%). For the EU the corresponding figure was 1.24%, and in the US 1.92%. As expected, ICT BERD intensity was relatively very high in Taiwan and Korea, followed, at a significant distance, by the US and Japan. ICT BERD intensity accounted for 0.2% in the EU, as compared with 1.5% in Korea, or 0.6% in the US and Japan.
Figure 4—14: Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP). European Union and other economies (2009, 2010)

a) 2009

b) 2010

Note: 2008 for Brazil and Switzerland for both years.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

Figure 4–15 plots ICT BERD intensity (ICT BERD/ICT VA) for the total ICT sector as well as for each of the five sub-sectors considered. As in the previous cases, the three Asian countries also stand out for this variable. ICT BERD intensity in Korea reached a high 17.97% in 2010, followed by Taiwan (12.51%) and Japan (11.65%). The US (10.94%) came next while the figure for the EU was 5.62%. Again, in Korea and Taiwan the sector with the highest ICT BERD intensity is Manufacture of electronic components and boards. This sub-sector is also important for Switzerland, Japan and the US. Computer and related activities is the most prominent sub-sector in the US, Norway and Australia. This sub-sector also has the highest ICT BERD intensity in the EU, followed by Manufacture of communication equipment.
Figure 4–15: Contribution of ICT sub-sectors to ICT BERD intensity (ICT BERD/ICT GVA). European Union and other economies (2010)

Note: 2008 for Brazil and Switzerland; 2009 for Japan.
Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

4.4 ICT sector R&D personnel

Figure 4–16 plots the share of ICT R&D personnel (expressed in full equivalent terms) in total ICT sector employment (expressed in terms of headcounts). As in many other variables already reviewed, Taiwan and Korea take the lead. In Taiwan the share of ICT R&D personnel amounted to 10.85% in 2010, and in Korea it was just over 10% (10.24%). It is interesting to note the high share for Canada (7.98%), and also for Norway (7.79%). By contrast, in the EU the equivalent percentage was less than half, 4.62%. Note that Taiwan, Korea, but also the EU, showed increases in the ICT personnel ratio between 2009 and 2010.

Data limitations impede inclusion of information for the ICT personnel variable for the US. Although the Survey of Industrial Research and Development (SIRD) and Business R&D and Innovation Survey (BRDIS) offer domestic R&D employment figures, these are not comparable with the definition of FTE R&D personnel used by OECD and Eurostat (following Frascati Manual), since they only include R&D scientists and engineers.

As for the BERD variable, the figures for China, India, Russia, and also Korea should be interpreted with caution since the available information is scarce and not fully comparable. China: for some years there is no data for business personnel by sector but only for total personnel. In these cases the total personnel sectoral structure is applied to business personnel. India: for sectors 63 and 58 United Kingdom’s weights are used. Korea: for some sectors Japanese weights are applied in order to estimate them. Russia: only GERD data are available, so this structure is applied to total BERD in order to estimate the sub-sectors. Official national data with sectoral disaggregation are expressed in terms of head-counts instead of full time equivalent, thus the ratio FTE/HC is applied to all sectors according to the total official values in order to estimate personnel in terms of full time equivalent.

19 Data limitations impede inclusion of information for the ICT personnel variable for the US. Although the Survey of Industrial Research and Development (SIRD) and Business R&D and Innovation Survey (BRDIS) offer domestic R&D employment figures, these are not comparable with the definition of FTE R&D personnel used by OECD and Eurostat (following Frascati Manual), since they only include R&D scientists and engineers.

20 As for the BERD variable, the figures for China, India, Russia, and also Korea should be interpreted with caution since the available information is scarce and not fully comparable. China: for some years there is no data for business personnel by sector but only for total personnel. In these cases the total personnel sectoral structure is applied to business personnel. India: for sectors 63 and 58 United Kingdom’s weights are used. Korea: for some sectors Japanese weights are applied in order to estimate them. Russia: only GERD data are available, so this structure is applied to total BERD in order to estimate the sub-sectors. Official national data with sectoral disaggregation are expressed in terms of head-counts instead of full time equivalent, thus the ratio FTE/HC is applied to all sectors according to the total official values in order to estimate personnel in terms of full time equivalent.
Figure 4—16: ICT R&D personnel (FTE) share of total ICT sector employment for the European Union and other economies (2009, 2010)

Note: 2010 data were not available for Japan, Switzerland, Brazil, China and India. 2009 data were used for Japan and 2008 data for Brazil and Switzerland. Data were not available for the United States.

Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.

The absence of reliable data for the US limits the interest of the information in Figure 4–17, which shows the contribution of the twelve remaining countries to total ICT R&D personnel (excluding the US). For those countries the EU presents the second highest share in 2010, only behind China, followed by Japan, Korea, Taiwan and Canada. China increased its share between 2009 and 2010, whereas the other three leading countries lost weight.

The ICT and non-ICT share of total R&D personnel is shown in Figure 4–18. Taiwan (68.29% of R&D personnel assigned to the ICT sector) and Korea (47.89%) are, by far, the leading countries. Norway (28.18%), Canada (26.90%), Japan (26.57%) and Australia (20.04%) have higher shares than the EU (19.09%).

Figure 4—17: Distribution of ICT R&D personnel (FTE) among the European Union and other economies (2009, 2010)

Note: 2008 for Brazil and Switzerland. Data were not available for the United States. Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.
Finally, Figure 4–19 shows the distribution of ICT R&D personnel in manufacturing and services sectors. The overwhelming superiority of manufacturing in the Asian countries is striking, but the position of Russia and Switzerland is also noteworthy. 91.28% of Taiwan’s ICT R&D personnel worked in manufacturing, the share was also high in Russia (86.87%), Japan (81.35%), Korea (80.09%) and China (80.02%). Compared with these percentages the share of ICT R&D personnel in the EU ICT manufacturing sector is very modest (31.45%). These figures again highlight the prominence of the ICT sector in the Asian countries—especially in their manufacturing sub-sectors—and the opposite situation of the EU, with a lower presence of the ICT sector, and its higher specialization in ICT service sub-sectors.

Note: 2008 for Brazil and Switzerland. Data were not available for China, India and the United States. Source: See methodology (hyperlink), elaborated by Ivie and JRC-IPTS.
4.5 **Comparison of indicators and data summary**

Figure 4–20 summarizes ICT sector value added, employment, BERD and R&D personnel and in terms of the countries’ contributions in 2010.

- The US enjoyed the highest share in ICT VA (32.85%) in 2010, followed by the EU (25.36%), China (11.79%), Japan (11.02%) and Korea (3.53%). These five players together represent 84.54% of the total ICT VA produced by the thirteen countries selected.

**Figure 4—20:** Comparison of ICT sector value added, employment, R&D personnel and BERD for other economies and the EU (2010)

- In terms of ICT sector employment, the picture is rather different from that obtained for ICT VA. The highest contribution to total ICT sector employment in 2010 corresponded to China (37.10%), followed by the EU (15.73%, less than half of China’s contribution), India (12.43%), the United States (10.47%) and Japan (7.15%). The sum of these five shares amounts to 82.89% of ICT sector employment in the thirteen countries analysed.

- The share of the ICT sector in the EU represents 25.36% in terms of ICT aggregate VA, but only 15.73% in terms of ICT sector employment. For the US the gap is even more striking: 32.85% for VA and 10.47% for employment.

- ICT BERD is much more concentrated in a small number of countries than value added or employment: almost half of total ICT BERD (44.18%) is made in the United States. The EU

---

*Note: ICT totals correspond to the operational definition of ICT sector.*


*Source:* Eurostat, elaborated by Ivie and JRC-IPTS.
follows representing 17.51% of the total, close to the 16.50% contribution of Japan, and the even smaller contribution of Korea (7.80%) and China (5.61%). These five countries represent 91.00% of total ICT BERD undertaken by the thirteen countries under consideration.

- The absence of reliable data for the US limits the interest of the information of the contribution of the twelve remaining countries to total ICT R&D personnel (excluding the US). For those countries the EU presents the second highest share in 2010, only behind China, followed by Japan, Korea, Taiwan and Canada.

Finally, Table 4–1 presents the main variables analysed in this chapter.

**Table 4—1: Summary table of ICT indicators for the European Union and other economies (2010)**

<table>
<thead>
<tr>
<th>ICT total:</th>
<th>Value added (Millions of current PPS)</th>
<th>Employment (thousand persons employed)</th>
<th>BERD (Millions of current PPS)</th>
<th>R&amp;D personnel (thousand full-time equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU-27</td>
<td>450,039.04</td>
<td>5,389.28</td>
<td>23,553.33</td>
<td>248.88</td>
</tr>
<tr>
<td>United States</td>
<td>595,300.44</td>
<td>3,587.76</td>
<td>65,133.81</td>
<td>-</td>
</tr>
<tr>
<td>Japan</td>
<td>165,811.00</td>
<td>2,449.63</td>
<td>18,970.17</td>
<td>163.37</td>
</tr>
<tr>
<td>Norway</td>
<td>5,952.04</td>
<td>64.48</td>
<td>450.48</td>
<td>5.02</td>
</tr>
<tr>
<td>Switzerland</td>
<td>12,007.08</td>
<td>137.48</td>
<td>783.50</td>
<td>7.53</td>
</tr>
<tr>
<td>Australia</td>
<td>22,705.24</td>
<td>254.49</td>
<td>980.38</td>
<td>11.33</td>
</tr>
<tr>
<td>Brazil</td>
<td>47,918.25</td>
<td>1,887.15</td>
<td>1,148.80</td>
<td>10.44</td>
</tr>
<tr>
<td>Canada</td>
<td>39,193.66</td>
<td>459.11</td>
<td>2,444.72</td>
<td>36.64</td>
</tr>
<tr>
<td>China</td>
<td>364,685.94</td>
<td>12,709.09</td>
<td>14,108.30</td>
<td>258.21</td>
</tr>
<tr>
<td>India</td>
<td>149,228.00</td>
<td>4,257.53</td>
<td>1,193.93</td>
<td>26.87</td>
</tr>
<tr>
<td>Korea</td>
<td>89,108.19</td>
<td>1,077.00</td>
<td>16,010.4</td>
<td>110.25</td>
</tr>
<tr>
<td>Russia</td>
<td>55,618.91</td>
<td>1,049.19</td>
<td>205.61</td>
<td>7.66</td>
</tr>
<tr>
<td>Taiwan</td>
<td>76,814.02</td>
<td>931.62</td>
<td>9,611.68</td>
<td>101.11</td>
</tr>
</tbody>
</table>

**Note:** ICT totals correspond to the operational definition of ICT sector.


**Source:** Eurostat, elaborated by Ivie and JRC-IPTS.
List of Abbreviations Used

BERD: Business Expenditure on R&D
BRDIS: Business R&D and Innovation Survey
DG CONNECT: Directorate General for Communications Networks, Content and Technology
EU: European Union
EUR: Euros
Eurostat: Statistical Office of the European Communities
FTE: Full-time equivalent
GDP: Gross domestic product
ICT: Information and Communication Technologies
ISIC: International Standard Industry Classification
Ivie: Valencian Institute of Economic Research
JRC-IPTS: Institute for Prospective Technological Studies
MS: Member State
NACE: Nomenclature statistique des activités économiques dans la Communauté européenne
OECD: Organisation for Economic Co-operation and Development
PPS: Purchase Power Standard
PREDICT: Prospective Insights on R&D in ICT
R&D: Research and Development
SIRD: Survey of Industrial Research and Development
SNA: System of National Accounts
US: United States
VA: Value added
List of Definitions

BERD: Intramural expenditures on R&D performed within business enterprise sector during a specific period, whatever the source of funds (Frascati Manual).

BERD intensity: BERD/GDP.

Business R&D personnel: All persons employed directly on R&D by business enterprise sector, as well as those providing direct services such as R&D managers, administrators and clerical staff. Those providing indirect services, such as canteen and security staff, should be excluded (Frascati Manual).

Business R&D researchers: Business enterprise sector’s professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned (Frascati Manual).

Full-time equivalent (FTE): A full-time equivalent corresponds to one year’s work by one person. Consequently, someone who normally spends 40% of his or her time on R&D and the rest on other activities (e.g. teaching, university administration or counselling) should be counted as only 0.4 FTE.

Employment: Number of persons employed. In the SNA is defined as all persons, both employees and self-employed, engaged in some productive activity that falls within the production boundary of the SNA and that is undertaken by a resident institutional unit.

GDP: Measures the total final market value of all goods and services produced within a country during a given period. GDP is the most frequently used indicator of economic activity and is most often measured on an annual or quarterly basis to gauge the growth of a country’s economy between one period and another.

GDP deflator: Implicit price deflator for GDP is calculated as GDP at current prices divided by GDP at “constant prices” (chained volume estimates or fixed-base volume estimates, depending on countries).

ICT BERD intensity: ICT BERD/ICT VA.

ICT manufacturing industries: Manufacture of electronic components and boards (NACE 261), Manufacture of computers and peripheral equipment (NACE 262), Manufacture of communication equipment (NACE 263), Manufacture of consumer electronics (NACE 264), and Manufacture of magnetic and optical media (NACE 268).

ICT sector comprehensive definition: this definition is available mainly for EU Member States for the period 2008-2010. It corresponds to the definition given by the OECD in 2007. This definition includes ICT manufacturing industries, ICT trade industries and ICT services industries. Data in accordance with this classification are not available for some non-EU countries. See OECD definition: http://www.oecd.org/science/sci-tech/38217340.pdf.

ICT sector employment: all employed people in the ICT sector definition given by the OECD in 2007.

ICT sector operational definition: this definition allows for an international comparison with non-EU countries over a longer period of time (2006-2010), as some of these countries do not have the necessary disaggregated information to estimate all the ICT sub-sectors included in the comprehensive definition. This definition takes into account the standard distinction between manufacturing and services, but does not include the following sectors: Manufacture of magnetic and optical media (268) and ICT trade industries (465). In addition, ICT services industries are only available for two sub-sectors: Telecommunication (61) and the aggregate Computer and related activities (5820, 62, 631, 951). See Technical report: http://ftp.jrc.es/EURdoc/JRC77364.pdf.
**ICT services industries:** Software publishing (NACE 5820), Telecommunications (NACE 61), Computer programming, consultancy and related activities (NACE 62), Data processing, hosting and related activities; web portals (NACE 631), Repair of computers and communications equipment (951).

**ICT trade industries:** Wholesale of computers, computer peripheral equipment and software (NACE 4651), Wholesale of electronic and telecommunications equipment and parts (NACE 4652).

**ICT total services:** ICT trade industries and ICT services industries.

**Labour productivity:** Is defined as value added per unit of labour input (persons employed).

**Member States:** Member States of the European Union up to 2012: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

**New Member States:** 2004 and 2007 European Union Eastern enlargements consisting of Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

**Other economies:** countries included for the non-European comparison using the ICT sector operational definition (see definition above), consisting of: Australia, Canada, China, Brazil, India, Japan, Korea, Norway, Russia, Switzerland, Taiwan, and United States.

**Purchasing Power Standard (PPS):** The artificial currency unit in which the PPPs and real expenditures for the European Union are expressed – namely, euros at average EU price levels. Euros at average EU price levels are euros that have the same purchasing power over the whole of the European Union. Their purchasing power is a weighted average of the purchasing power of the national currencies of EU Member States. As such they reflect the average price level in the European Union or, more precisely, the weighted average of the price levels of EU Member States. PPS are defined by equating the total real expenditure of the European Union on a specific basic heading, aggregation level or analytical category to the total nominal expenditure of the European Union on the same basic heading, aggregation level or analytical category.

**Value added:** In the SNA is defined as the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry or sector.
Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*): 00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server http://europa.eu.

**How to obtain EU publications**

Our publications are available from EU Bookshop (http://bookshop.europa.eu), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

---

**European Commission**

**EUR 26828 EN – Joint Research Centre – Institute for Prospective Technological Studies**

**Title:** The 2013 PREDICT Report: An Analysis of ICT R&D in the EU and Beyond

**Authors:** Matilde Mas and Juan Fernández de Guevara Radoselovics

**Luxembourg: Publications Office of the European Union**

2014 – 73 pp. – 21.0 x 29.7 cm

**EUR – Scientific and Technical Research series – ISSN 1831-9424 (online)**


doi:10.2791/12522
JRC Mission

As the Commission’s in-house science service, the Joint Research Centre’s mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society  
Stimulating innovation  
Supporting legislation

doi:10.2791/12522  