Presentation of the Key Findings of the Study on the Competitiveness of the EU Engineering Industries and the Impact of Digitalisation

Olivier Coulon, Associate Consultant

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Thought Leaders Program by IPC

I) Study objectives and scope

Context

The **"Study on the Competitiveness of the EU Engineering Industries and the Impact of Digitalisation"** was commissioned by the **Executive Agency for Small and Medium-sized Enterprises (EASME) of the DG GROW (European Commission).**

The study was undertaken between June 2019 and November 2020 by CSES, KMU Forschung Austria, IDEA Consult, Prognos and DECISION.

This presentation summarises the key findings.

Scope

The geographic scope was the **EU-27 plus the UK** and selected third countries: **the U.S., Japan, South Korea and the BRICs** (Brazil, Russia, India and China).

The sectoral scope covers the **definition of the EU engineering industries** (2-digit NACE level codes in the statistical revision NACE Rev. 2 business nomenclature).

The time scope was 2008-2017, though, where possible, more recent **data for 2018-2020 was included**. Given the sizeable impacts of COVID-19 on short to medium-term industrial competitiveness, the pandemic's impacts to date were assessed.

Objectives

The main study objective was to provide an assessment of the **competitiveness of the electrical, electronic and mechanical engineering industries at European** level across the 27 European Union (EU) Member States (+UK) . The specific aims were to:

- Provide an **assessment of the competitiveness** of the European engineering industries (electronic, electrical and mechanical);
- Map and analyse the **baseline situation in terms of market size and structure** and analyse key competitiveness drivers and inhibitors;
- **Assess the impact of digitalisation and Industry 4.0** on the competitiveness of the European engineering industry overall, and at a sub-sectoral level;
- Provide a **comparative assessment of the situation internationally** by benchmarking with major global competitor countries.
- Identify **future scenarios for the next 10 years** in terms of the evolution of the competitiveness and regulatory situations, and the extent of digitalisation; and
- Analyse **the impacts of the COVID-19 pandemic on the EU engineering industries** in the short and medium term.

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II) ECONOMIC AND COMPETITIVENESS ANALYSIS OF THE EU'S ELECTRONIC, ELECTRICAL AND MECHANICAL ENGINEERING INDUSTRIES

Sectoral structure of the engineering industries in the EU-27 + UK, 2018

	Enterprises	Persons employed	Turnover in € million	Value added in € million
Fabricated metal products, except machinery and equipment	400,332	3,846,275	530,043	184,136
Computer, electronic and optical products	41,003	1,104,050	406,666	85,500
Electrical equipment	44,985	1,515,222	326,597	96,000
Machinery and equipment n.e.c.	87,592	3,146,677	764,819	224,748
Medical and dental instruments and supplies	65,400	531,065	84,062	33,432
Repair and installation of machinery and equipment	214,157	1,301,978	179,388	63,000
Engineering industries total	**853,469**	**11,445,267**	**2,291,575**	**686,816**

[1] Latest available year; data on value added is available only for 2017
Source: Eurostat, Structural Business Statistics; own calculations; Status: August 2020

Sectoral performance

In terms of market performance (turnover, GVA) in the 2013-2018 period, while **all engineering industries experienced positive annual growth rates**, **the sub-industries of computer, electronic and optical products**, as well as medical and dental instruments and supplies **have experienced higher growth levels in the previous decade**.

However, these two industries are still relatively small in Europe and the engineering sector is still dominated by the manufacture of fabricated metal products and manufacture of machinery and equipment. In contrast, in **most Asian countries, value-added in the engineering industries grew faster than in the EU**, but in two of the major competitor countries – Japan and the U.S. – value added grew at around the same pace.

Regarding the evolution in competitiveness across different sub-sectors, **Europe has strengthened its competitiveness in mechanical engineering and in niche sub-sectors, such as specialist semi-conductors and cyber-secure sensors** in sectors such as the automotive industry and medical instruments.

However, the EU engineering industries have lost ground to the U.S., China and certain other Asian countries in electronic components and mass-produced semi-conductors. Overall, **unit labour costs in the EU's engineering industries remain considerably above those in key competitor countries**.

Patent applications at EPO by field of technology, 2009-2018

Field of technology[2]	2009	2018	Change 09-18 in %	Average annual change 09-13 in %	Average annual change 13-18 in %
Electrical engineering:	**37,045**	**48,612**	**31.2**	**3.3**	**2.9**
Electrical machinery, apparatus, energy	7,658	10,722	40.0	7.3	1.1
Audio-visual technology	4,678	4,171	-10.8	-3.9	0.9
Telecommunications	5,254	3,819	-27.3	-8.6	0.8
Digital communication	6,478	11,940	84.3	9.7	4.9
Basic communication processes	1,072	932	-13.1	-3.9	0.4
Computer technology	7,780	11,718	50.6	4.2	5.1
IT methods for management	1,237	2,378	92.2	8.0	7.2
Semiconductors	2,888	2,932	1.5	2.7	-1.8
Engineering industries (total)	**79,408**	**105,392**	**32.7**	**3.0**	**3.3**

Note: data available only from 2009 onwards (no data available for 2008)
[1] European patent applications include direct European applications and international (PCT) applications that entered the European phase during the reporting period.
[2] The definition of the fields is based on the WIPO IPC technology concordance.
Source: EPO Statistics, 2019

- In 2018, there were more than 105,000 patent applications in the field of engineering industries at the EPO. Thereof, 46% were patent applications in electrical engineering, 37% in mechanical engineering and 17% in instruments (optical, medical technology).
- The highest growth rates in patent applications since 2009 can be observed in IT methods for management, computer technology, digital communication, other special machines, electrical machinery/apparatus/energy, as well as medical technology.
- The highest annual average growth rates since 2014 can be found in other special machines (+7.8%), medical technology (+5.3%) and computer technology (+4.6%).

Production value of the engineering industries in the EU-27 + UK by sectors, 2019

	Value in € million 2019	Share in Engineering industries in % 2019	Average annual change 2008-2013 in %[1]	Average annual change 2013-2019 in %[1]
Fabricated metal products, except machinery and equipment	372,621	24	-3.0	2.3
Computer, electronic and optical products	209,386	13	-3.7	2.5
Electrical equipment	226,409	14	-2.2	1.9
Machinery and equipment n.e.c.	535,515	34	-1.7	1.3
Medical and dental instruments and supplies	51,426	3	1.4	2.3
Repair and installation of machinery and equipment	179,632	11	n/a	0.9
Engineering industries total	**1,574,989**	**100**	**-2.4**	**1.9**

[1] Development is in 2015 prices: Total output price index (Short-term business statistics for industry, excluding NACE 33 (Repair and installation of machinery and equipment)
Source: Eurostat, Statistics on the production of manufactured goods (PRODCOM); own calculations; September 2020

- In 2019, according to PRODCOM data on industrial production, the production value of the engineering industries12 of the 27 EU countries plus UK amounted to approx. € 1,600 billion. The largest share of production value for the EU engineering industries can be attributed to the manufacture of machinery and equipment n.e.c (34%), followed by the manufacture of fabricated metal products (24%).

- While the production value decreased taking the annual average for the period 2008 to 2013 in real terms in most sectors, all sectors experienced positive annual growth between 2013 and 2019.

- Between 2008 and 2013, the manufacture of computer, electronic and optical products had the highest decline among the sectors of the engineering industries. It had also the highest increase between 2013 and 2019.

International trade (extra-EU) of engineering goods of the EU-27 + UK. 2008-2019

	2019 (Value in € million)	Share in engineering goods in %	Average annual change[1] 2008-13 in %	Average annual change[1] 2013-19 in %
Extra-EU imports				
Tube or pipe fittings of iron or steel	1,682	0.3	-2.8	2.5
Fabricated metal products. except machinery and equipment	46,201	7.7	3.8	5.5
Computer. electronic and optical products	290,655	48.3	-0.4	4.2
Electrical equipment	106,072	17.6	3.4	6.2
Machinery and equipment	125,709	20.9	-1.7	6.0
Medical and dental instruments and supplies	31,766	5.3	7.0	3.3
Engineering Industries total (incl. tubes or pipe fittings)	602,085	100.0	0.5	4.9
Extra-EU exports				
Tube or pipe fittings of iron or steel	2,616	0.4	-1.1	-4.5
Fabricated metal products. except machinery and equipment	51,358	8.0	6.2	0.1
Computer. electronic and optical products	167,196	26.2	0.2	4.4
Electrical equipment	105,303	16.5	1.7	1.8
Machinery and equipment	270,778	42.4	2.0	1.2
Medical and dental instruments and supplies	41,333	6.5	8.6	4.3
Engineering Industries total (incl. tubes or pipe fittings)	638,584	100.0	2.1	2.2

Note: Data is based on the CN-classification and engineering goods as defined in the frame of the present study; tube or pipe fittings have been added
[1] Annual changes are based on 2015 prices.
Source: Eurostat. International trade in goods; own calculations

- Since 2011, exports of engineering goods have been performing distinctly better than EU exports overall, particularly since 2016. Looking specifically at extra-EU exports, there was an average annual growth for total engineering products of 5.7% in the 2013-2018 period. The (relatively small) medical instruments industry experienced the most dynamic development of exports markets, followed by computer, electronic and optical products, which was ranked second in terms of growth rates.

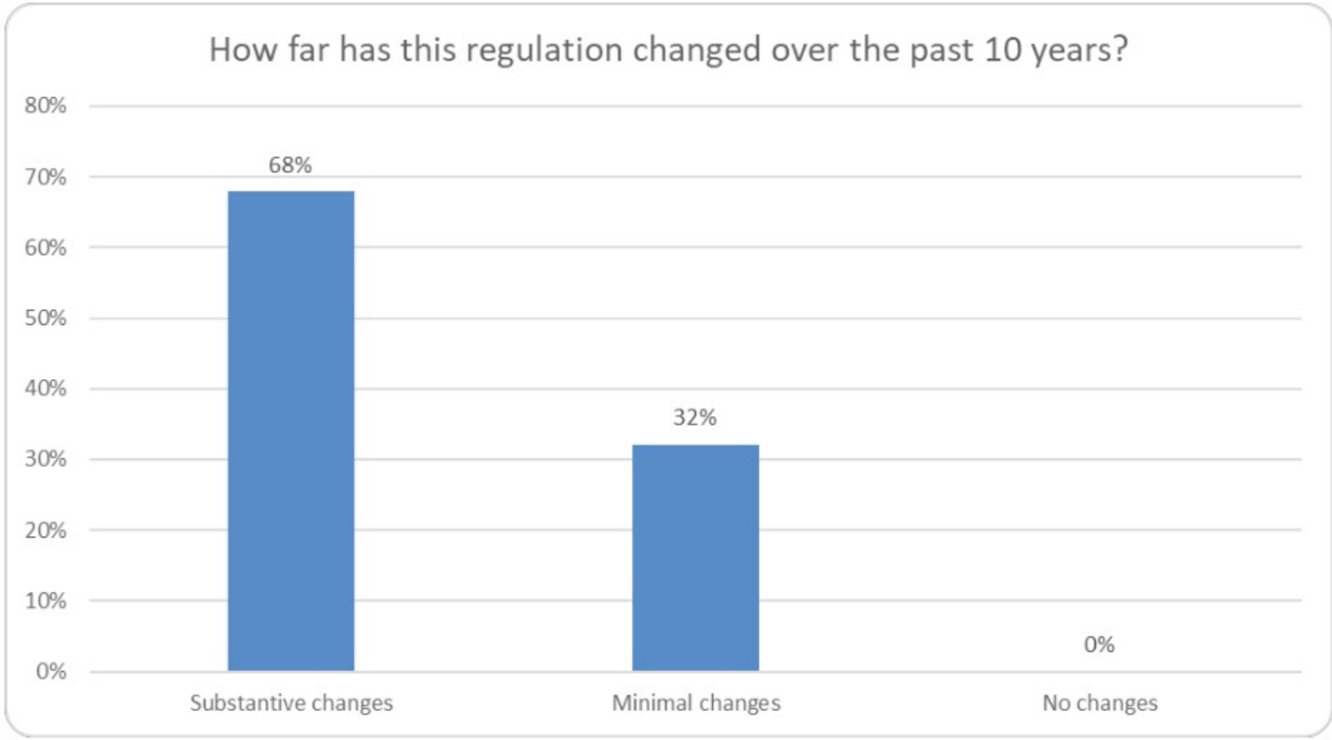
- However, exports of machinery and equipment still account for the majority of extra-EU engineering exports (43%) and the EU has a high global market share. However, while exports of computer, electronic and optical products experienced some growth, this is still the only product category where the EU has a negative trade balance and achieved a low market share in comparison to its main competitors in Asia and America.

- In Europe, electronics production was found to be oriented towards embedded devices and intermediate sectors, such as automotive electronics, industrial, building and service electronics, medical electronics, aerospace, defence and security. Contrastingly, in Asia, the production structure has mostly been driven by mass-market, consumer-type products such as TVs, smartphones and PCs. Whereas the EU is not present in mobile phone manufacturing, it has a strong competitive position in the infrastructure equipment segment globally.

  Within the computer, electronic and optical products engineering subsector (NACE 26), EU engineering companies are world leaders in niche markets, such as microscopes, and regulating and controlling instruments, yet have a low market share regarding the production of integrated circuits and semi-conductors.

III) REGULATORY ANALYSIS OF EU LEGISLATION AFFECTING THE EU'S ELECTRONIC, ELECTRICAL AND MECHANICAL ENGINEERING INDUSTRIES

Impacts of EU regulation on the European engineering industry



Source: CSES' Survey of testing and certification bodies (incl. notified bodies) and MSAs

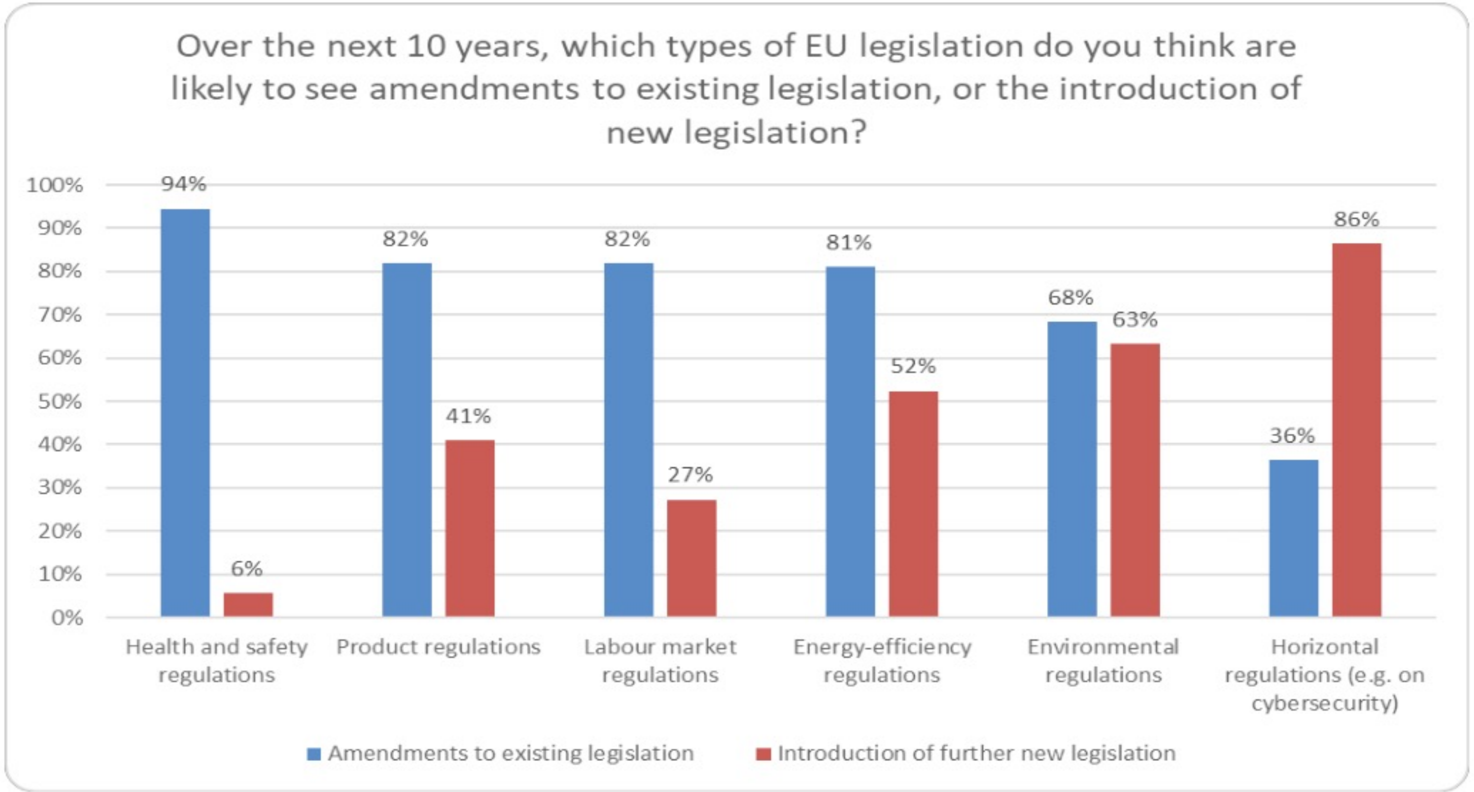
- The core applicable EU industrial product legislation was perceived by industry stakeholders to be working effectively overall.

  The EU legal framework was seen to have provided stability and regulatory certainty, and comparatively greater flexibility as to how to comply compared with regulatory jurisdictions in third countries.

- The principles that underpin industrial product legislation characterised in the New Approach and the New Legislative Framework (NLF) were seen positively.

  These approaches have kept the legislation technology-neutral and harmonised standards have been used as a mechanism to accommodate risks linked to new technologies. Such standards were considered to be the optimal way to address the 'state of the art'.

Impacts of EU regulation on the European engineering industry



Source: CSES' survey of testing and certification bodies (incl. notified bodies) and MSAs

- Looking ahead, there were seen to be opportunities associated with the updating of EU legislation concerned with new technologies. There was a preference to avoid recasting EU legislation to incorporate digitalisation and any risks associated with using new technologies in production processes, or in the industrial products being manufactured. Harmonised standards were instead seen as an effective means to address these concerns.

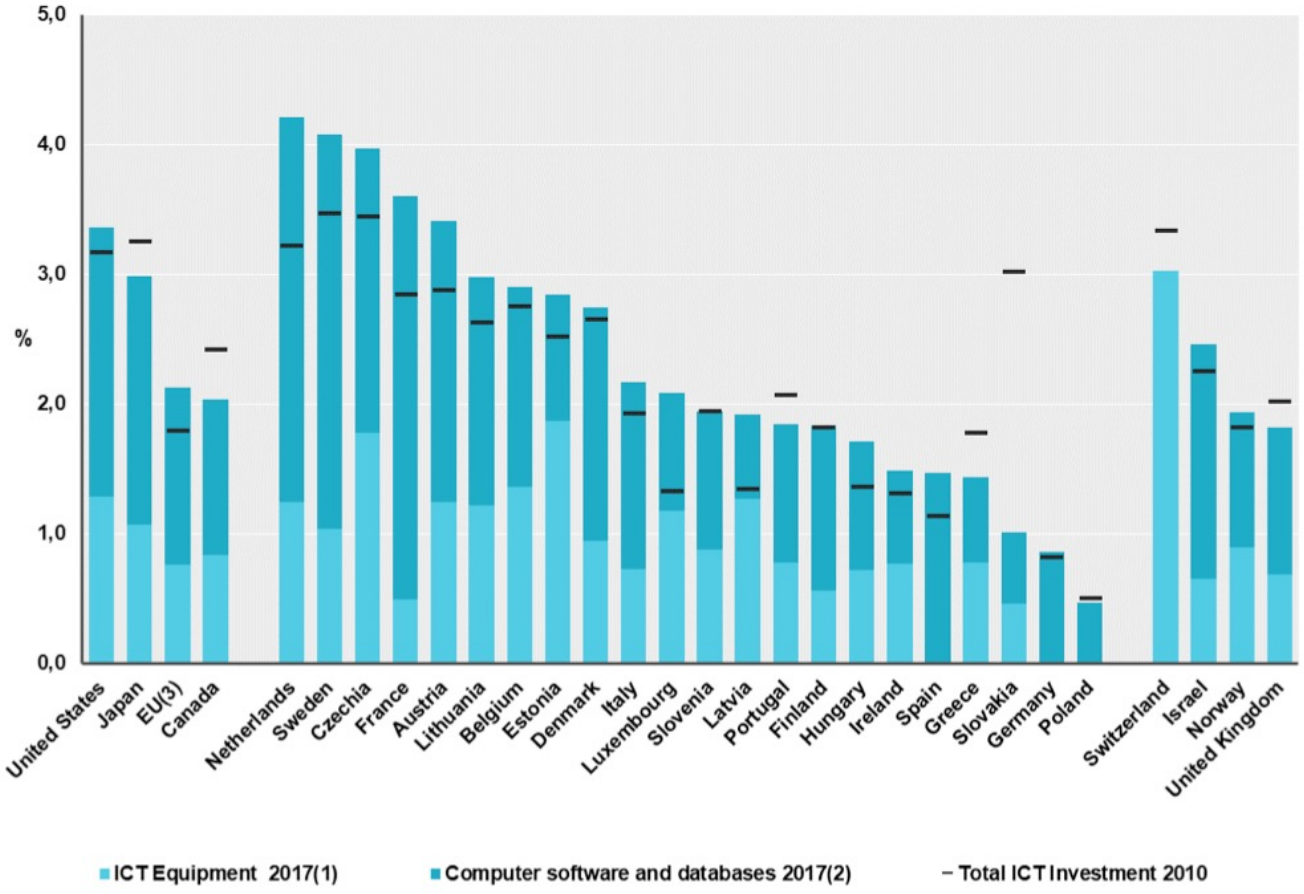
- However, there was some support for horizontal EU legislation to address considerations such as cybersecurity, AI and the digitalisation of production processes.

- Additionally, there were concerns that new environmental legislation, such as the Carbon Border Adjustment Mechanism, and a possible extension to environmental reporting requirements within existing EU environmental legislation, such as in the areas of waste, electronics recycling, etc. could lead to additional administrative burdens on industry.

IV) IMPACTS, CHALLENGES AND OPPORTUNITIES OF DIGITALISATION OF THE EU'S ELECTRONIC, ELECTRICAL AND MECHANICAL ENGINEERING INDUSTRIES

Impacts of digitalisation on the European engineering industry

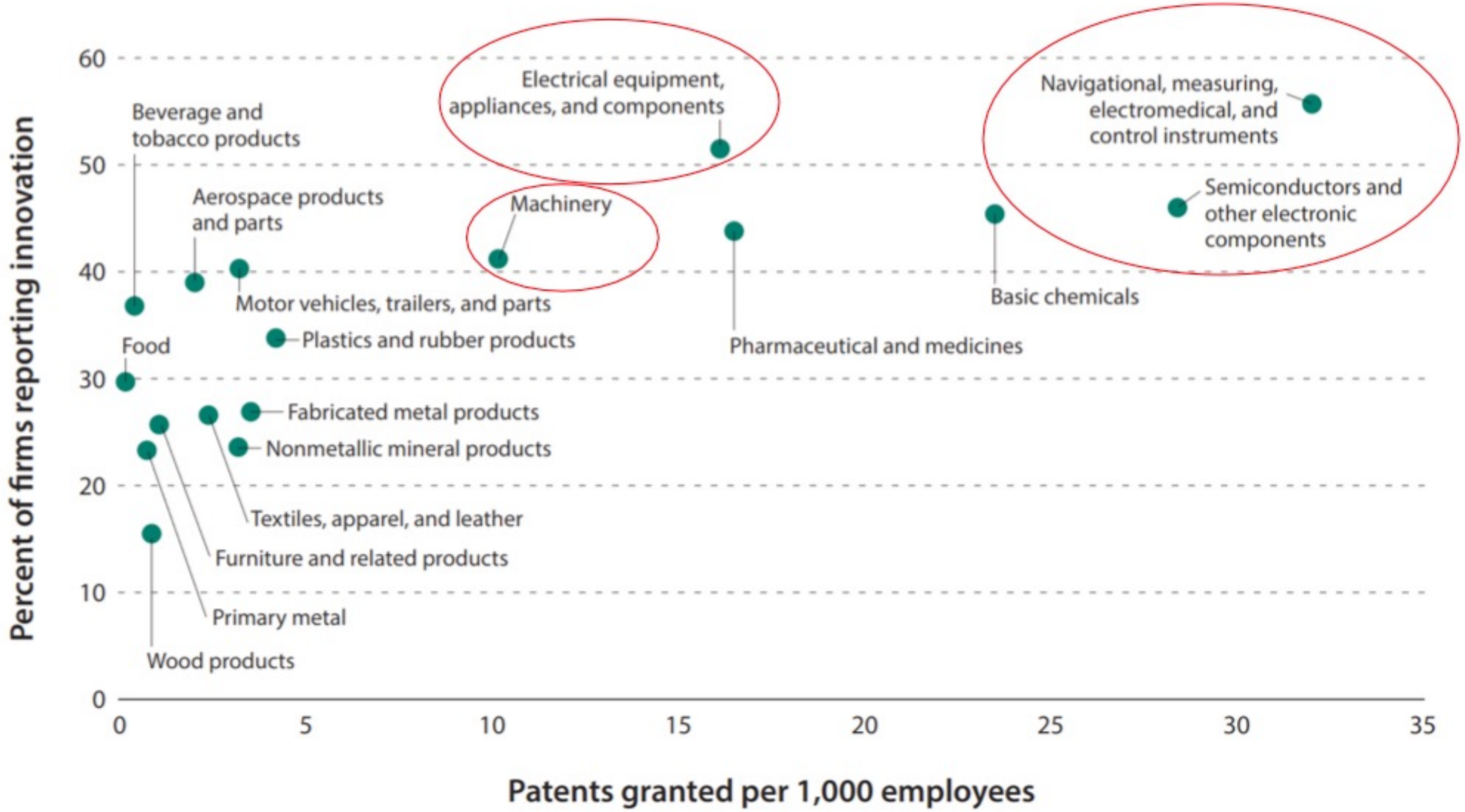
Investment in ICT as % of GDP by country, 2010 and 2017



Source: OECD (Capital formation by activity ISIC Rev4) and Eurostat (online data code: nama_10_gdp).
Note: (1) DK: 2015. LV, NO: 2016. (2) DK, EE, EL, PL: 2015. IE, ES, LV, PT, SE, NO: 2016. (3) EU value estimated with the available countries.
The number of countries is not the same in both categories.
Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter54/figure-54-3.xlsx

Impacts of digitalisation on the European engineering industry

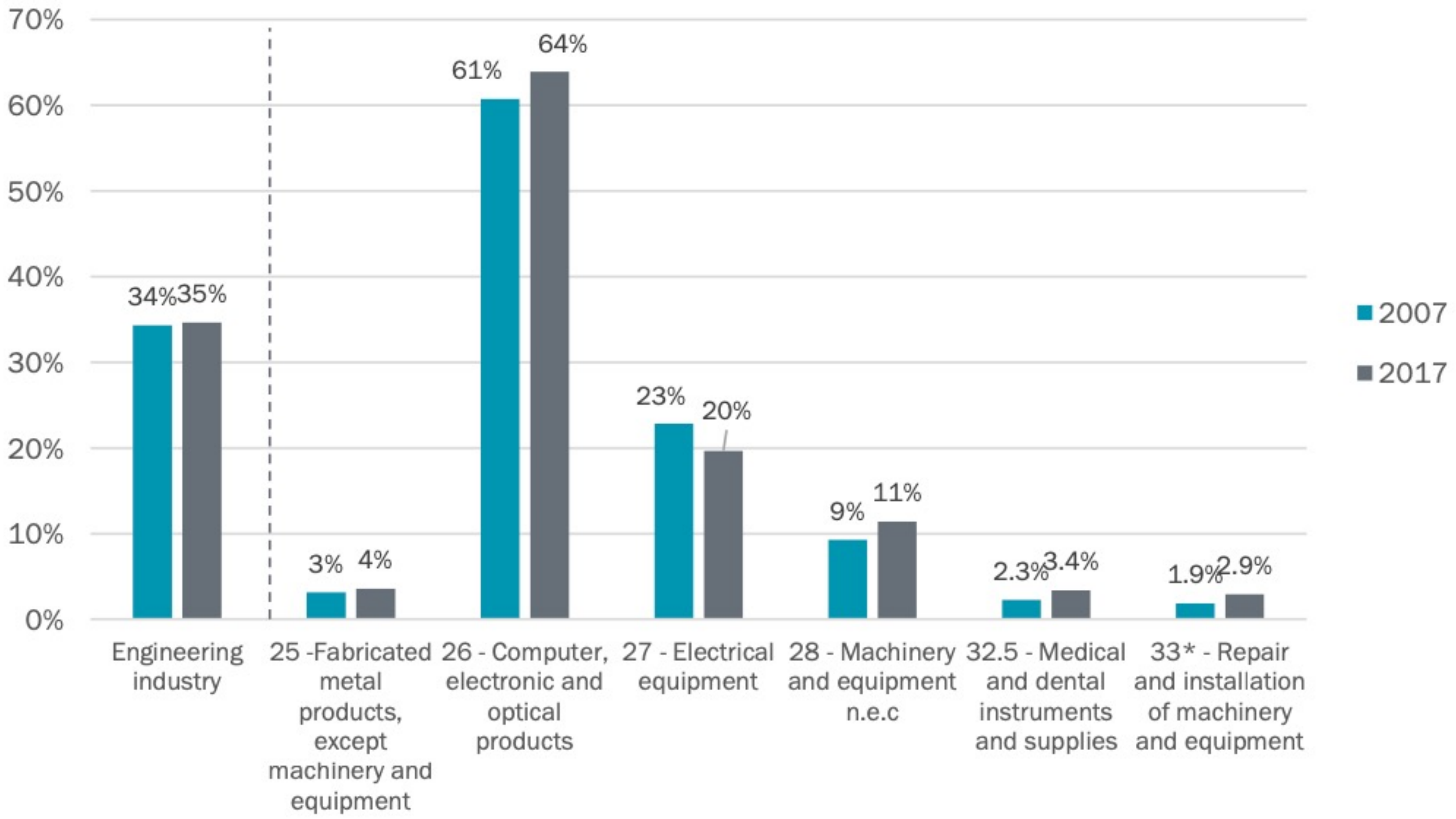
Patents Granted per 1,000 Employees and Share of Firms Reporting Innovation



Source: Shambaugh J., Nunn, R. & Portman, B.(2017): Eleven Facts about Innovation and Patents. The Hamilton Project. p.2.

Impacts of digitalisation on the European engineering industry

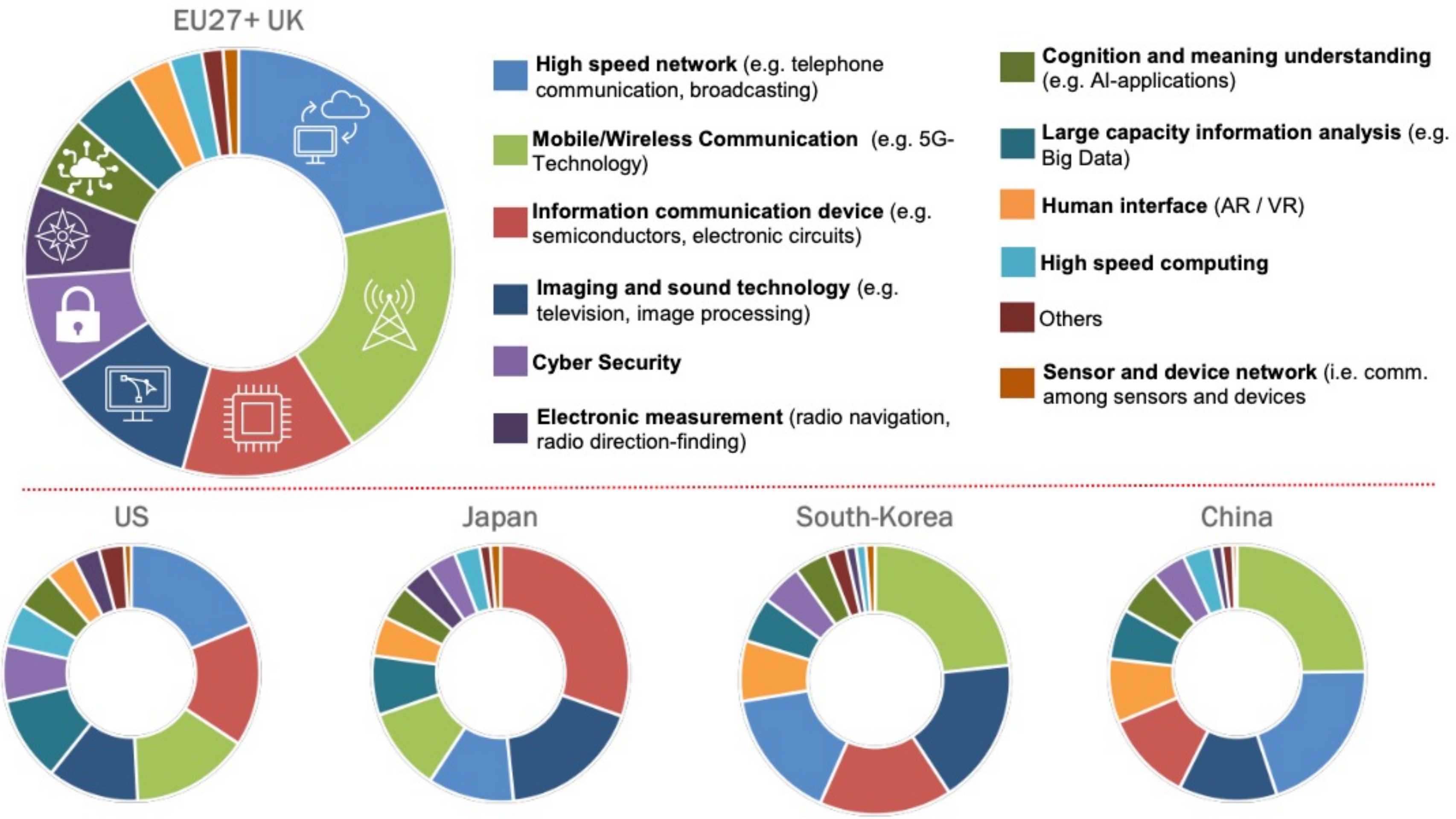
Estimated share of digital patents in all patents in the sub-sectors of the EU engineering industry, 2007 vs. 2017



Source: Prognos AG (2020) based on PATSTAT, Inaba, T. & Squicciarini, M. (2017) and Lybbert & Zolas (2014).
**For sub-sector 33 a different approach was used for the computation of the digitalisation share (see Annex 8: Technical Methodological Note).*

Impacts of digitalisation on the European engineering industry

Technological focus of the regions' digital patents for the "Manufacture of computer, electronic and optical products", 2017



Source: Prognos AG (2020) based on PATSTAT, Inaba, T. & Squicciarini, M. (2017) and Lybbert & Zolas (2014)

Impacts of digitalisation on the European engineering industry

- **Digitalisation has already had a significant impact on the European engineering industry, a trend likely to be accentuated in future due to the digital transition**. Digitalisation has been integrated into the organisation of manufacturing through the creation of digitalised production hubs, which gather big data across factories situated in different countries in Europe and globally to optimise production efficiencies. They have also been integrated into advanced engineering production processes, for instance through the growing use of Artificial Intelligence (AI), machine learning, robotisation and automation.

- The **EU engineering industries are a relatively important user of digital applications**. Yet digitalisation poses a number of challenges for engineering enterprises in terms of increasing the level of uptake to catch up with global competitors, technology choices, investment capacity, business model development and skills.

- One of the main findings was that, whilst the **EU engineering industry remains a strong innovator, it appears to be less dynamic in (digital) patenting activities compared to its global competitors**. Innovations from the EU engineering industries address significantly fewer digital technologies compared to major global competitors. However, relative strengths in digital patenting can be observed in European countries such as Sweden and Finland.

- Digitalisation is leading to **new capital-intensive production methods involving robotisation, the IIoT, artificial intelligence (AI)** within a wider ‘eco-system’ of advanced engineering and ICT skills, finance, and knowledge centres. It is expected that the digitalisation wave will continue in the future and that **investments will be increasingly geared towards digital applications and business opportunities, especially in the software** segments of the value chain.

  The widespread adoption of such technologies has the **potential to reduce new offshore outsourcing of manufacturing** in future. However, although there is scope for digitalisation to reshore some high value added manufacturing activities to the EU, it is unrealistic to expect much production to be brought back to Europe from East Asia, given overall cost competitiveness of offshoring production (especially labour cost differentials) and the high efficiency of factories in East Asia, where Industry 4.0 technologies are already the norm.

V) FUTURE SCENARIO ANALYSIS AND STRATEGIC OUTLOOK

Impacts of digitalisation on the European engineering industry

- Among the opportunities for the future development of the European engineering industries are the scope for **increased collaboration between different sectors in the value chain**. An example is the close ties between the automotive and metal production and processing industries in Europe. As many EU engineering companies are SMEs, collaboration is becoming an increasingly important competitiveness factor, helping them to remain competitive, innovate, digitalise and adapt to new business models.

- A further opportunity is the necessity of **increased digitalisation** to ensure the competitiveness of the EU engineering industries. Digitalisation is key to maintaining Europe's industrial competitiveness, by optimising operating efficiencies across different production hubs, identifying production problems earlier and harnessing the potential of Industry 4.0 technologies. The research found evidence that a lower percentage of Europe's SMEs have adopted Industry 4.0 technologies and incorporated digitalisation, automation and robotisation into their production processes compared with Asia and US. Addressing this competitive gap will require capital investment and the strengthening of both advanced and lower-level digital skills. Achieving the digital transition quicker could also help to mitigate the economic impacts of the COVID-19 pandemic.

- **New business models** are likely to emerge in future. For example, the use of additive manufacturing technologies allows greater scope for product customisation. There are broader trends, such as a greater service orientation among manufacturers of industrial products in the engineering industries, with digitalisation enabling the acceleration of the transition to more integrated value chains. Customer-driven approaches and open innovation are among the key factors that will be key in enabling digital transition and greater service-oriented business models (known as 'servitization'). Such trends and developments will bring about new opportunities for EU engineering firms.

- The **European Green Deal and Circular Economy Action Plan** provide opportunities for engineering enterprises in Europe, for instance, through the cleantech industry and the fact Europe could become globally-leading in producing sustainable products, in recycling and in the sustainable use of raw materials. Relevant developments include the Sustainable Product (Policy) Initiative, a regulatory approach that could move beyond existing eco-design and energy labelling legislation, and incorporate other requirements to encompass a product lifecycle approach to fostering product sustainability.

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For more information:

- Olivier Coulon, Associate Consultant, DECISION Etudes & Conseil

ocoulon@decision.eu / +33 (0) 1 45 05 70 13