Monitoring industrial ecosystems

EU MEMBER STATES FACT SHEETS

Czech Republic

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EUROPEAN COMMISSION

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PDF ISBN: 978-92-9469-726-4 doi: 10.2826/083641 EA-05-24-009-EN-N

Luxembourg: Publications Office of the European Union, 2024

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Key Highlights

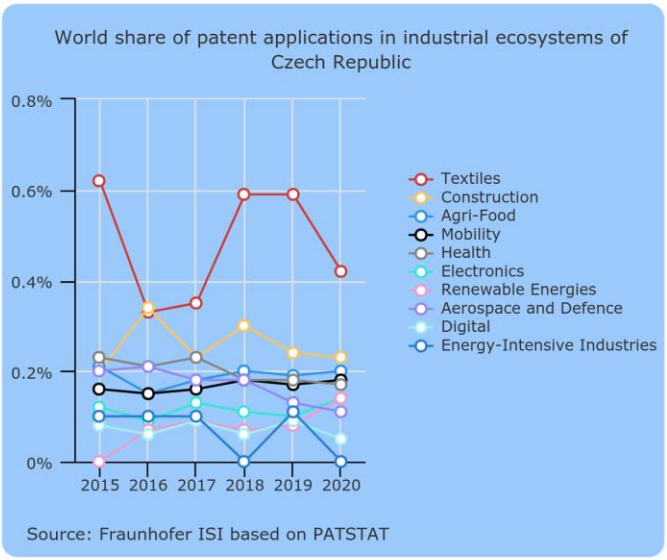
This country report has been developed as part of the '**European Monitor of Industrial Ecosystems'** project of the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and SMEs Executive Agency. It provides data insights into the twin transition and the technological performance of industrial ecosystems. The key findings of the report are summarised below:

Technological performance in industrial ecosystems:

- The Czech Republic had the highest country share of patent applications in the **Electronics, Agri-Food and Healthcare** industrial ecosystems.
- In a global comparison, it has some advantage in **Textiles**, in Construction, Agri-Food, and Mobility.

Digital and green transition technologies:

- Within the country, the Czech Republic has been the most specialised in generating technologies related to **Advanced Manufacturing and Robotics, Micro- and Nanoelectronics and Photonics and Internet of Things.** In the field of green technologies, the highest country share has been in **Advanced Materials and Renewable Energy Technologies**.
- Trends in the world's patent applications show that Czech Republic increased its global share in various green technology fields including Advanced Materials and Nanotechnology, Renewable Energy and Biotechnology.
- Trends over time indicate that Czech Republic decreased its global position in various digital technology fields over the period from 2010 to 2020. It had the largest drop in the Internet of Things from 2019 to 2020.



Capacity to produce goods based on digital and green technologies:

- The Czech share in the global production of digital technologies was the highest in the field of **Big Data and Artificial Intelligence,** where it has increased its production of related technology-based products over the period from 2010 to 2021.
- The Czech Republic expanded its share of production in green technologies in areas related to **Renewable Energy Technologies and Energy Saving Technologies.**

1. Introduction

This country report has been prepared within the '**European Monitor of Industrial Ecosystems' (EMI)** project, initiated by the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and SMEs Executive Agency (EISMEA). The overall goal of the project is to **analyse the green and digital transformation of industrial ecosystems**.

The EU's updated industrial strategy from May 2021[1] has outlined 14 industrial ecosystems that are in the focus of the project. The 14 industrial ecosystems include *aerospace and defence, agri-food, construction, cultural and creative industries, digital, electronics, energy intensive industries, energy-renewables, health, mobility – transport – automotive, proximity, social economy and civil security, retail, textile and tourism.* The industrial strategy defined industrial ecosystems as encompassing all players operating in a value chain: from the smallest startups to the largest companies, from academia to research, service providers to suppliers[2].

The objective of this report is to **present key findings from data** collected within the framework of this project at country level notably on **patent applications, production data, trade** (available only for ten industrial ecosystems)**, private equity and venture capital** investments. Nonetheless, this report does not aim to be comprehensive; the data presented here only complement other important statistics on technology development in each country.

The monitoring framework has a technological focus. Industrial transition is driven by technological, economic, and social changes, and in particular by digital technologies and the shift to a green and circular economy. The green and digital technologies that have been taken into account are presented in the table below.

Table 1: Technologies monitored in the project by patent, trade and prodcom data

Green technologies
Advanced Materials and Nanotechnology
Biotechnology (for sustainability)
Energy Saving Technologies
Renewable Energy Technologies
Solar Power
Wind Power
other (geothermal, hydropower, biomass)

Digital technologies
Advanced Manufacturing & Robotics
Advanced Manufacturing
Robotics
Artificial Intelligence
Big Data
Digital Security & Networks/ Cybersecurity
Digital Technology for Mobility
Internet of Things
Micro- and Nanoelectronics & Photonics
Micro- and Nanoelectronics
Photonics

Source: Technopolis Group, IDEA Consult and Fraunhofer ISI

The methodological report that sets the conceptual basis and explains the technical details of each indicator is available on the EMI website. This report was prepared by Emma Coroler, from Technopolis Group for the European Commission. However, it does not necessarily reflect the views of the European Commission.

2. Advanced technologies fostering the green and digital transition of industrial ecosystems

2.1. Data sources

This chapter outlines a set of indicators that capture the capacities of EU Member States to generate technologies that foster the green and digital transformation of industrial ecosystems. Industries that are underpinned by a strong technology basis and supported by vibrant entrepreneurial communities have better conditions for success. The production of technology-based products indicates that technologies are commercialised, while a positive trade balance in technologies is a sign of international competitiveness.

Patent analysis is a widely used method for tracking technological development activities. With a view to industrial ecosystems under study in this project, technology generation and hence patenting takes place in a relatively limited number of ecosystems, while others mainly profit from technologies generated elsewhere. Technology development drives industrial transformation in a general way. The patent analysis is based on transnational patents, notably those filed through the WIPO PCT procedure[1] or at the European Patent Office[2] directly. They have been localised based on the address of the applicant. The different advanced technologies have been identified based on International Patent Classification (IPC) codes and keyword searches.

Trade data, more specifically export data, is a further relevant indicator to document industrial development at higher technology readiness levels. It informs on countries' competitive advantage in specific technology-based product areas. While somewhat simplistic, export strengths in certain technological areas still mark a specific relevance of technology relevant goods for the economy and remain among the reliable indicators of performance. The analysis focuses on trade balances based on UN Comtrade[3] statistics processed specifically for the purposes of this project. The trade balance can help reveal how nations are intricately involved in supply chains with substantial imports and relevant exports. By putting exports in relation to parallel imports, it is possible to assess whether a country displays strength in production.

Prodcom data[4] allows the monitoring of technology diffusion. Prodcom provides statistics on the production of manufactured goods carried out by enterprises on the national territory of the reporting countries. It helps measuring the uptake of technology through the production of manufactured goods by focusing on the specific components and elements enabled by green and digital technologies. Production data allows to measure to what extent technology-related products are being produced in the country. The production indicators are calculated based on product-level data from the Eurostat's Prodcom database.

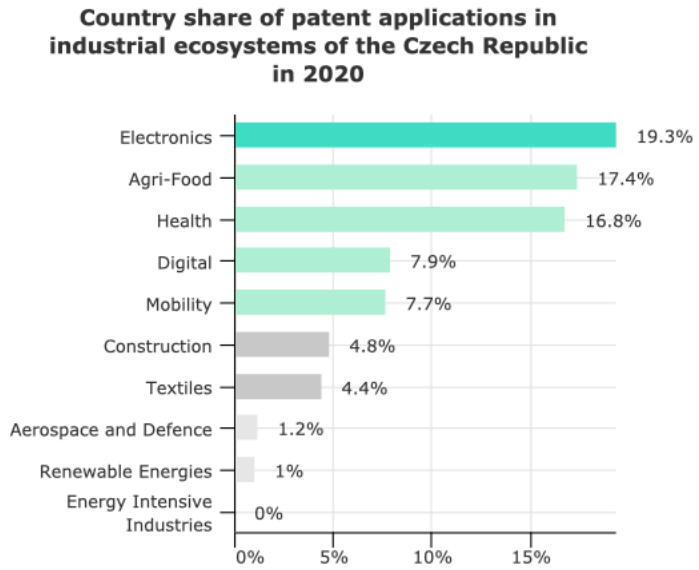
Crunchbase data[5] were used to analyse entrepreneurial dynamics and private equity and venture capital investment. Crunchbase is a widely trusted source of information on venture capital backed innovative companies. Technology startups represent key building blocks in the transition towards a more digital, green and resilient economic model. Entrepreneurial activity helps accelerate the diffusion of technologies in industrial ecosystems and startups that provide green and digital solutions are relevant indicators of how the industrial ecosystem is transforming itself to reach environmental sustainability objectives. More information about these data sources can be found in the methodological report of the project.

[1] World Intellectual Property Organization, WIPO Patent Cooperation Treaty (PCT) https://www.wipo.int/pct/en/
[2] European Patent Office, Supporting Innovation and Patents in Europe https://www.epo.org/en
[3] United Nations Comtrade, UN Comtrade Plus-International Trade Data Platform https://comtradeplus.un.org/
[4] Eurostat, Eurostat PRODCOM-European Union Production and Trade Statistics https://ec.europa.eu/eurostat/web/prodcom
[5] Crunchbase, Business Information and Networking Platform https://www.crunchbase.com/

2.2 Technology development in industrial ecosystems

Regarding technology development, the Czech Republic had the highest country share of patent applications in the Electronics, Agri-Food and Health industrial ecosystems in 2020 as captured by patent data. In a global comparison, it ranked relatively well in Textiles and in Construction and Mobility within the EU27 countries.

Figure 1: Czech Republic's country share and world share (expressed in terms of ranking) in patent applications in industrial ecosystems



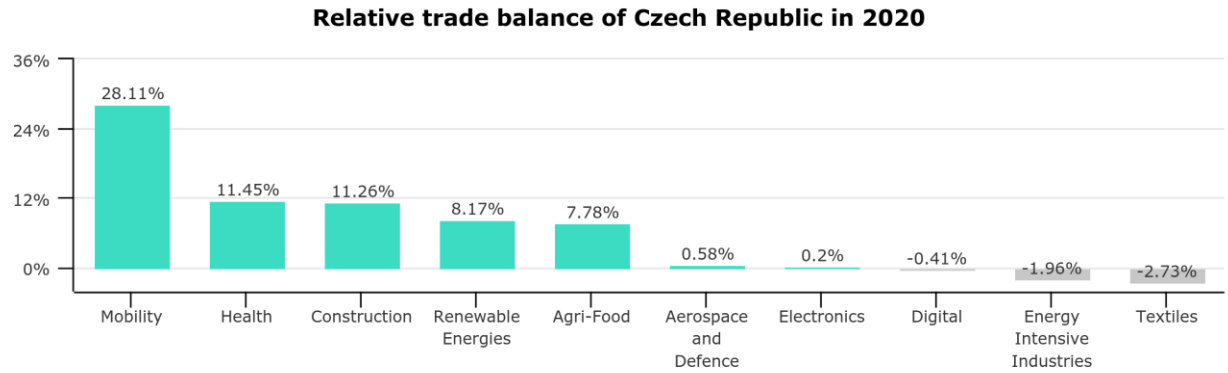
Ranking of Czech Republic within EU27 in terms of its share of global patent applications in 2020
(1 - best performer, 27 worst performer)

Textiles	**11**
Construction	12
Mobility	12
Electronics	13
Agri-Food	13
Health	14
Aerospace and Defence	15
Renewable Energies	15

Source: Fraunhofer ISI based on Patstat

Trade is a common indicator of international competitiveness because it shows how attractive a country's products are outside of its domestic market. Total exports provide evidence about a country's role as a producer, and trade balance captures its sovereignty in certain areas of production. Figure 2 displays the trade balance in relation to overall trade volume by technology development in industrial ecosystems. The Czech Republic registered a trade surplus in technology-based products related to Mobility, Health, Construction, Renewable Energies, Agri-Food, Aerospace and Defence, and Electronics in 2020.

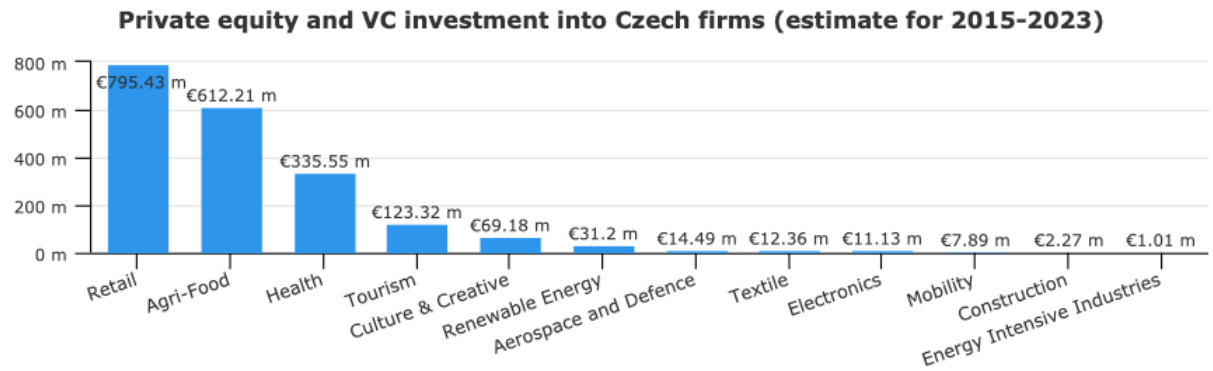
Figure 2: Trade balance in relation to overall trade volume ((exp - imp)/(exp+imp)) (2020)



Source: Fraunhofer ISI based on UNCOMTRADE

Most private equity and venture capital investment in the Czech Republic were directed towards innovative companies in the sector of Retail, Agri-Food and Health, over the period from 2015 to 2023.

Figure 3: Private equity and venture capital investment into tech companies related to industrial ecosystems in Czech Republic

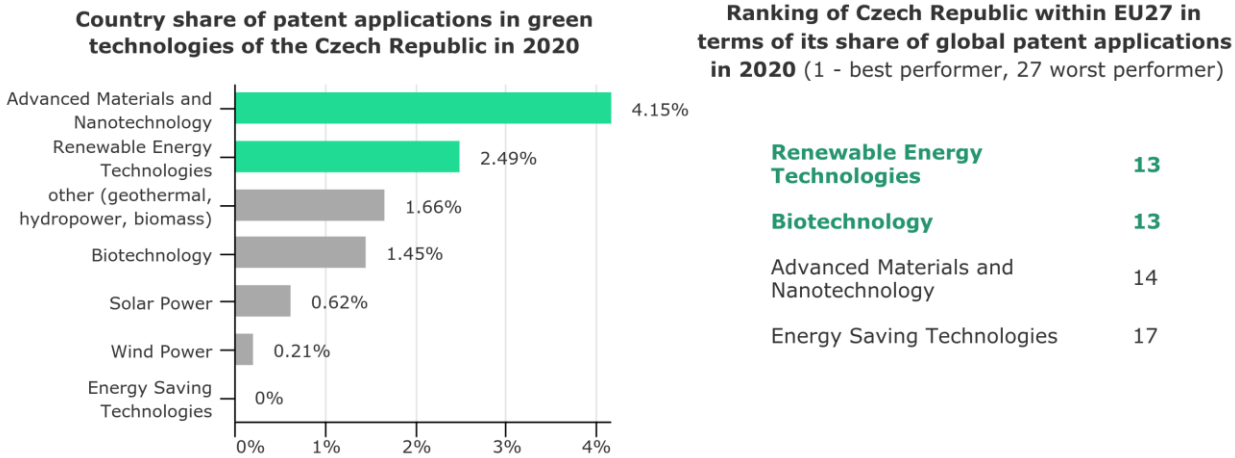


Source: Technopolis Group based on Crunchbase

2.3 Green transformation

The Czech Republic had the highest country share of patent applications in Advanced Materials and Nanotechnology and Renewable Energy Technologies. In the latter as well as in Biotechnology, it had some relative advantages also within the EU27 taking into account its size.

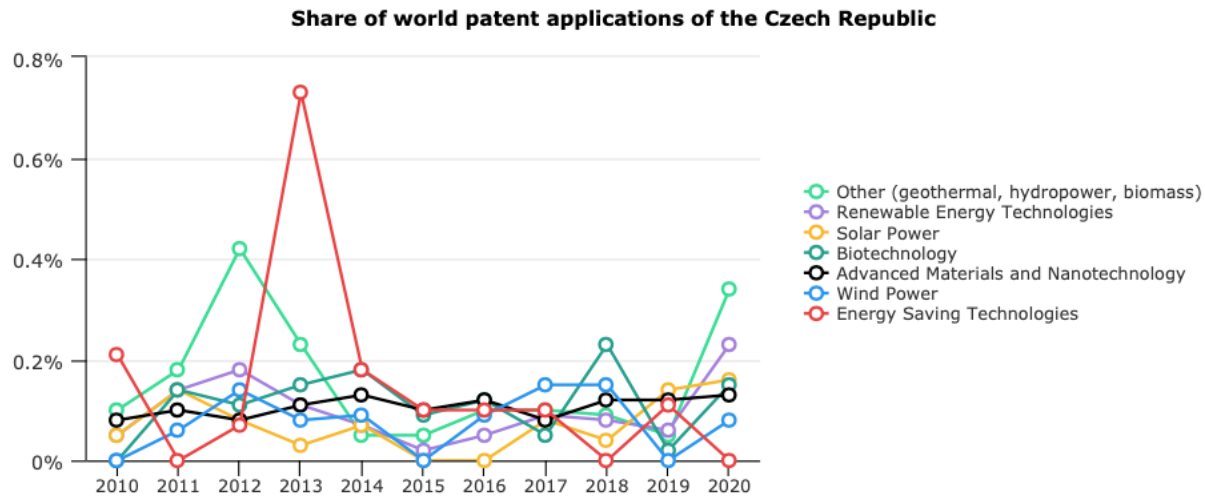
Figure 4: Country share and world share (expressed in terms of ranking) in patent applications of the Czech Republic



Source: Fraunhofer ISI based on Patstat

Trends in the world's patent applications show that Czech Republic increased its global share in various fields including Advanced Materials and Nanotechnology (+4.15%), Renewable Energy (+2.49%) and Biotechnology (+1.45%).

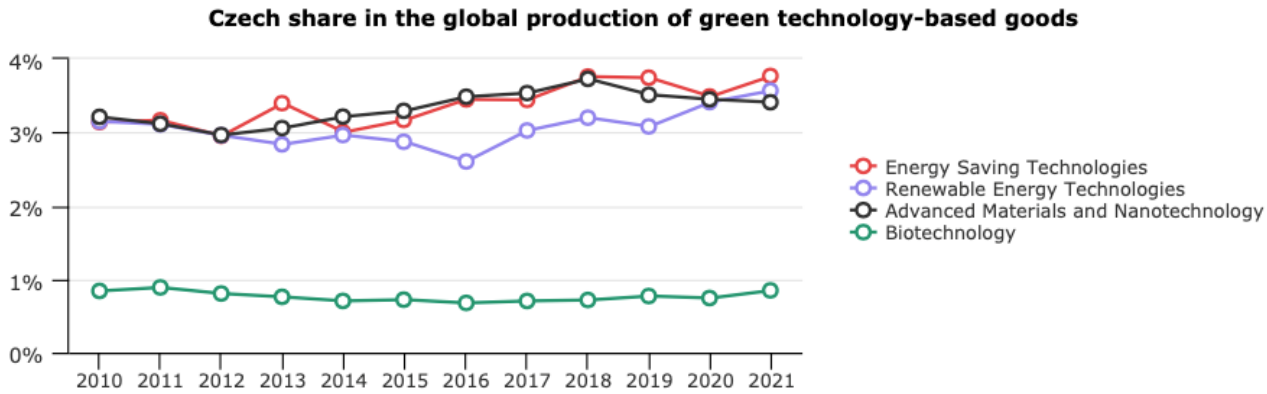
Figure 5: Trends over time in Czech Republic's share in world patent applications



Source: Fraunhofer ISI based on Patstat

The indicators based on Prodcom data measure the share of advanced technology-related production in the Czech Republic for a given year and it also captures the country share in global production of manufacturing goods. The Czech share of production in green technologies over global production indicates a positive trend in the field of Renewable Energy technologies (from 3% in 2010 to 3.5% in 2021), and Energy Saving Technologies. In the field of Advanced Materials and Nanotechnology, a recent downward trend can be observed since 2018.

Figure 6: Production of advanced technology-based products in Czech Republic

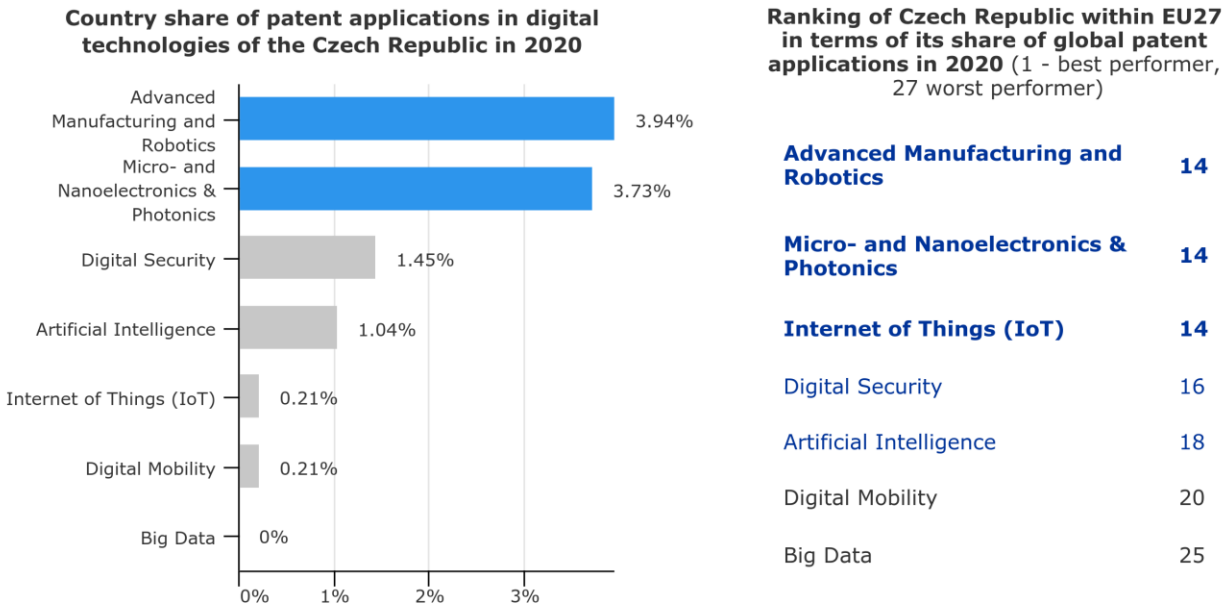


Source: IDEA Consult based on Prodcom data

2.4 Digital transformation

In this project, the Czech Republic had the highest share within the country in Advanced Manufacturing and Robotics, as well as in Micro- and Nanoelectronics and Photonics among the digital technologies monitored. It also held the best position in an EU27 comparison in the same technologies.

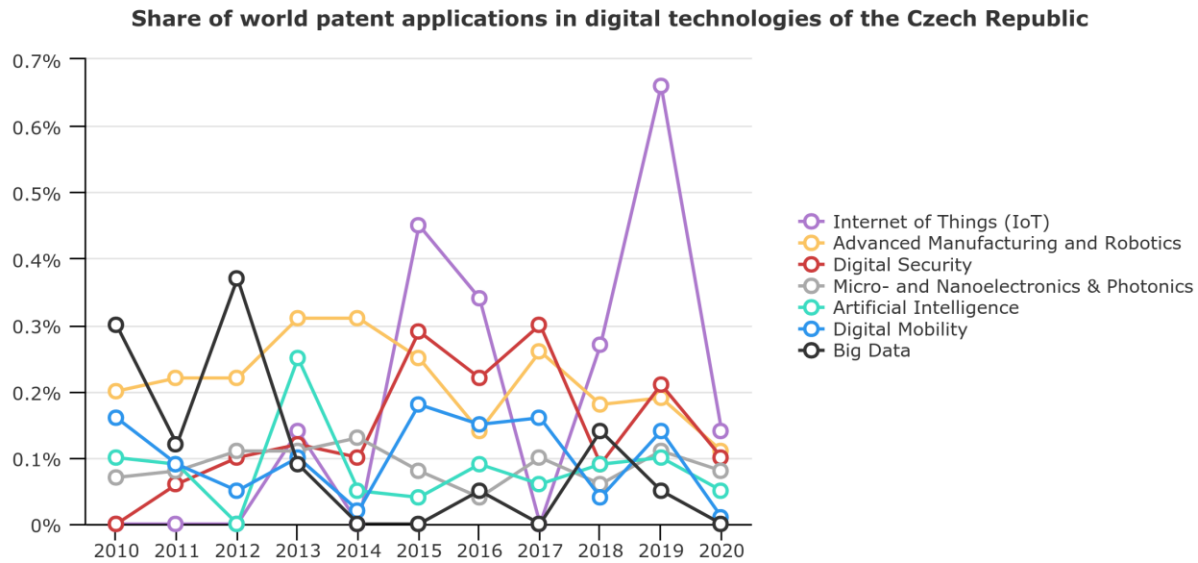
Figure 7: Country share and world share (expressed in terms of ranking) in digital technology related patent applications of Czech Republic



Source: Fraunhofer ISI based on Patstat

Trends over time indicate that the Czech Republic decreased its global position in various digital technology fields over the period from 2010 to 2020. It had the largest drop in the Internet of Things from 2019 to 2020.

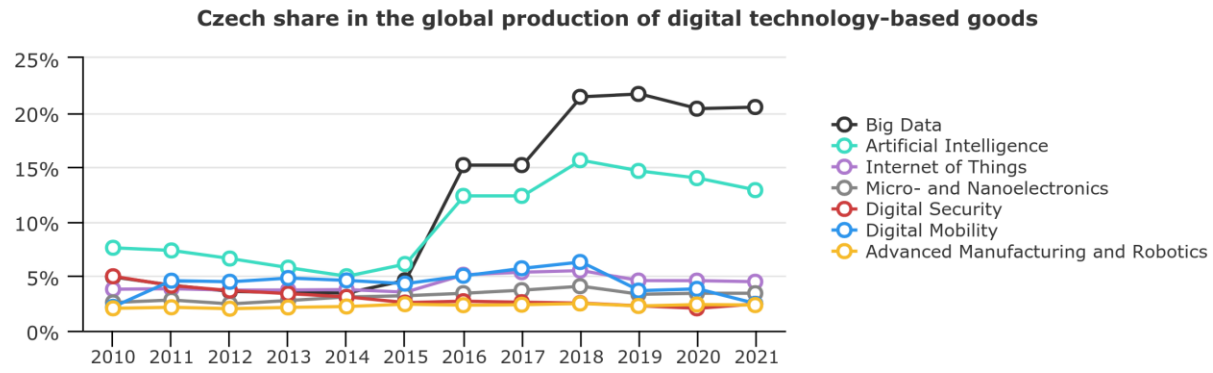
Figure 8: Trends over time in Czech Republic's share of world patent applications



The Czech Republic's share of production in a particular technology over global production indicates that it created the highest value by the deployment of Big Data and Artificial Intelligence technologies. The Czech share of production in digital technologies over global

production indicates that both the significance of Big Data and AI increased over the period from 2015 to 2020.

Figure 9: Production of advanced technology-based products in Czech Republic



Source: IDEA Consult based on Prodcom data

EA-05-24-009-EN-N

Publications Office
of the European Union

ISBN: 978-92-9469-726-4