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May 2023

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Although Europe has historically led the world's regions in many economic and social indicators, it is currently facing challenges in maintaining its position, particularly around supply chains, energy and food security, and defense.

The future economic growth and strategic autonomy of Europe—and particularly of smaller economies like Croatia—is at risk due to widening corporate performance and technology gap between Europe and its global competitors.

Specifically, Europe is falling behind in the key transversal technologies that are expected to revolutionize many sectors in the coming decades—from industrial production, agriculture, and infrastructure, to healthcare, retail, and finance. More research is needed to determine how to tackle the tech gap and build long-term resilience across sectors.

This article is a part of an ongoing McKinsey initiative to address these questions by gathering insights across Europe.

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A widening tech gap threatens to leave Europe—and Croatia—behind

Recent McKinsey research has found that a corporate and technology gap, widening for the past 20 years, threatens to undermine Europe's competitiveness with other global players such as the USA and China. Failure to close this gap could see Europe losing out on growth, inclusion, sustainability, strategic autonomy, and a potential corporate value-add of €2 trillion to €4 trillion a year by 2040 (see sidebar, "Europe eclipsed in technology innovation and adoption").[1] This potential gain, six times the amount the region needs to achieve net-zero emissions by 2050, is key to securing Europe's achievements and sustainable development.[2]

Within the EU, certain countries lag even further—such as Croatia, where the economic and technology gap was deepened by the impact of COVID-19. As Croatian tourism (the top GDP contributor) experienced months of depressed bookings in 2020, the country's GDP dropped by 8.1 percent, making it one of the hardest hit in Europe.[3] While GDP has since recovered at a fast pace and surpassed pre-pandemic levels, the country is facing new challenges, including high inflation rates and even a possible global recession.

In the long term, lack of competitiveness and subdued growth prospects across all sectors could threaten Croatia's ability to improve the lives of its citizens—who already experience levels of inclusion, well-being, and growth and prosperity that are below the EU average. Catching up on ten key transversal technologies—those expected to have a strong, wide-ranging impact across key sectors—is crucial to building enduring economic resilience in a rapidly changing world.

Keeping up with global competitors will thus require both the EU leadership as well as national governments to push for initiatives to close the technological gap. Some policy initiatives may need to happen at the EU level—where Croatia could contribute by raising awareness of their importance, (co)leading their development, and providing political support for their adoption.

Other initiatives could be implemented directly by the Croatian government on a national level or through bilateral and multilateral agreements. European, and especially Croatian companies, will also need to adapt, shaking up long-held business approaches in order to compete and prosper by leveraging the possibilities unlocked by transversal technologies.

1 For more, see "Securing Europe's competitiveness: Addressing its technology gap," McKinsey Global Institute, September 2022.
2 McKinsey research finds that reaching net zero by 2050 would require $9.2 trillion in annual average spending on physical assets, $3.5 trillion more than today. For more, see: "The net-zero transition: What it would cost, what it could bring," McKinsey, January 2022.
3 Overnight stays of tourists in commercial accommodation facilities, Croatian Bureau of Statistics, October 21, 2022; GDP and main components (output, expenditure and income), Eurostat, October 21, 2022.

Sustainability, inclusion, and growth: Where does Croatia stand?

Improving Croatia's performance across three interdependent dimensions—sustainability, inclusion and well-being, and growth and prosperity—is key to making the lives of Croatian citizens better in the long term.[4] As noted in recent McKinsey research: The three dimensions reinforce—or can undermine—one another; it is not a question of *or*, but *and.* Growth is needed to achieve prosperity and well-being, and to pay for the transitions required to make Europe's economies more sustainable and inclusive. Not only is sustainability critical for our planet, but without it, there can be no long-term prosperity. Inclusivity is a goal in its own right and is needed to strengthen aggregate demand and propel growth as well as to secure sufficiently broad support to sustain necessary sustainability investments.[5]

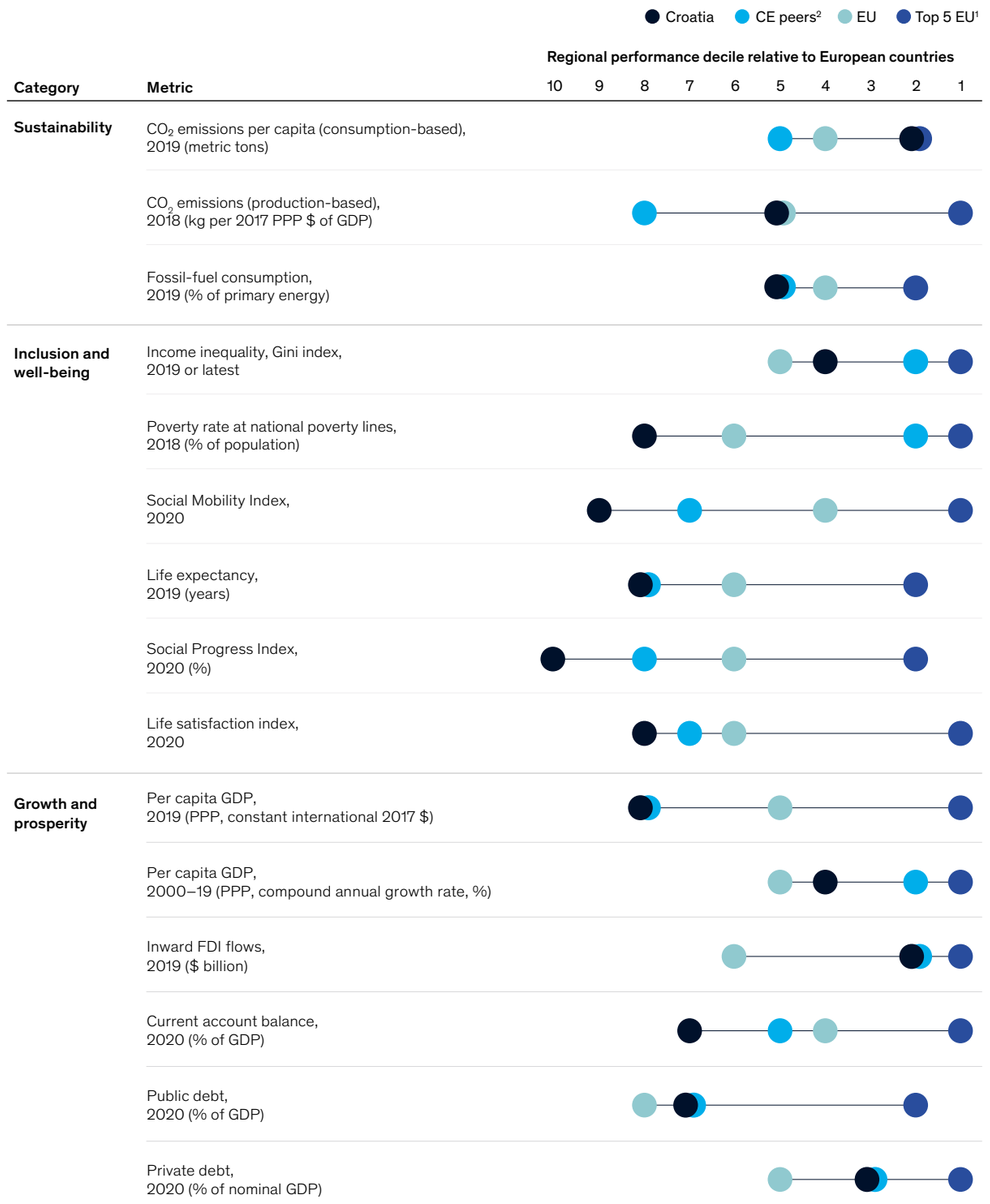
However, high growth could also stimulate investment, spurring sustainability-related innovation and generating new income streams to pay for the energy transition. Furthermore, it could also generate additional funding for social programs, strengthening Croatia's society by supporting more inclusion-boosting policies.

Exhibit 1 provides a snapshot of how Croatia, its Central European (CE) peers, the EU average, and the top five EU countries in each key performance indicator (KPI) compare on selected metrics of sustainability, inclusion and well-being, and growth and prosperity.[6]

4 Bob Sternfels, Tracy Francis, Anu Madgavkar, and Sven Smit, "Our future lives and livelihoods: Sustainable and inclusive and growing," McKinsey, October 26, 2021.
5 Securing Europe's competitiveness: Addressing its technology gap, McKinsey Global Institute, September 2022. See also Bob Sternfels, Tracy Francis, Anu Madgavkar, and Sven Smit, "Our future lives and livelihoods: Sustainable and inclusive and growing," McKinsey, October 26, 2021.
6 In our analysis, 38 OECD countries were scored on these metrics and ordered in deciles. Croatia, CE peers,

Exhibit 1

Croatia is performing well in sustainability, has mixed results in growth and prosperity, and is mostly lagging in inclusion and wellbeing (although is still comparable to CE peers)



1. Average of top 5 EU performing countries for each KPI
2. Average of CE peers (Czech Republic, Hungary, Poland, Slovakia and Slovenia)
Source: CEIC; Eurostat; Gallup; OECD; Our World in Data; Social Progress Organization; WEF; World Bank; McKinsey Global Institute analysis

Sustainability

Croatia's record on sustainability is good: emissions per capita are low, below those of both its Cental Europe peers and the EU, and on par with the five top-performing EU economies. However, while Croatia's fossil-fuel consumption is lower than that of its CE peers, it is still higher than that of the EU and top-performing EU economies. This is because, even though its share of fossil fuels in energy is higher, Croatia uses less total energy per capita. Still, the country has the fourth-lowest carbon footprint per capita in the EU and it has further pledged to reduce CO^2 emissions by 45 percent by 2030 and to phase out coal by 2033.[7]

Croatia's National Development Strategy 2030 is focused on the "green" and "digital" transition, with four strategic goals: ecological and energy transition for climate neutrality, food self-sufficiency and the development of the bioeconomy, sustainable mobility, and digital transition of the economy and society. KPIs and targets include:

- Reducing greenhouse gas (GHG) emissions to 65 percent of 1990 levels by 2030, from 75.2 percent in 2018 (compared to the EU average of 79.2 percent achieved in 2018)
- Doubling the national waste-recycling rate from 25.3 percent in 2018 (against the EU average of 47.4 percent that year) to 55 percent by 2030
- Increasing the share of renewables in gross energy expenditure from 28 percent in 2018 (versus the EU average of 18.8 percent) to 36.4 percent by 2030

Despite these efforts, Croatia still falls somewhat short of EU-wide green initiatives. While Croatia's total greenhouse gas GHG emissions declined by 17 percent from 2005–19, the EU-wide drop was 19 percent in the same period.[8] In addition, Croatia's land use, land-use change, and forestry (LULUCF) carbon-sink capacity dropped by 35 percent from 2005–18. In 2018, Croatia's total emissions were 24.4 million tons CO_2 equivalents ($MtCO_2e$), but with a LULUCF carbon-sink capacity of only 5.1 $MtCO_2e$, Croatia's net emissions were 19.3 $MtCO_2e$.

35%

decline in Croatia's carbon-sink (LULUCF) capacity from 2005-18

Croatia's relatively good performance in reducing GHG emissions is also largely due to de-industrialization of the country during the last few decades, with a considerable share of domestic production being replaced by imports. Furthermore, as evidenced by the National Development Strategy 2030 targets, the country has fallen behind in other areas of sustainability such as recycling. It appears that Croatia has a long way to go to reach some of its sustainability targets.

Inclusion and well-being

Croatia remains behind its European peers on inclusion and well-being. When it comes to income equality, although Croatia performs better than the EU average, it still lags behind its CE peers, with a Gini index of 29.2 in 2019—compared to 25.4 for CE countries and 30.2 for the EU average.[9]

and EU countries were then positioned in these deciles based on performance on the same metrics. (Note that the average of the top five EU countries might not always fall in the first decile.)

7 "Croatia will reduce CO^2 emissions by 45 percent by 2030, our coal phase-out year is 2033," Government of the Republic of Croatia, November 2, 2021.

8 Climate action in Croatia, European Parliament, June 2021

9 Gini coefficient of equivalized disposable income—EU-SILC survey, Eurostat, October 10, 2022. The Gini coefficient measures the deviation of actual income distribution (or consumption expenditure) among individuals or households from an equal distribution. Values closer to 0 indicate more egalitarian distribution of income among the population, while values closer to 100 indicate a larger income gap between the rich and the poor. See also Metadata Glossary: Gini index, The World Bank, 2022.

As a region, Europe has the highest life expectancy at birth in the world: the EU average was 81.3 years in 2019. In Croatia this is shorter by nearly three years (78.4 in 2019).[10] Additionally, Croatians can expect to spend around 27 percent of their life in poor health, which is close to the bottom quartile of the EU.[11]

When it comes to social mobility, calculated by combining measures for health, education, technology, work, resilience, and quality of institutions, Croatia had an index score of 66.7 in 2020. This is relatively low compared to European peers (with Denmark scoring the highest at 85.2), although on par with CE peers (such as Poland, with 69.1) and better than most developing countries.[12]

In recent years, Croatia has made strides in improving inclusion and well-being. The unemployment rate has halved since 2016, reaching 5.9 percent in August 2022, roughly on par with the EU average.[13] However, just 5.3 percent of Croatia's total employed persons were at risk of poverty or social exclusion in 2021, significantly below the EU average of 11.1 percent.[14]

Since 2000, the country has created a legislative framework to protect women and children from violence, strengthen the rights of victims, and persecute offenders.[15] In 2018, Croatia ratified the 2011 Council of Europe Convention on Preventing and Combating Violence Against Women and Domestic Violence (known as the Istanbul Convention), which improves the rights of women, minorities, and victims of domestic violence.[16]

Croatia also supports the special rights of national minorities, such as cultural autonomy.[17] Furthermore, the Office for Human and National Minority Rights has developed the National Roma Inclusion Plan, which aims to raise the the position of this marginalized group in Croatian society.[18]

With respect to inclusive political representation, the number of women in the national parliament is a commonly used benchmark. While there is still room for improvement, Croatia has seen a significant increase in the number of female MPs—from 12.5 percent in the 2016-20 period to 22.5 percent since the 2020 elections.[19]

On the World Happiness Ranking for 2019–21, Croatia ranks behind many of its EU counterparts, placing 22nd in the EU (and 47th out of 146 countries). Croatia's lag is due to the country's general underperformance across dimensions such as GDP per capita, healthy life expectancy, social support, freedom, generosity, and perceived corruption.[20]

5.3%

of Croatia's employed are at risk of poverty or social exclusion

10 Mortality and life expectancy statistics, Eurostat, April 29, 2022.

11 Healthy life years by sex (from 2004 onwards), Eurostat, November 9, 2022.

12 Mortality and life expectancy, April 29, 2022.

13 Republic of Croatia Basic Indicators, Croatian Bureau of Statistics, October 10, 2022; Total unemployment rate, Eurostat, October 20, 2022.

14 Persons at risk of poverty or social exclusion by most frequent activity status (population aged 18 and over), Eurostat, October 12, 2022.

15 Report of the Republic of Croatia on implementation of the Council of Europe Convention on preventing and combating violence against women and domestic violence, Government of the Republic of Croatia, February 2022.

16 Status of signatures and ratifications of Treaty 210, Council of Europe, November 9, 2022.

17 "Position and rights of members of national minorities in the Republic of Croatia," Government of the Republic of Croatia.

18 "Development of the National Roma Inclusion Plan 2021-2027 and the accompanying Action Plans," Government of the Republic of Croatia.

19 "Parliamentary elections 2020," Government of the Republic of Croatia, Office for Gender Equality, 2020.

20 John F. Helliwell et al., World Happiness Report, The United Nations, March 2022.

2.4%

annual rate of GDP (PPP) growth from 2000-2019

Growth and prosperity

As part of Croatia's National Development Strategy 2030, the country aims to improve its competitiveness as an innovative economy.[21] KPIs and targets include:

- Increasing GDP per capita, according to purchasing power parities (PPP), from 65 percent of the EU average in 2019 to 75 percent by 2030
- Moving from the 63rd place (out of 140 countries) on the Global Competitiveness Index in 2019 to a place within the top 45 by 2030
- Increasing the value of exports of goods and services from 52.3 percent of GDP in 2019 to 70 percent by 2030
- Boosting the share of total expenditure on R&D (GERD) from 0.97 percent of GDP in 2018 to 3 percent by 2030
- Moving from 25th place in the EU in 2020 on the European Scale of Success in Innovation to a place within the top 18 in 2030

In addition, Croatia aims to improve its position on WEF's Global Competitiveness Index in the infrastructure component (encompassing transport, energy, water, and telecommunications) to create an environment that supports and enables growth and productivity. Croatia aims to place within the global top 28 in infrastructure by 2030, up from 32nd place out of 141 countries in 2019.[22]

In 2021, Croatia's GDP per capita (PPP) was around €21,330—below the EU average of €29,496.[23] However, the country's GDP (PPP) grew at an average annual rate of 2.4 percent in the 2000–19 period, slightly above the EU average of 2.2 percent, but below CE peers' average of 3 percent.[24] Similarly, Croatia's private debt equaled 61.2 percent of GDP in 2020, below the EU average of 74.5 percent, although still above the CE countries' average of 55.2 percent.[25]

Croatia has been an EU member since July 2013 and has benefited from participating in the single market and increased labor mobility. Foreign direct investments from EU countries have contributed to Croatia's growth, with countries like the Netherlands, Austria, Luxembourg, Germany, and Italy acting as major investors and strategic partners.[26] Total foreign direct investment (FDI) into Croatia in 2019 amounted to around €5.3 billion—equal to 6.3 percent of the country's GDP that year—compared to the EU average of around 2 percent.[27] However, it should be noted that 2019 was a strong outlier, and FDI in Croatia has commonly ranged from 1 to 2 percent of GDP in recent years.

Croatia has also been a net beneficiary of EU development funds, receiving around €12.2 billion while contributing only around €3.7 billion to the EU budget.[28] Some parts of Croatia are eligible for the EU's Structural Funds and Cohesion Fund—which directly fund NUTS-2 regions with GDP per capita below the EU average.[29] Notably, the Panonska Hrvatska NUTS-2 region has a GDP per capita that is less than half the EU average.[30]

The EU has also earmarked up to €5.5 billion in grants for the 2021-26 period - through the National Recovery and Resilience Plan (NRRP) - to support Croatia's long-term sustainable development.[31] Roughly 40 percent of this funding will support achieving climate objectives and the "green transition" through energy efficiency, sustainable mobility, and modernization of energy infrastructure. Another 20 percent will go toward the digital transition—for example, supporting digitalization of the justice system and higher education and increasing broadband coverage in rural areas.

21 National Development Strategy, February 5, 2021.
22 National Development Strategy of the Republic of Croatia until 2030, Government of the Republic of Croatia, February 5, 2021; The Global Competitiveness Report 2019, World Economic Forum, October 8, 2019.
23 World Bank GDP per capita in 2017 international dollars converted to Euros using the OECD exchange rate for PPP in 2017 ($1 = €0,687); GDP per capita, PPP (constant 2017 international $), World Bank, October 24, 2022; Purchasing Power Parities (PPP), OECD, December 6, 2022.
24 "GDP per capita growth," World Bank, August 2022.
25 Private Debt: % of Nominal GDP, CEIC, November 9, 2022.
26 "About Croatia," Government of the Republic of Croatia, Ministry of Economy and Sustainable Development, October 25, 2022; EU direct investment positions, breakdown by country and economic activity (BPM6), Eurostat, June 20, 2022.
27 EU direct investment positions, flows and income, breakdown by partner countries (BPM6), Eurostat, October 11, 2022; Foreign direct investment, net inflows (% of GDP), The World Bank, October 11, 2022.
28 Expenditures and revenues of the EU for the period 2014-2020, European Commission, October 25, 2022.
29 Gross domestic product for Republic of Croatia HR_NUTS 2021, Croatian Bureau of Statistics, February 14, 2022.
30 GDP at regional level, Eurostat, October 14, 2022.
31 Croatia's National Recovery and Resilience Plan: Latest state of play, January 27, 2023.

Europe's technology gap is impacting its global competitiveness

3rd

worst in the EU in innovation (based on 2021 Global Innovation Index)

Croatia's progress in sustainability, inclusion, and aspects of growth reflects what the country is able to achieve when it puts its best foot forward. To maintain its position and meet its development goals, Croatia, like the rest of Europe, will need to boost innovation, performance, and profitability—all underpinned by corporate competitiveness in technology.

But, Europe experiences difficultiesstaying competitive, and lags behind the United States in macrolevel indicators of competitiveness (Exhibit 2). While data on Croatia is limited, it is worth noting that this gap is even larger for comparable CE countries—with relatively low rates of return on invested capital (ROIC), despite greater rates of revenue growth.

With the exception of Switzerland and Sweden, European countries also lagged behind the US in innovation as measured by the Global Innovation Index (GII) in 2021, while the EU average score was below that of China. Croatia is further behind, placing 25th within the EU (and 42nd out of 132 countries total). This innovation gap threatens the country's future competitive potential.[32]

To close this corporate and technology gap, Europe will need to focus on developing and leveraging key transversal technologies. Otherwise, it could miss out on half of the GDP growth considered possible[33] in the period up to 2040, with significant negative impact. Smaller economies like Croatia, battling to keep up within an already lagging European economy, could face the steepest struggle.

[32] Soumitra Dutta et al., Global Innovation Index 2021, World Intellectual Property Organization, September 2021.
[33] "Securing Europe's competitiveness," McKinsey Global Institute, September 2022.

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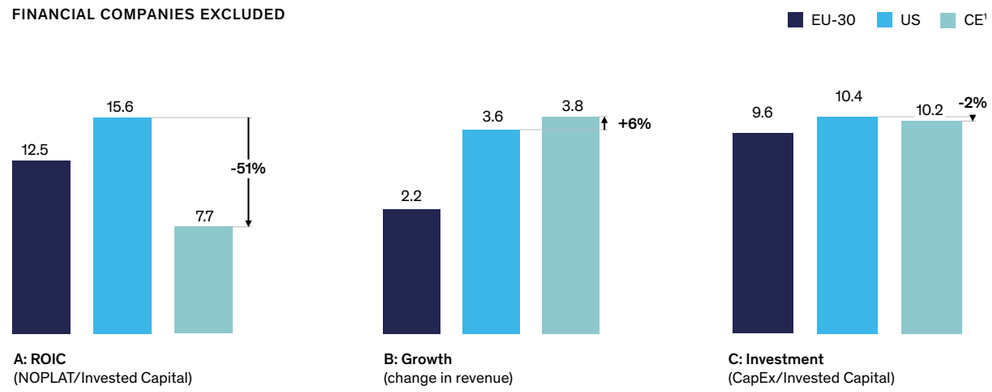
Exhibit 2

CE peers have high growth companies, with investment on par with the US, but still with lower profitability than the US and Europe

Weighted average, 2014–2019, in %



1. CE countries included: Czech Republic, Hungary, Poland, Slovenia and Slovakia (Croatia, Romania and Bulgaria did not have companies in the sample)
Source: CAPT

Europe eclipsed in technology innovation and adoption

In September 2022, a McKinsey Global Institute report, "Securing Europe's competitiveness", compared the corporate and technological competitiveness of the EU-30 countries to that of the US and China.[1] It found that Europe has been outperformed in industrial-scale technology adoption and is lagging in most transversal technologies—such as artificial intelligence (AI), biotechnology, and cloud computing—which, coupled with delayed regulation and lack of funding, jeopardizes its global competitive position.

It has long been thought[2] that this lagging performance is offset by Europe's specialization and competitive advantage in sectors such as chemicals, materials, and fashion. However, this no longer holds. Technology now underpins all sectors, especially transversal technologies, presenting a growing corporate-performance challenge for the region.

This is true even in traditional European strongholds like the automotive industry. Currently, two of the world's top three auto manufacturers by revenue are European,[3] and so were three of the top five luxury car brands based on 2021 unit sales in the US.[4] However, Europe's lack in innovation when it comes to potential industry game-changers, such as autonomous vehicles, could severely impact the value proposition and competitiveness of European car-makers in the coming years. According to McKinsey's 2019 survey, two-thirds of premium car buyers were willing to switch brands to obtain better autonomous-driving features.[5] However, the US manufacturers accounted for almost 70 percent of all kilometers traveled by L4 fully-autonomous vehicles –mostly due to Europe's lag in AI and regulatory development, as well as limited funding.[6]

Markets have taken note: market-capitalization shifts reflect poor investor expectations of future sales performance. From 2000 to 2019, European companies improved their ranking in market capitalization relative to US companies in only three of more than 20 sectors: household and personal products, pharmaceuticals, and retail. In most sectors, European companies lack the scale and strategic control of those in the US. At the end of 2019, US companies had almost double the market-to-book ratios of their European counterparts and 30 percent higher levels of book equity.

1 "Securing Europe's competitiveness: Addressing its technology gap," McKinsey Global Institute, September 2022. The EU-30 consists of the EU plus the UK, Switzerland, and Norway.
2 "Securing Europe's competitiveness," McKinsey Global Institute, September 2022.
3 "Top publicly traded automakers by revenue", Companies Market Cap. Revenue data for 2021 Q4–2022 Q3.
4 "Leading luxury car brands in the U.S. in 2021, based on unit sales", Statista.
5 "Private autonomous vehicles: The other side of the robo-taxi story", McKinsey 2020. Data from McKinsey's 2019 Future Mobility Survey.
6 "Securing Europe's competitiveness: Addressing its technology gap," McKinsey Global Institute, September 2022.

Ten transversal technologies that will shape the future

Information and communications technology (ICT) used to be its own sector; now it permeates everything. The ICT technology base has given rise to a range of transversal technologies with applications across most vertical sectors. These applications are driving the bulk of value creation in a "winner-takes-most"[1] environment, with network effects and economies of scale in adoption. The World Economic Forum (WEF) estimates that 70 percent of new value created over the next decade will be digitally enabled, a development further accelerated by the COVID-19 pandemic.[2]

In the earlier report on Europe's competitiveness, the McKinsey Global Institute analyzed ten key transversal technologies or groups of technologies that promise to revolutionize multiple sectors and could become vital to Europe's performance and prosperity in the coming decades (Exhibit 3).[3] As Europe did not keep pace with the US in the first technology wave—also rooted in ICT, but primarily the internet and software—the region is now playing catch-up in many transversal technologies. By contrast, China has made much faster advances in these technologies, and has emerged as a global leader in some.

1 "Securing Europe's competitiveness," McKinsey Global Institute, September 2022.
2 "Shaping the future of digital economy and new value creation," World Economic Forum.
3 "Securing Europe's competitiveness," McKinsey Global Institute, September 2022.

Exhibit 3

There are 60+ future arenas of competition at the intersect of transversal technologies and sectors

Industrials (including auto and defense)	Chemicals and materials (including agriculture)	Transportation, energy, and infrastructure	Pharmaceuticals and healthcare	Consumer and retail	Financial and professional services
Next-level automation					
Robotics, additive manufacturing, drones, digital twins	Virtual development modeling, testing, agriculture next-generation	Modular construction, prefab, additive manufacturing, robotics	Virtual clinical trials, surgery robot, additive manufacturing	Domestic service robot, warehouse automation	-
Future of connectivity					
Industry 4.0, connected cars, connected soldier	Smart farming	Smart cities, smart power plants/grids, embedded sensors	Remote health monitoring, wearables	Wearables, smart home	-
Distributed infrastructure					
← Cloud and edge computing →					
Next-generation computing					
← Quantum computing →					
Applied AI					
Autonomous vehicles	Precision agriculture	Last-mile drone usage, smart power plants/grids	AI imaging and diagnostics/ drug discovery	Marketing analytics, speech recognition, LLMs[1]	Pricing risk analytics, automated operations, techaugmented advisory, LLMs
Future of programming					
← Software 2.0 (including LLMs) →					
Trust architecture					
Cyberwar	Traceability	Smart contracts	Blockchain in supply chain and records	Smart sourcing	Blockchain, smart contracting
Bio revolution					
Industrial enzymes, exoskeleton	Next-generation crops, bioroutes for chemicals	Biopolymers, biofuels, engineered produce transportation	Gene and stem cell, therapy tissue engineering, brain-device interaction, neurogenomics, biomolecules	Alternative proteins, microbiome-based products	-
Next-generation materials					
Nanomaterials, new materials, new generation of weapons	Nanosensors, next-generation composites, synthetic materials/ chemical design	New materials, new construction materials	Tissue engineering	Personalization, new materials	-
Future of cleantech					
Decarbonization, electric vehicles	Wireless irrigation systems, green cement/steel, recycling	Modular, virtual twins, renewables, CCS, green energy	-	-	-

1.Large language models

Source: McKinsey analysis

Exhibit 4

Croatia is performing relatively well in production and adoption of trust architecture, and adoption of future of programming

Relative Croatian score compared to the average of Top 5 performers among EU-28

Transversal technologies	Keywords	Innovation	Production	Adoption	Average
Next-level automation	Industrial, collaborative, and professional robots; additive manufacturing; virtualization	0,18	n/a	0,57	0,38
Future of connectivity	5G, Internet of Things	0,00	0,20	0,43	0,21
Distributed infrastructure	Cloud, edge computing	0,00	n/a	0,56	0,28
Next-generation computing	Quantum computing, neuromorphic software	0,05	n/a	n/a	0,05
Applied AI	Robotic process automation, optimized decision making, natural language processing, computer vision, speech technology	0,17	0,41	0,42	0,33
Future of programming	Software 2.0, no-code and low programming	0,24	0,43	0,67	0,45
Trust architecture	Blockchain, zero-trust security/cybersecurity	0,01	0,59	0,68	0,43
Bio revolution	Biomolecules, biosystems, biointerface, biocomputing	0,07	0,03	n/a	0,05
Next-gen materials	Nanomaterials, composite materials	0,01	n/a	0,24	0,12
Future of cleantech	Solar power, wind energy, hydropower, nuclear, electric vehicles, hydrogen	0,35	0,57	0,34	0,42
Average		**0,11**	**0,37**	**0,49**	

Source: McKinsey analysis

This report takes a similar comparative approach, but focuses on assessing Croatia's performance in the EU context, comparing the country against the top five EU performers across three dimensions—innovation, production, and adoption.[4] Croatia scores best on future of programming, cleantech, and trust architecture, while lagging in next-generation computing, materials and bio-revolution. Overall, Croatia tends to perform well in the adoption of transversal technologies, while it remains relatively weak on innovation.

To increase its corporate and technological competitiveness and unlock the prosperity needed to achieve its sustainability, inclusion, and growth goals, Croatia could aim to accelerate uptake of key transversal technologies—while also striving to stimulate innovation and increase production.

1. Next-level process automation

Process automation can help companies improve efficiency and enhance functionality, thus turbocharging operations. This technology can be widely applied across sectors: from collaborative robots in manufacturing to virtual clinical trials in healthcare and military robots in defense.

While Croatia is still significantly behind EU's best innovators in next-level process automation, it performs reasonably well on adoption. Croatian companies in this space are relatively small, but are making strides. One of them is Gideon Brothers with ten patents in robotics automation, more than 150 employees, and around €30 million in financing. The company produces autonomous warehouse robots for (un)loading and case picking.[5]

Another company, DOK-ING, makes heavy-duty robotics and autonomous systems for use in military engineering, underground mining, and emergency response. An example is MVF-5, a unique multifunctional robotic system that extinguishes fires in inaccessible areas. According to DOK-ING, the company holds 80 percent of the market share in its field in more than 40 countries.[6] Other Croatian robotics companies include HSTec and H20 Robotics.

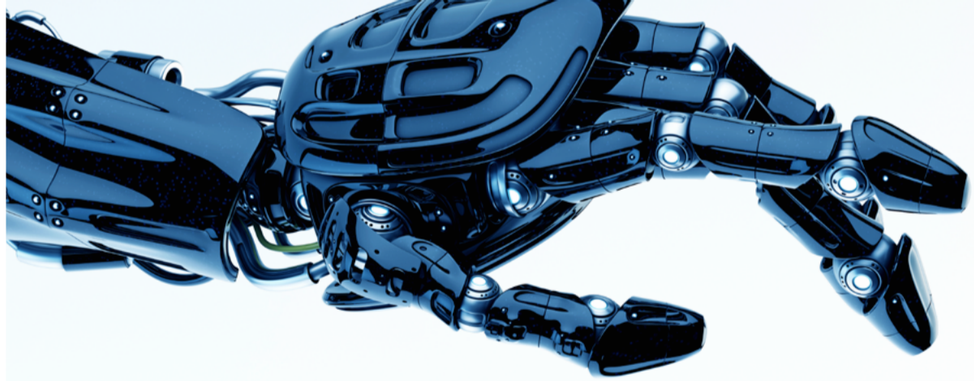
When it comes to adoption, Croatia scores well on some metrics—for instance, the use of 3D printing in manufacturing in Croatia is on par with the EU average, with 5 percent of sampled enterprises reportedly making use of 3D printing in 2020.[7]

2. Future of connectivity

Advances in connectivity infrastructure—such as 5G/6G cellular, low-power wireless networks, and low-Earth-orbit satellites—support the online exchange of rapidly swelling amounts of information between devices.

Most future-of-connectivity technologies consist of digital solutions that leverage this increased connectivity to drive growth and productivity across industries. For example, massive Internet of Things (IoT) networks of smart devices can communicate in real time—providing a vast number of sensory inputs and

[4] The score for each technology was calculated as an unweighted average of scores for each of its three dimensions. The score for each dimension was calculated as an unweighted average of scores in underlying metrics. Where such comparable scoring was not possible due to limited country-level data, no scores were assigned (marked n/a in the Exhibit).
[5] "People are at the center of everything we do," Gideon Brothers website.
[6] "Don't send a man to do a machine's job," DOK-ING website.
[7] 3D printing and robotics, Eurostat, May 23, 2022. Sample only includes enterprises with 10 or more employees.



receiving instructions based on “big data” analytics—to enable insights and optimize operations. Such technologies have widespread applications, including in Industry 4.0, smart farming, smart-city infrastructure, remote healthcare monitoring, and wearables.

When it comes to future of connectivity infrastructure, Croatia scores poorly on innovation, and production. However, Croatia has improved substantially in adoption - after a somewhat late start, Croatia’s 5G coverage is finally catching up with the EU, going from zero to 34 percent of populated areas between 2020 and 2021. This provides crucial infrastructure for further development and adoption of future-of-connectivity solutions.

Croatian smart farming company Agrivi has branched out from farm-management software into offering a suite of IoT farming-software solutions, including a fleet-management platform, weather-data monitoring, and pre-integrated soil sensors for moisture, temperature, and electrical conductivity.

Croatian startup Include offers a range of smart-city devices, from their breakout hit—the wi-fi-enabled Steora solar bench—to smart solutions for waste collection and air-quality monitoring. The company also offers its own cloud-based smart-city platform that links public IoT devices and enables data collection and analysis, as well as remote management. Include was recognized in 2018 by the Deloitte Technology Fast 50 program as the fastest-growing “rising star” in Central Europe—the first Croatian company to win in this category.[8]

39%

of Croatian companies with more than ten employees reported buying cloud computing services in 2021

Croatia’s public healthcare system offers remote health monitoring services, such as at-home heart monitoring via EKG Holter devices, as well as remote specialist support to local medical facilities for blood transfusion, hemodialysis, neurology, and radiology.

Considered one of the largest Croatian future-of-connectivity players, Bellabeat makes smart wearables for women. Founded in Croatia in 2013, it is now headquartered in San Francisco, with offices in Zagreb and London. Bellabeat has raised almost €20 million over six funding rounds with a major presence on the US market.[9] According to some estimates, Bellabeat makes between €230 million and €500 million in annual sales.[10]

3. Distributed infrastructure

Distributed infrastructure involves the use of remote servers to manage, store, and process data, primarily via cloud and edge computing. Distributing computing workloads across remote data centers and local nodes in this way improves data sovereignty, autonomy, resource productivity, latency, and security. It allows companies across all sectors to utilize significant amounts of computing power and data storage as needed, without having to invest in and maintain their own centralized hardware.

Croatia lags significantly in innovation, but scores relatively well in adoption of these technologies.[11] However, Croatia scores relatively well in adoption of these technologies. For example, 39 percent of sampled Croatian companies with more than ten employees reported using cloud computing services in 2021.[12] Croatia has started to attract key players in this space, with Amazon Web Services (AWS) launching an AWS Edge location in Zagreb in February 2021, thus providing local users with a reduction in first-byte latency.[13]

Croatia could also begin to close the gap in innovation and production. In September 2021, AWS announced the opening of a data-center design facility in Zagreb that would focus on data design, product development, and research to support AWS cloud services.

4. Next-generation computing

Quantum-based technologies could provide an exponential increase in computational performance for certain problems and transform communication networks by making them more secure. Such next-generation (or high-performance) computing uses technology based on quantum phenomena, which enable complex calculations that improve productivity, to process data and solve problems. Such technology has a range of uses across sectors, from aerospace and defense to energy and utilities. The global next-generation computing market is forecast to grow at almost 20 percent CAGR this decade, reaching around €750 billion by 2030.[14]

Although the available comparable data is limited, it seems that Croatia is largely behind in innovation, production, and adoption in this area, and could be missing out on lucrative opportunities. Still, Croatia has also had some recent successes. In August 2021, scientists from the Center of Excellence for Advanced Materials and Sensing Devices (CEMS) at Ruđer Bošković Institute (RBI) successfully tested the first inter-European quantum-communication network between Italy, Slovenia, and Croatia, as well as the new method of quantum-enhanced cryptography.[15]

Furthermore, several academic institutions, such as the Faculties of Electrical Engineering and Computing (FER) and Science and Mathematics (PMF) at the University of Zagreb, are offering quantum-computing courses to prepare Croatian ICT students to harness this potential in the future.

5. Applied AI

Machine learning can be used to train models to aid decision making, automate actions, and add or boost capabilities.[16] Such applied AI involves a range of AI-driven solutions, such as customer-service chatbots, AI imaging and diagnostics in healthcare, autonomous vehicles, and precision agriculture. Recent breakthroughs in large language models (LLM) as well as text-to-image models, capable of aiding humans in programming, textual, visual, and audio content creation

8 “The young inventor of the smart bench from Solin has a new product,” Index.hr, November 6, 2018; “Green technology meets public service,” Include Ltd website.
9 Bellabeat, Crunchbase, October 27, 2022.
10 Bellabeat, PipeCandy, November 21, 2022.
11 Croatia was not scored on production due to lack of comparable data for relevant indicators.

12 “Cloud computing services by size class of enterprise,” Eurostat, December 8, 2022.
13 First-byte latency represents the amount of time it takes for a browser to receive the first byte of data from a server; AWS Public Sector, “AWS opens data centre design facility in Croatia,” September 16, 2021.
14 Next Generation Computing Market, Allied Market Research, March 2022.
15 “First public demonstration of quantum communication between three states,” Center of Excellence for Advanced Materials and Sensing Devices (CEMS), August 5, 2021.
16 Michael Chui, Roger Roberts, and Lareina Yee, “McKinsey Technology Trends Outlook 2022,” McKinsey, Augut 4, 2022.

McKinsey & Company

+200M

Euro funds raised for the launch of public transportation via self-driving cars in Zagreb in 2024

and organization, as well as analytics, strategic planning, and decision-making have the potential to profoundly transform many existing occupations.

While Croatia still significantly lags in innovation indicators, it fares relatively well in production and adoption of applied AI. As of October 2022, there were over 130 Croatian AI-related startups across all industry verticals.[17] Various AI incubators, accelerators, and startup programs (including Bird Incubator, ZICER, HUB385, ZIP Zagreb, and Impact Hub Zagreb) provide an ecosystem for these startups, while investors such as SC Ventures and Crane and investment platforms like Funderbeam supply the necessary early funding. Furthermore, CroAI (the Croatian AI association) offers a course on the elements of AI which has been completed by more than 30,000 people.[18]

Project 3 Mobility, led by Rimac Automobili—a Croatian manufacturer of electric hypercars, drivetrains, and batteries—in partnership with Kia Motors, has been awarded more than €200 million in EU RRP funding for the development of a self-driving public transport network, to be launched by end of 2024 in Zagreb.[19] Rimac Automobili is also exploring advanced autonomous driving features, and has developed Driver Coach—an automotive AI system that gives instructions to drivers on the racetrack with the aim of enhancing vehicle performance.

6. Future of programming

The "future of programming" represents a move towards a no-code or low-code development environment with increasingly automated processes, exemplified by Software 2.0, wherein new software and code is written by AI using neural networks and machine learning. This will boost the efficiency and speed of software development across sectors, enabling the proliferation of tailor-made software solutions to optimize company operations and processes. Multiple large language models (LLMs) have been released in recent months, demonstrating the ability to generate complex code for multiple platforms based on user prompts.

Croatia scores comparatively very well in indicators relevant to adoption and even production, but is relatively behind in innovation. With many educational centers serving IT and STEM students, the number of programmers in Croatia increased by 165 percent from 2009–19.[20] Croatia has also matched the EU average in share of country revenues generated from services in computer programming, consultancy, and related sectors.[21]

7. Trust architecture

Digital-trust technologies enable organizations to build and scale digital-enabled products and services while maintaining the trust of stakeholders regarding the use of their data. This includes tracking assets and storing contracts and transactions as encrypted data on distributed ledgers via blockchain technology. Trust architecture also involves cybersecurity solutions that focus on protecting resources such as assets, workflows, services, and network accounts. Trust principles can be used to plan industrial and enterprise infrastructure and workflows, with a broad range of applications—including cybersecurity in defense and smart sourcing in consumer and retail.

Croatia again performs relatively well in macro indicators: lagging in innovation, but making strides in production and adoption. Croatia also has a solid base when it comes to production of earlier-generation digital-trust solutions—for example, the core business of Infobip, a Croatian IT unicorn that serves some of the largest global companies, is built around 2FA authentication services.

Part of the adoption score is driven by uptake in blockchain and decentralized finance. For example, Croatia had a 22 percent adoption rate of blockchain in the top 100 companies, placing it in the EU top quartile. Furthermore, Croatia ranked 36th (out of 144 countries) in adoption of decentralized finance (DeFi), placing as high as 15th when comparing the number of DeFi transactions to the country's total number of internet users.[22]

Supporting Croatia in this technology is the University of Zagreb's Faculty of Electrical Engineering and Computing (FER), which offers a course in distributed ledgers and cryptocurrencies. Notably, Croatia osiguranje became the first Croatian insurance company to accept cryptocurrency as a payment for its LAQO car insurance policies.[23]

8. Bio revolution

Advances in biological science, computing, automation, and AI have enabled a revolution in biological technology. Converging biological and information technologies can improve human performance, transform food value chains, and create innovative products and services. While important for healthcare, biotechnology has potential far beyond medical applications—from agriculture, and waste treatment, to consumer goods and energy production.

McKinsey research shows that currently as much as 60 percent of physical inputs to the global economy are either biological (such as wood, crops or domestic food animals), or are items that could potentially be produced or substituted by biological means, for example cement or plastics.[24]

The biotech industry is in its nascency in Croatia, with some innovation but very little production or adoption. However, players are emerging. In January 2020, the first EU-funded blockchain incubator in Croatia, BICRO BIOCentre, was officially licensed as a scientific research institution.[25]

Additionally St. Catherine Special Hospital in Zagreb and the Israeli biotechnology corporation, Bonus BioGroup, have initiated strategic, cooperative research in cellular treatment of COVID-19 and degenerative diseases like osteoarthritis, and laboratory production of bone tissue.[26]

9. Next-generation materials

Next-generation materials are based on breakthroughs in materials science and engineering. They have extraordinary or novel properties that increase existing functionalities or create new ones. This enables the creation of improved or new

22%

adoption rate of blockchain in the top 100 Croatian companies

+2x

growth of installed solar and wind capacity (in MW) in Croatia since 2015

17 "Artificial intelligence will transform the world. Croatia will have a say in it," CroAI website.
18 Ibid.
19 Vladimir Spasić, "Rimac is developing urban mobility ecosystem with autonomous electric cars for Zagreb," Balkan Green Energy News, March 26, 2021.
20 "Developers responsible for HRK 3.8 billion in exports, and annually generate HRK 9.3 billion," 24SATA, May 18, 2021.
21 Turnover in services—index by NACE Rev. 2, Eurostat, May 31, 2022.

22 The 2021 Geography of Cryptocurrency Report, Chainanalysis, October 2021.
23 "It is LAQO to pay with cryptocurrency!" LAQO, August 29, 2022.
24 Tom Brennan, Michael Chui, Wen Chyan, and Axel Spamann, "The third wave of biomaterials: When innovation meets demand," McKinsey, November 18, 2021.
25 "Incubation centre for biosciences," BIOCentre website.
26 "St. Catherine's Hospital and Israeli company to investigate covid cellular treatment," Index.hr, September 6, 2022.

engineering solutions in manufacturing, energy production, decarbonization, and many other areas, with the potential to improve product performance or reduce production costs.

Croatia's next-generation materials industry is relatively small, but there are some research centers developing these technologies. For instance, CEMS has four key research and development units: photonics and quantum optics, graphene and related 2D structures, new functional materials, and ion-beam physics and technology. In addition, the Center for Micro and Nano Sciences and Technologies (CMNZT) at the University of Rijeka has several laboratories, such as the Laboratory for Synthesis of Functional Materials, conducting research in this field.

10. Future of cleantech

Renewable energy is an important example of cleantech, helping the advance toward net-zero GHG emissions across the energy value chain, from power generation to power storage and distribution. With the rising costs of food and energy, Croatia's development and mitigation strategy will likely rely on renewable energy, which is supported by the government.[27] However, there are many other clean technologies—such as electric vehicles (EVs), green cement and steel, eco-friendly waste management and recycling, wireless irrigation, and other sustainable products and services.

Croatia performs relatively well on all three dimensions in cleantech, especially when it comes to renewable energy. With regards to innovation, scientists at the Center of Excellence for Science and Technology (CZI-STIM) in Split have successfully partnered with European researchers and companies in developing next-generation hydrogen and solar cells.[28]

When it comes to adoption, thanks in part to generous subsidies and funding for renewable-energy sources, installed capacity has grown quickly: between 2015–2022, both solar and wind capacity more than doubled, from 44 to 96MW and from 429 to 925 MW respectively.[29] There is now also a push toward distributed solar—where solar-panel owners can sell generated electricity back to the grid—with around €12.5 million allocated to the support of an estimated 2,350 renewable-energy systems in Croatia.[30]

However, in other cleantech areas, Croatia's performance is uneven. For instance, although the total number of electric vehicles (EVs) almost doubled in 2021, the total EV fleet still comprises only around 3,000 vehicles, a paltry 0.17 percent of registered cars. Even including hybrid vehicles, the total share remains just 1 percent.

When it comes to eco-friendly waste management, Croatia struggles with simple elements such as recycling. One of the key challenges is the low level of recycling in the largest cities like Zagreb and Split. However, Zagreb has recently introduced changes to waste collection that incentivized recycling, with encouraging initial results: the amount of unsorted municipal waste declined by 27 percent, while the quantities of sorted plastics, bio-waste, and paper increased by 40, 36, and 9 percent respectively.[31]

27%

decline of unsorted muncipal waste

[27] "Plenković announced a new tax, the Government presented new electricity and gas prices, limited the prices of some foodstuffs," Dnevnik, September 8, 2022.
[28] "These are Croatian geniuses! They create miracles and patent inventions, and live anonymously in incubators: Does the state value them enough?" Večernji list, June 6, 2022.
[29] Installed capacity per production type, Entsoe Transparency Platform, December 2, 2022.
[30] "Public call for the promotion of renewable energy sources in family houses (EnU-2/22)," Environmental Protection and Energy Efficiency Fund, September 28, 2022.
[31] "We uncover whether residents of Zagreb follow the new rules on waste disposal," Večernji list, December 22, 2022.

The time to act is now: ramping up Croatia's tech capabilities and competitiveness

1.2B

Euro in annual exports from Croatia's ICT sector

As for other EU countries generally, Croatia's lack of scale in transversal technologies jeopardizes its position in nearly all sectors, including current strongholds like ICT, manufacturing of light machinery, and pharmaceuticals. At stake are not only the performance of Croatia's companies, its tech prowess, and its economic growth and prosperity, but also its progress on sustainability and inclusion. While tourism would likely not be heavily impacted by the country falling behind on transversal technologies, Croatia's other strongholds could feel the blow:

ICT: Croatia has a comparatively strong and growing ICT sector with almost 6,000 companies, from established global players to startups. Revenue from this industry is expected to grow from around €4 billion in 2021 to around €4,5 billion in 2022. Croatia's ICT sector contributed over €1.2 billion in exports in 2021, or 6.4 percent of the country's total exports, while employing over 35,000 people.[32]

Croatia boasts many successful IT companies: Infobip is one of the largest global players in authentication, security, and omnichannel engagement, with more than 65 offices and over 3,000 employees across six continents.[33] The Photomath app, which allows users to solve an equation by snapping a photo of it, has reportedly been downloaded over 220 million times, and is among the most popular education apps for iPhone. Nanobit, an award-winning gaming studio, was acquired by the Stockholm-based Stillfront for around €120 million in 2020.[34]

The future of Croatia's ICT sector will depend on keeping up with transversal technologies like future of connectivity, trust architecture, and future of programming. Croatia's relatively low innovation scores in these areas could impact future competitiveness of its ICT sector.

Manufacturing light machinery and vehicles: Another stronghold is the light-machinery and equipment sector, which employs around 11,700 people in 700 companies.[35] Within the sector, key export industries are manufacturing of electric machinery and shipbuilding. While there is stiff international competition, recent global supply-chain issues have once again increased the need for transportation vessels.

Another strong export industry is manufacturing of firearms and defense solutions, which generates over €200 million in sales, with €100 million coming from exports.[36]

Automotive manufacturing is a growing branch of the Croatian economy, directly employing over 3,000 workers and contributing over €500 million in exports.[37] Aside from Rimac hypercars, the industry is mostly focused on production of parts for top international carmakers.[38]

To stay competitive on the global markets, Croatia's manufacturing sector would benefit from adopting transversal technologies such as next-level process automation, applied AI, and next-generation materials. One example of such adjustments could be HS Produkt, which claims to deploy the highest number of robots in the production process out of all Croatian manufacturers.

Pharmaceuticals: In 2020, the Croatian pharmaceutical industry reached almost €1 billion in total revenue (73 percent from exports). In the last ten years, revenues from pharmaceuticals increased by 61 percent; while employee numbers have almost doubled since 2010, from 3,500 to 6,000.[39]

PLIVA, Belupo, and Jadranski-Galenski Laboratorij (JGL) are among the largest pharmaceutical companies in Croatia, with the US and the EU as their key export markets.[40] PLIVA is the largest exporter in Croatia and has invented and produced one of the world's bestselling antibiotics, azithromycin (sold in US as Sumamed), which saw a sales peak of around €1,7 billion in 2005.[41] Azithromycin is on the World Health Organization's List of Essential Medicines and was the

+500M

Euro in annual exports from Croatia's automotive industry

[32] "The IT industry has made it clear what it needs to breathe," HGK, April 11, 2022.
[33] "Infobip Continues Exponential Growth Journey with Definitive Agreement to Purchase Peerless Network and Raises Additional $500m," Infobip, November 2, 2021.
[34] Tanja Ivančić, "Nanobit, a company that started with a fitness app, sold for HRK 1 billion," Večernji list, November 18, 2020.
[35] "Manufacture of Machinery and Equipment," Government of the Republic of Croatia, Ministry of Economy and Sustainable Development, 2021.
[36] "HS Product created a highly sophisticated product," Izvozni Portal, April 6, 2020; "Proven and strong companies: Croatian defense industry is presented in Paris," Izvozni Portal, June 13, 2022.
[37] "Vehicles 'Made in Croatia' will go to world markets: Croatia could become an automotive power", Poslovni.hr, August 13, 2020.
[38] "Automotive industry in Croatia," Government of the Republic of Croatia, Ministry of Economy and Sustainable Development, 2020.
[39] "Analysis of the pharmaceutical industry in Croatia and the world with a focus on the business of leading companies," InSolve, May 13, 2022.
[40] "Pharmaceutical Industry," Government of the Republic of Croatia, Ministry of Economy and Sustainable Development, 2022.
[41] "Azithromycin: A world best-selling Antibiotic," World Intellectual Property Organization, August 25, 2021

first of a new class of antibiotics.[42] As recently as 2017, azithromycin was the second-most prescribed antibiotic for outpatients in the US.[43]

Falling behind in transversal technologies such as next-level process automation, applied AI, and bio revolution could jeopardize Croatia's pharmaceutical industry and its global competitiveness.

+60%

increase in revenue of Croatia's pharma companies from 2010 to 2020

[42] World Health Organization model list of essential medicines: 21st list 2019, World Health Organization, 2019.
[43] Outpatient Antibiotic Prescriptions—United States, 2017, Centers for Disease Control and Prevention, March 26, 2020.


ICT


Manufacturing light machinery and vehicles


Pharmaceuticals

Closing the technology gap

Globally, competition and growth are increasingly affected by disruptive innovation. Croatia, like the rest of Europe, faces four mutually reinforcing challenges which the US and China do not share: market fragmentation and lack of economic scale; smaller and less-established technology ecosystems and companies; less developed risk-capital and scale-up funding; and a complex and slow regulatory environment (Exhibit 5).

These problems are particularly pronounced in Croatia due to its relatively small size and underdeveloped economy. As the most recent country to join the EU, Croatia may have to outdo other nations in speed and impact to remain competitive.

Scale, speed, and established technology ecosystems are vital to Europe's drive to catch up with its global competitors. At national and supernational levels, it will be key to reevaluate trade-offs in policy and regulation. Addressing these issues will involve pooling resources; intervening where needed to bolster the competitiveness of local companies in the global context; and balancing the precautionary principle against accelerated decision making and failure tolerance.

Croatia can help advance relevant EU-level initiatives

Many important policy changes can only be implemented at the EU level (see sidebar, "EU-wide initiatives"). However, there are actions that the Croatian government and Croatia's representatives in EU institutions could take to support relevant policy initiatives:

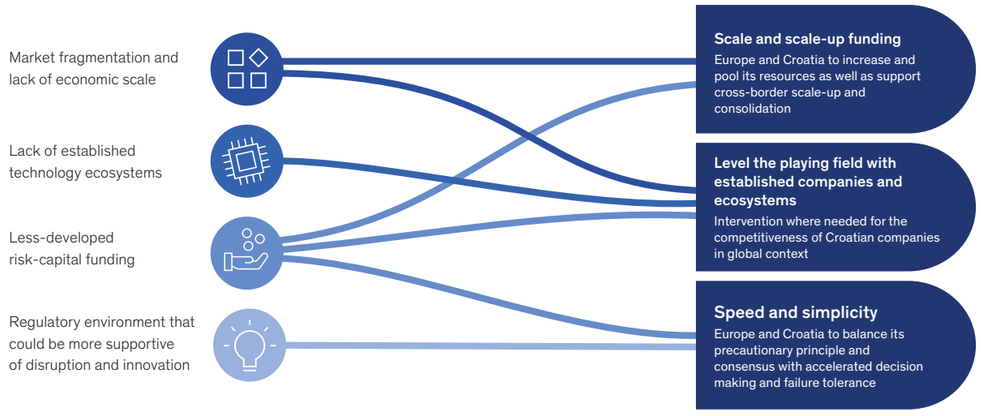
Raising awareness of transversal technologies: Croatia can help emphasize the need to boost Europe's technological competitiveness. For example, France initiated and hosted a ministerial conference on digital sovereignty in February 2022 as part of Scale-Up Europe.[44] Croatia could continue to support such events, or initiate and host a similar event on a topic related to one or more of the ten transversal technologies.

Providing political support for EU initiatives: Croatia's representatives in European and especially EU bodies (such as the Council, Commission, and Parliament, as well as general directorates and EU agencies) could provide political and institutional support for the promotion and development of tech-innovation initiatives.

Taking the lead in implementing EU-wide initiatives: Croatia could play a prominent role in developing policy and pilots that enable Europe to catch up on innovation, production, and adoption of transversal technologies. Croatia might take the lead in areas where it has comparative advantage, such as future of connectivity, distributed infrastructure, and applied AI. For example, Croatia is one of the frontrunners in implementing e-Health, focusing on digitalization of processes and data connectivity.[45]

Exhibit 5

Four standout, intertwined challenges, can be addressed through policies in three areas



Source: McKinsey analysis

[44] Scale-up Europe brings together more than 30 start-up and scale-up founders, investors, researchers, and corporations. The aim is for Europe to become home to ten tech giants, each valued at more than €100 billion, by 2030; "Scale-up Europe spurs collective action to accelerate European tech," French Presidency of the Council of the European Union, February 2022.

[45] Digital Economy and Society Index (DESI) 2022 Croatia, European Commission, July 2022.

EU-level initiatives to close the technology gap

Certain policy initiatives to boost Europe's (and Croatia's) technological competitiveness can only happen at the EU level, as they involve policy decisions delegated to the Union or need all the EU countries to act together. These initiatives (covered in more detail in the earlier MGI report) could include[1]:

Developing a European corporate rule book or 28th regulatory entity for greater harmonization: Companies cite a lack of regulatory harmonization as a major barrier to growth in Europe. Europe (or even the EU) is still not a single market in many ways, and this fragmentation means that the region's startups encounter cross-border complexity early on. While regulation is becoming more streamlined, congruent standards for taxes, regulation, labor rules, and administrative processes have not yet been achieved. Europe could develop a pan-European, 28th regulatory entity that supersedes national standards, allowing high-growth companies that comply to operate in all European countries.

Initiating debate on ways to protect nascent technology companies on the global stage: As Europe is made up of relatively small markets, compared to the US and China, innovative new companies generally need more time to scale than their counterparts in competitor regions. They also tend to have lower valuations than companies in the US. The EU could explore ways to protect such small European companies and help them to build their capabilities—without compromising the opportunities for learning, scaling, and funding that cross-border competition can generate.

Facilitating cross-border consolidation: Greater scale requires cross-border consolidation of companies, and European decision makers could do more to remove political barriers for such consolidation. The proposed framework for the single market is in place and should be implemented.[2] More integration is needed in energy, while in finance, progress toward capital-markets and banking unions could be hastened. In digital, common standards could be established to ease data sharing across EU member states. Antitrust and concentration rules could be applied at the European level for M&A in sectors where competition is global.

Building European scale-up capital: Europe's later-stage growth funding is small compared to the US. Europe could build institutions like the United States Defense Advanced Research Projects Agency (DARPA) by further developing the Joint European Disruptive Initiative (JEDI). To encourage investment in alternative asset classes, the EU could reduce restrictions and capital requirements, build sophisticated pension institutions, and create a public venture-capital fund.

Increasing development and crisis support for regions in need. Enhanced support for less developed parts of Europe could help EU structural funds and the Recovery and Resilience Facility reach their full potential and grow internal markets. Effectiveness here would require good governance, locally and at the European level, as it would involve monetary transfers and economic-development support.

[1] "Securing Europe's competitiveness: Addressing its technology gap," McKinsey Global Institute, September 22, 2022.
[2] European industrial strategy and Business journey on the Single Market: Practical obstacles and barriers, European Commission, March 2020.

Croatia can also work directly toward reducing its technology gap

There are also actions that Croatia can initiate—either alone or with partner countries, through bi- and multi-lateral agreements—without needing to wait for the EU to act. Such initiatives would address challenges in three areas: scale and scale-up funding, leveling the playing field with established companies and ecosystems, and increasing speed and simplicity.

Scale and scale-up funding

Where the scale of markets, companies, and investment is important, Croatia could take action to enable corporates to scale up key transversal technologies.

Conducting joint public R&D procurement: Croatia spent over €626 million of its gross domestic expenditure on R&D in 2020 (equal to 1.25 percent of its GDP that year), compared with €310 billion by the whole EU (equal to 2.31 percent of total GDP).[46] Joint procurement with other interested countries in innovation-related areas, from defense and healthcare to education technology, would lead to larger orders and more negotiation leverage, and consequently better deals. EU regulations and legal frameworks allow for such joint procurement—for example, countries pooled their orders for medical supplies during COVID-19.

Opening more funds for risk capital: Croatia could build on the initiative of the Venture Capital Funds-of-Funds (under the auspices of VentureEU) to create a public venture-capital fund. Unlocking this finance hinges on innovative policy and development of a strong angel-investor ecosystem. At a later stage, co-investment schemes and tax incentives could be applied.[47]

Stimulating demand for new technologies through early adoption by the public sector: Collaboration between the private and government sectors could be key to unlocking economic opportunities. For example, Croatian authorities could create more local demand for the IoT by updating and expanding its network of monitoring and data-collection devices.[48] This additional data could be leveraged with advanced analytics to improve functions such as national defense, city planning and management, transport, food and water supply, and pollution control.

Level the playing field with established companies and ecosystems

The Croatian government could help level the playing field for local companies by intervening where needed to allow them to become and remain globally competitive. Some policies might focus on developing talent as Croatia's prime future success factor, others might involve limiting natural monopolies and further incentivizing R&D for smaller players.

Increase resources and support for low-income students: Croatia's education system is comparatively well funded—while the average EU government expenditure on education was 5 percent of GDP in 2020, Croatia's was 5.4 percent. Textbooks are free

626M

Euro spent on R&D in Croatia in 2020

[46] GERD by sector of performance, Eurostat, November 4, 2022.
[47] Under VentureEU, the EU provides cornerstone investment of €410 million in independently managed venture capital funds-of-funds. See more at "VentureEU: Pan-European Venture Capital Funds-of-Funds Programme," European Commission, April 10, 2108.
[48] "Internet of Things: Information on Use by Federal Agencies," U.S. Government Accountability Office, August 13, 2020.

McKinsey & Company

5.4%

of Croatian GDP is spent on education (slightly above EU average)

at primary-school level.[49] Yet there are regional inequalities: there is a dearth of education programs in poor communities, and a high number of secondary-school students live in poverty. Further, a relatively high share of Croatian 15-year-olds underperform in reading, mathematics, and science compared with the EU average.[50] Croatia could enhance its assessment system—for example, by redesigning examinations to evaluate broader skills, set a higher bar for teaching and learning, and give students and teachers greater support.

Increase STEM graduate numbers and general digital literacy: Ramped-up skills development is necessary to remain competitive in the vital science, technology, engineering, and mathematics (STEM) fields. Croatia offers 1,781 study programs, of which almost 39 percent are in STEM. However, the country has a relatively low tertiary attainment rate overall, with a significant gender gap, and the lowest graduate employment rate in the EU.[51] More could be done to increase STEM student numbers, including increasing direct funding grants for foundational research at universities and other educational institutions.

Attract and retain talent: Croatia could invest more in attracting, developing, and retaining entrepreneurial and STEM talent. For example, since January 2021, Croatia's digital-nomad visas have helped to draw talent from abroad. The country could market itself to such workers as a low-cost, geographically favorable destination, with relatively high standards of living and infrastructure, low crime, and abundant natural beauty.[52]

Ensure a level playing field for smaller companies in the context of natural digital monopolies: The EU has established a digital strategy to ensure that large online platforms in gatekeeper roles act fairly.[53] Croatia might consider similar actions to grant smaller companies more space for innovation. These might include strong support and faster action on service unbundling, and open or regulated access to platform services and data. Croatia could also explore ways to give local tech innovators time to scale up—protecting them to some degree in their formative stages from global competitors operating in less fragmented markets.

Utilize taxation to encourage R&D by smaller players: To incentivize and boost R&D efforts by small and medium-sized enterprises, Croatia could further intensify aid and grant maximum tax relief for industrial research, experimental development, and feasibility studies for smaller players (to the extent allowed by the EU competition legislation on state aid). [54]

Speed and simplicity

The ability for companies to act quickly, without getting mired in complex bureaucratic procedures or human-resource constraints, will be vital in helping Croatia close the technology gap. Croatia could ramp up its agility in a broad range of innovation-related areas.

Develop fast-track regulatory approval and decision-making processes: In disruptive innovation, speed matters, yet Croatia frequently lags even behind the notoriously slow-moving European regulators. For example, as the bio revolution continues to impact the pharmaceutical sector, promising dramatic breakthroughs in treatment outcomes, Croatia still takes 414 days on average—eight times longer than Germany—to approve advanced treatments that have already been approved by the EU regulatory agency.[55] Improved public-sector productivity would help to speed up bureaucratic funding and permitting processes.

Rebalance the regulatory approach to one that rewards disruptive innovation: In certain breakthrough technologies, Croatia could choose to ease requirements (within the bounds of EU regulations) in areas such as consumer protection. This would allow faster disruptive research and innovation roll-out, prioritizing better outcomes over minimizing risk. For example, given the planned launch of a robo-taxi service in Zagreb in the next few years, it will be important to act quickly in regulating the use of autonomous vehicles on public roads.

Boost upskilling and reskilling of workers and enable faster labor reallocation: As disruptions spread, existing occupations could see rapid declines in demand, driving up unemployment rates. According to McKinsey research, up to 140,000 Croatian workers may need to be reskilled into new occupations by 2030 in order to stay employed.[56] At the same time, large numbers of workers may be needed to fill new roles, requiring new skills—creating workforce-based bottlenecks in business expansion. Companies may also face the need for changes in work organization and internal workforce deployment.

In response, Croatia could further increase the incentives it offers to companies—tax credits, subsidies, grants, and vouchers—to retrain employees and develop their professional competencies. (Currently, Croatia covers up to 80 percent of total training costs for upskilling workers.)[57] The reskilling ecosystem could be considerably strengthened in other ways, too: programs could be updated and shortened, and support for workers and unemployed persons in need of reskilling could be increased. Additionally, labor-market rules may need to be reviewed to support faster internal reallocation.

414

days on average to approve advanced medical treatments already approved by the EU

140K

Croatian workers might need to change occupation to stay employed by 2030

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How Croatian companies can step up and compete

While policy and regulation could help create an environment that would enable European and Croatian companies to be more competitive, their longer-term growth and success in the global markets will also likely depend on the companies themselves acting to develop scale and increase agility. Actions that companies might take include:

- **Setting long-term targets and incentives:** In the current environment of disruptions, companies need to look beyond their current ways of doing business. It will be important to develop a long-term vision for global leadership, taking risks and deploying appropriate capital and R&D investment—with compensation for executives and employees to match.
- **Leveraging programmatic M&A and alliances to acquire scale and capabilities.** Such actions might involve cross-border European and global consolidation. Vertical and capability-based acquisitions could boost innovation and strengthen ecosystems. Companies could seek out and develop cross-sector alliances, important in the development of transversal technologies.[58]
- **Investing in innovation, governance and capabilities at unprecedented levels:** Agile, customer-centric innovation governance will be required for high-risk, long-term projects. Companies will need to build skills and source funds on a larger scale than before—and utilize them for long-term innovation and business development.

As geopolitical and technological shifts continue to disrupt the status quo, Croatia can revamp collaborations between its private and public sectors, and with other EU member states, to boost its technological and corporate competitiveness. This could be key to Croatia keeping up with EU counterparts and driving economic growth and investment, while maintaining social progress.

[58] "How one approach to M&A is more likely to create value than all others," McKinsey Quarterly, October 13, 2021.

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