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5G for Industry 4.0:

Actors, Challenges, and
a New Start for Europe

Abstract:

The European industry will benefit from the introduction of fifth-generation (5G) network technology, which will enhance the internal market's competitiveness. The article takes a closer look at the practical challenges that this innovation entails for Europe and what needs to be done to address them and thus ensure a smooth transition to the digital future. The deployment of 5G for Industry 4.0 will involve a plurality of actors, from mobile and telecom operators to the manufacturing and automation industries. They all have the potential to shape the ecosystem of European industry with the introduction of 5G. A new start will have to pass through scalability, harmonisation, and investment in digital skills.



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5G as a transformative force for European industries

Economic recovery plans across Europe are promoting the accelerated provision of 5G wireless services. Not only a successor to 4G on consumer markets, 5G is also a transformative force towards Industry 4.0. This aspect is certainly more complex, as industry users are highly diverse, but its business potential is equal if not higher. This is a key economic issue for industries across Europe that are facing a new post-pandemic world. Large swaths of manufacturing, building, agriculture, and health industries will have to adjust to changing civic and consumer behaviours.

Therefore, the future competitiveness of European industry and the European economy in international trade is also at stake. We do not yet know what deep and swift changeovers will occur, but we do know that new trade-offs will be established between free-trade and cost optimised supply chains, on the one hand, and sovereignty and risk-mitigating requirements, on the other. In this context, the ongoing transformation of European industries and the European economy as a whole will be essential to positioning Europe in the post-pandemic world and allowing it to deal with the inevitable social transition costs of this forthcoming economic phase.

Significant competitive advantages are expected from 5G networks, whether in transforming manufacturing industries or helping reverse negative trends.¹ When it comes to the latter, European industries are facing a number of structural problems, including costly cable connectivity, inflexible production lines, outdated real-time data use for production control, and suboptimal wireless solutions. With the rollout of 5G across the continent, it is expected that Industry 4.0 will benefit from a range of transformations: reliable, low latency, and all-purpose wireless networks; wireless sensors and real-time data analytics; ultra-versatile robots; Automated Guided Vehicles; and cloud control.

In view of such a transformative process, this brief focuses on 5G for Industry 4.0 and examines the actors that are best positioned to take advantage of 5G technical and business opportunities as well as the challenges they are facing. Critical policy issues affecting Industry 4.0 issues regarding skills, investments, and competition will have to be addressed if Europe is to compete in a highly competitive digital environment running on 5G.

¹ Davies, R., Industry 4.0: [Digitalisation for productivity and growth](#), EPRS Briefing (Brussels: European Parliament, 2015).

Industrial actors and their challenges

The industrial manufacturing market is an attractive potential part of future 5G revenues. The sales market for 5G manufacturing solutions has been estimated to reach 132 billion USD in 2030, at a growth rate of 75 percent over the period 2020–2030.²

The complex nature of 5G for industry attracts a plurality of actors which have to compete and cooperate to provide the best possible services. World leaders in manufacturing are forging ahead. Runner-up businesses and countries see their chance to catch up and leapfrog leaders. We can, however, already identify the main actors with the potential to shape the 5G industry ecosystem.

Actors	Role in the 5G ecosystem for Industry 4.0	Challenge(s)
Mobile network operators (MNOs)	Addressing vertical industry requirements, implementing network slicing (and virtualisation), being capable of critical operation, real-time automation, and secure handling of critical data.	Matching technical and commercial requirements defined by vertical industry.
Manufacturing industries	5G for Industry 4.0 represents an opportunity for the European manufacturing industry in the broader context of the global ICT market.	EU industrial giants prefer to manage connectivity by themselves and avoid outsourcing.
Industrial automation companies	Applying know-how to vertical industries, achieving economy of scale.	Strong internal competences or a loyal customer base are needed to succeed.
Telecom equipment vendors	Improving opportunities for cooperation in the Industry 4.0 vertical market.	Managing relations between consumers (industries and MNOs)
Digital services firms	Incrementing strategic partnerships.	Ability of stakeholders to transfer and adopt co-creation/co-design methodologies.
National regulatory agencies (NRAs) or spectrum regulators	Allocating the spectrum for full deployment of 5th Generation networks.	Lack of consistency in allocation and licensing within the EU.

2 Fortier, P. et al., [5G for business: a 2030 market compass](#) (Ericsson & Arthur D. Little, October 2019).

Mobile Network Operators (MNOs)

MNOs are deploying 5G networks which enable multiple virtual networks on a shared physical infrastructure (“network slicing”). They can address vertical industries through customised network slices relying on nationally assigned individual spectrum licenses. Their connectivity and slicing run like dedicated networks and are capable of critical operation, real-time automation, and secure handling of critical data.

Tight knowledge and experience-sharing as well as cooperation between MNOs and vertical industries are required; MNOs and vertical industries have already engaged in some trials and experiments in 5G connectivity. MNOs have a track record of high-availability networks with a quality of service that will not be easy for newcomers to match by themselves. MNOs, however, devote important resources to expand their industry applications. Even if large verticals move to set up “private” networks, experience shows that MNOs have some role in these private networks as manager, consultant, or spectrum access provider. This is even more true with SMEs. There is currently no consensus on the number of manufacturing industries planning to set up a network of their own; some say most industries while others claim only the biggest contenders will do so. Even in those cases, MNO expertise will presumably be required. 5G will be a differentiating factor for MNOs. Not all of them will build an extensive Industry 4.0 presence. A divide will appear between those who succeed and the rest. One major challenge facing their expected role in the Industry 4.0 ecosystem is their ability to combine recognised global competence with more local know-how.

MNOs have market scale. The challenge for them is to expand on their knowledge of industry transformation as previous generations of wireless services for industries become mainstream. MNOs work hard to demonstrate they can match the technical and commercial requirements defined by vertical industries.

Manufacturing industries

5G for Industry 4.0 presents the manufacturing sector with an opportunity to keep up with the worldwide rise of ICT and digital companies. The world leaders of manufacturing now expect further improvements of their industry productivity.³ Companies and countries which played a lesser role in the past decade now have the ambition to catch up by taking the upper hand.⁴

Their success in implementing 5G for industry services and equipment will depend on their ability to: emphasise 5G’s added value in enhancing connectivity as part of the engineering factory design process; demonstrate the cost-efficiency contribution of 5G; work on the compatibility and inter-operability of mobile networks within existing industrial systems; provide security and data privacy-

³ See, for example, [Manufacturing Institute, Connecting manufacturers with the future: how 5G is transforming the manufacturing landscape](#) (2021).

⁴ See Digital Catapult, [Made in 5G: 5G for the UK Manufacturing Sector](#) (July 2019).

proof solutions; and work with telecommunications sectors to co-design solution-based, not just service- or equipment-based, business models.

In June 2019, a Cap Gemini study found that “one third of industrial companies, and almost one half of large industrial organisations, will apply for their own 5G licenses”⁵ in a timeline of 2 to 3 years. It concluded:

This research makes it clear that industrial companies are confident about the benefits of 5G before it has even come to market. That said, 5G is an emerging technology and there will be many challenges to overcome before it is ready to be deployed at scale. Co-innovation between industrial companies and the telco ecosystem, in the form of pilots and open experimentation platforms, will be essential to create win-win business, service and operating models that will foster 5G adoption.⁶

Industrial giants in European manufacturing, airports, and ports are bound to own and manage network connectivity for all of their supply chains and production lines. These industries share the same reluctance to outsource connectivity out of control and liability concerns.

Industrial automation companies

Industrial automation business propositions draw on their experience to apply system integrators to a series of vertical industries, and they claim that in comparison to singular self-deployment solutions they can achieve economies of scale. It is a tempting offer, e.g., for computer services giants employing tens or hundreds of thousands of software engineers to expand as providers of 5G connectivity services into the Industry 4.0 market. System integrators with strong competence areas of their own or a loyal customer base have the potential to succeed.

Telecom equipment vendors

Network vendors themselves are engaged in the search for revenue and economies of scale. It seems logical for them to leverage their own core VtoO (Vendor to Operator) experience, know-how in handling radio frequencies, and network equipment into a compelling VtoInd (Vendor to Industry) proposition. Vendors, however, might be reluctant in principle to engage directly with industry customers for fear of alienating their much larger MNO customer constituency. Does not a well-known management motto say ‘don’t compete with your customers’? Yet all vendors now have Industry 4.0 propositions for the vertical markets, including a wide range of possible cooperation arrangements and making sure to accommodate rather than antagonise their large-scale MNO customer base.

5 Capgemini Research Institute, [5G in Industrial operations. How telcos and industrial companies stand to benefit](#) (2019).

6 Ibid.

Digital service suppliers

Looking at all the trials, experiments, future visions, and strategic plans emanating from every quarter, the current evidence seems to suggest that no single actor possesses all the necessary competences to set up Industry 4.0 by itself. The perspective in the deployment of 5G connectivity services to vertical industries is definitively one of reciprocal knowledge and understanding, cooperation, joint supply, and partnership agreements.

As noted by the Dutch Radiocommunications Agency, “providers and industry should change their game in the telecommunications sector”⁷ in order to create added value in a cooperative environment and, further: “[a] possible future of hybrid cellular networks for industry will involve all actors, co-operating in designing and operating integrated systems, but also fighting for market share and revenue.”⁸

In this sense, strategic partnerships are likely needed to achieve the necessary combination of MNO know-how and that of the actors involved in industry processes, whether they are the industries themselves or systems providers or integrators. Much has already been implemented with 4G wireless technologies and WiFi. However, in some industries, the ability to fully implement 5G will be a differentiating factor which will split the competition in the middle between winners and losers, with dire consequences at the national economic level.

The relationships between industry and telecommunications operators are of a complex nature. They imply an ability to go beyond generic fixed and mobile service provision and achieve the real co-creation of a full-fledged 5G industry ecosystem. Co-creation, or co-design, is nothing new in creative management processes.⁹ The ability of stakeholders to transfer and adopt co-creation/co-design methodologies will be a Key Success Factor.

NRAs and Spectrum for Industry 4.0

5G implementation requires access to radio spectrum frequencies. As different network solutions can serve Industry 4.0, different structural options revolve around its use and access, the corresponding network solutions, and the actors involved:

- Private network (self-deployed, through an MNO or third party)
- Public network (MNO);
- Hybrid private/public combination.

Issues of access and pricing of the radio spectrum, a limited public resource, involve regulatory monitoring. Concerns have been expressed by the Commission and the European spectrum regulators body, Radio Spectrum Policy Group

7 Verkerk, H., [CEPT workshop on New Spectrum Solutions for Industry Sector, Radiocommunications Agency NL](#) (June 2021).

8 Ibid.

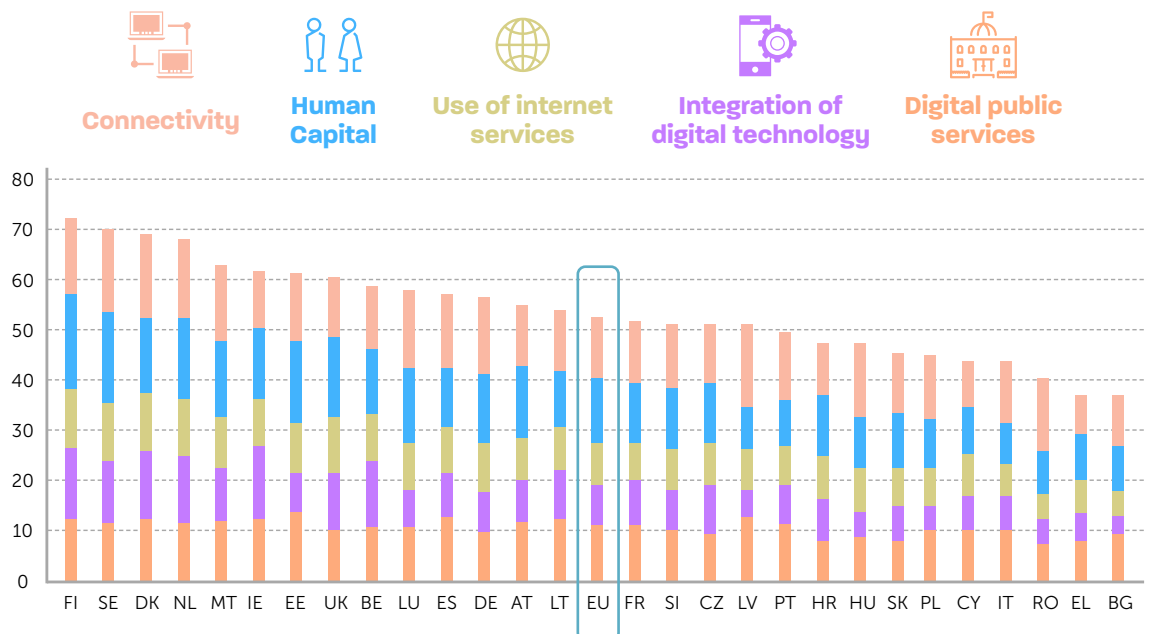
9 See Gentès, A., *The In-Discipline of Design* (Springer, 2018).

(RSPG). The lack of EU-wide consistency in allocation and licensing conditions of frequencies for Industry 4.0 hinders harmonisation and standardisation, delaying and weakening European developments. This issue is monitored by regulators, for instance, AGCom in Italy.¹⁰

Digital skills and investments: a new start for Europe

For Europe to succeed in this technological transition, two issues will eventually have to be addressed: digital skills and investments in ICT. Digital science and technology play an ever-growing role in manufacturing and all industrial sectors, from mechanical engineering to agriculture. As an illustration, the share of automotive electronics in the total cost of a car has risen from 10% in 1980 to 35% in 2010, and it is expected to reach 50% by 2030.¹¹ Accordingly, production processes will have to go through a digital transformation process. The existence of a digital skills gap in Europe, however, has been acknowledged.¹²

We can refer on that matter to the Digital Economy and Society Index (DESI), “a composite index that summarises relevant indicators on Europe’s digital performance and tracks the evolution of EU Member States in digital competitiveness”.¹³



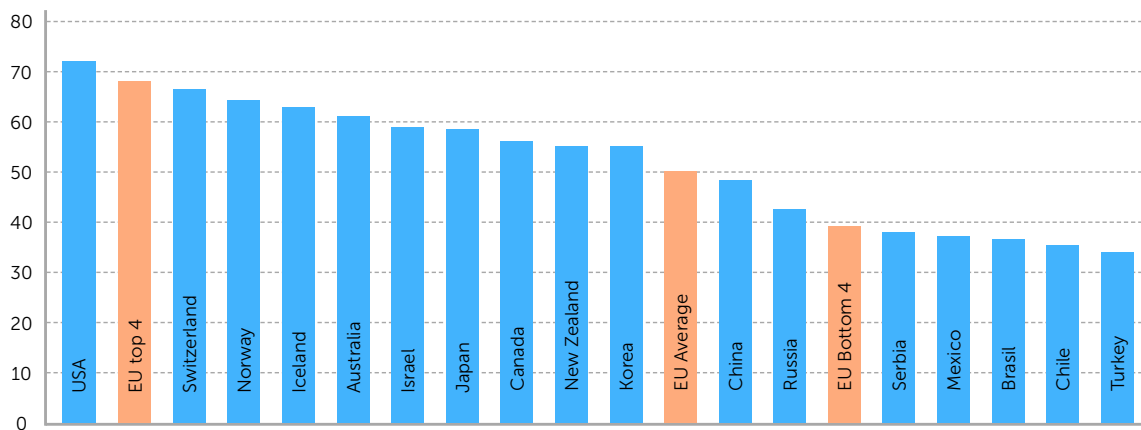
Indicators of digital performance in Europe
(European Commission, [The Digital Economy and Society Index \(DESI\)](#) (2020).

¹⁰ Autorità per le Garanzie nelle Comunicazioni, [Indagine conoscitiva sull'utilizzo dello spettro radio al servizio dei settori verticali](#) (2021).

¹¹ Statista, [Automotive electronics costs as a percentage of total car cost worldwide from 1970 to 2030](#) (2021).

¹² European Commission, [Digital skills and jobs](#) (2020).

¹³ European Commission, [The Digital Economy and Society Index \(DESI\)](#) (2020).



International Digital performances compared with data from 45 countries.
(European Commission, [International Digital Economy and Society Index 2020](#) (2020).

Advanced and specific skills are needed to cope with the sweeping expansion of complex ICT across industries. Whether we look inside Europe or at international comparisons, too many European workers lack basic digital skills. The EU and its Member States have launched a series of initiatives to bring 70% of adults basic digital skills by 2025.¹⁴ Competencies, moreover, are scattered across production process actors. The current feeling is that comprehensive solutions from contiguous actors in the value chain is still a work in progress. Several EU programs and initiatives intend to fill these gaps, for instance, by supporting the advanced manufacturing research centres which exist at universities in Europe.

A similar picture can be painted for ICT and digital investments. The European Investment Bank Investment Survey “shows that European firms currently lag behind in adopting digital technologies”¹⁵ This reflects the observation that investments in ICT in Europe are significantly lower than in the USA, with negative effects on innovation as well as productivity.¹⁶ The EU and its Member States have already launched numerous initiatives in this area.¹⁷

Skills and investments go hand in hand. In its 2020 report, the European Court of Auditors found that “the Commission strategy for supporting the digitisation of European industry was soundly based and supported by Member States, but lacked information on intended outcomes, result indicators and targets”.¹⁸

14 Stolton, S., [Commission in bid to ensure ‘70% of EU adults’ have digital skills](#) (1 July 2020).

15 European Investment Bank, [Who is prepared for the new digital age? – Evidence from the EIB Investment Survey](#) (20 April 2020).

16 Gordon, R. J. & Sayed, H., Transatlantic technologies: [Why did the ICT revolution fail to boost European productivity growth?, VOXEU](#) (21 August 2020).

17 European Commission, [Shaping Europe’s digital future](#) (2021).

18 European Court of Auditors, [Digitising European industry: an ambitious initiative whose success depends on the continued commitment of the EU, governments and businesses \[Special Report\]](#) (2020).

Numerous initiatives are currently being taken in the EU. The effort targeting SMEs, for instance, is centred on the European Digital Innovation Hubs in Digital Europe Programme.¹⁹ Promoting the digital age is a major EU policy.²⁰

At this take-off stage of 5G for Industry 4.0, the definite picture of relationships between actors and definite solutions has not yet emerged. Partnerships and close technological linkages between MNOs, industries, vendors, industry automation specialists, and third parties are the pre-conditions for a successful 5G-for-industries expansion. We are witnessing a competitive and transformative process between diverse forms of co-operations among actors. Of course, it is important to leave all options open and let diverse scenarios competitively confront reality.

In two to three years, the European landscape will be a diverse one, with leadership positions in different Member States held by either MNOs or manufacturing industries, vendors, industry integrators, and powerful third parties, depending on the relative strengths demonstrated by all these actors. Nevertheless, the important outcome will be to achieve scalability, standardisation, and harmonisation where necessary for Europe to engage in this new start and seize this critical opportunity to compete on the world scene.

Author bio

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19 European Commission. (2021, 25 January). [European Digital Innovation Hubs in Digital Europe Programme](#) [Draft working document].

20 European Commission. (2021). [A Europe fit for the digital future: Empowering people with a new generation of technologies](#).

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