Digitalisation in international comparison: Germany lags far behind in IT investment

No. 352, 14 October 2021

Author: Dr Volker Zimmermann, phone +49 69 7431-3725, volker.zimmermann@kfw.de

The digital transformation is regarded as a key driver of technological progress and growth. Germany, however, is midrange at best in the use of digital technologies by businesses. The development of information technologies is also not among the strengths of the German innovation system.

An international comparison also reveals that Germany's investment in information technologies (IT) lags far behind other major highly developed countries such as the US, France or the United Kingdom. In order for its IT investment-to-GDP ratio to catch up with these countries, IT investment volume will have to double or treble. With respect to digitalisation expenditure in the SME sector as captured in the KfW SME Panel, that means an increase from currently around EUR 18 billion to EUR 35–50 billion.

A number of hurdles still stand in the way, however. On the one hand, efforts must continue to make businesses aware of the benefits of digitalisation, particularly from a strategic perspective. On the other hand, specific barriers such as the shortage of qualified specialists and lack of skills, limited access to finance and continuing deficits in digital infrastructure must be addressed. Economic policies must now set the course in the right direction.

Digitalisation is viewed as an important driver of economic growth and increasing prosperity. As a general purpose technology,[1] digitalisation is a beacon of hope for increasing the competitiveness of broad sections of the economy and for kick-starting productivity growth. One factor that contributes to this is that digitalisation and innovation activity are connected in many different ways. Thus, digitalisation influences innovation activity as it often constitutes the technological basis that makes innovation possible in the first place.[2] For example, digital data represent important input for innovation. Furthermore, digital technologies make it possible to develop innovative products and services, improve efficiency, create new forms of interaction with customers and business partners and speed up innovation cycles.

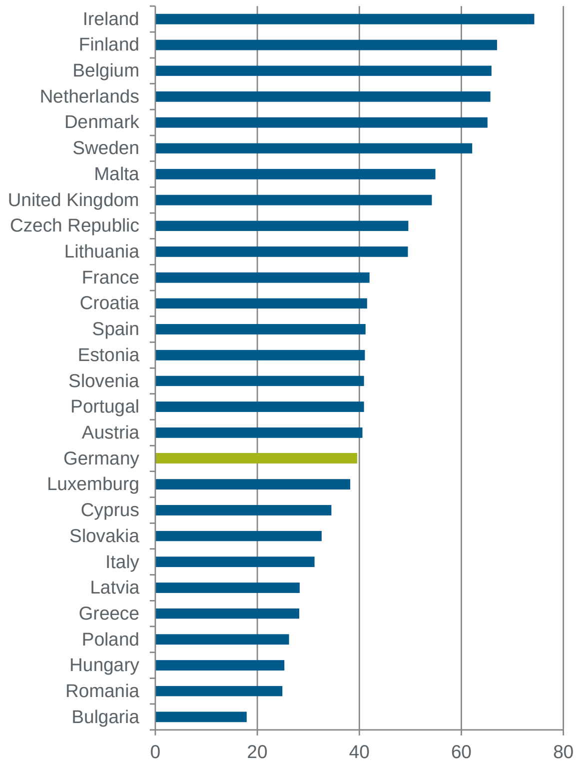
On the other hand, it is particularly innovative enterprises that are driving digitalisation forward in great strides.[3] Digitalisation activities are therefore important investments in the future with which companies can position themselves in the market and strengthen their own competitiveness.

The penetration of information technologies (IT) into the economy and society is certainly not a new trend.[4] But the current digitalisation wave is a far-reaching process that is not only sweeping through individual sectors but leading to profound changes in business and society.

The following analysis presents Germany's position in the area of digitalisation in international comparison. In particular, it compares the country's expenditure on digitalisation with that of other countries.

Figure 1: Germany's rank in the integration of digital technologies

In index points



Source: DESI 2020

In the degree of penetration of information technologies in the economy, Germany only ranks in the middle of the pack

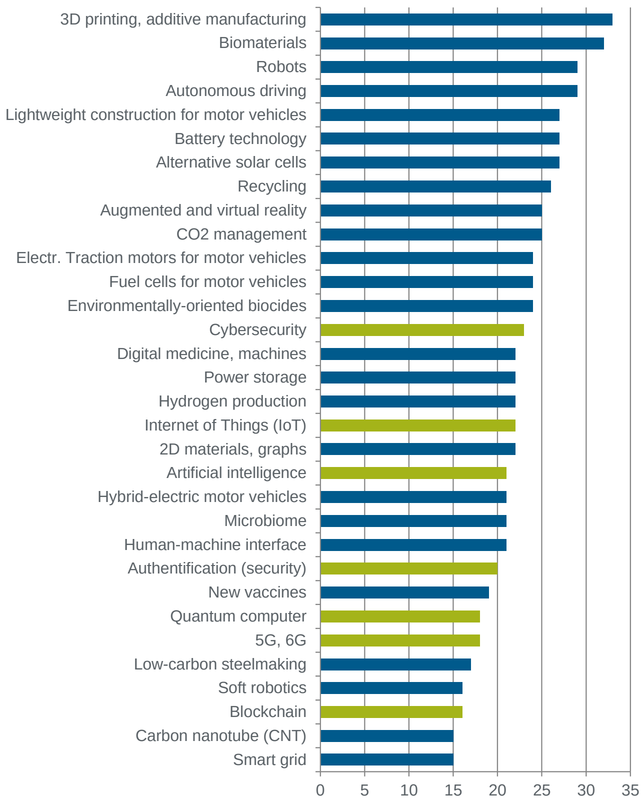
In international comparison, Germany merely occupies a midfield position in the use of information technologies. It ranks 12th within the EU 28 on the Digital Economy and Society Index of the European Union (DESI).[5] Indeed, the country is also merely in 18th position for integrating digital technologies into business processes (Figure 1). Seven individual indicators were used to measure how widespread the use of various digital applications is in the German economy. According to the Wirtschaft DIGITAL economic monitoring

Note: This paper contains the opinion of the authors and does not necessarily represent the position of KfW.

report from the year 2018, Germany does not possess any distinct digitalisation-specific strengths.[6] The report identified a pronounced export weakness in information technologies as a symptomatic consequence.

Figure 2: Ranking of technologies of the future by technological indicators from a German perspective

In index points



Source: Schmoch et al. (2021)

The development of information technologies is not one of Germany's strengths either

A study conducted by the Fraunhofer Institute for System and Innovation Research (ISI), Karlsruhe, on behalf of KfW Research found that the development of information technologies is not one of Germany's strengths either.[7] It determined the dynamic of the development of a number of technologies and Germany's respective technological position on the basis of indicators for patents, research publications and trademark registrations. These indicators were combined into a composited indicator so as to enable the technologies to be ranked.

With cybersecurity, information technologies that are fundamental to digitalisation are only in 14th place (Figure 2). Most of the information technologies examined occupy positions 18 and lower. The Internet of Things, for example, which is important for Industry 4.0 applications from a German perspective, occupies this position. Blockchain technology, the subject of intense public debate, even ranks only 30th. Between them, artificial intelligence[8], which has also come under intense public scrutiny, ranks 20th, for example. The development of the future mobile telecommunication standards 5G and 6G occupies rank 27.

But information technologies are of great importance as general-purpose technologies

Information technologies therefore pose a particular challenge for Germany. After all, as general-purpose technologies, information technologies are of increasing importance for other economic sectors and technological fields as well, such as motor vehicles, production technologies and climate and environmental technologies. Any dependence on foreign producers in this area is regarded as particularly problematic.

The increasing spread of information technologies into the traditionally strong domains of Germany's innovation system can be seen in the fact that high shares of German patents in these fields already relate to applications of information technologies. In technologies that are relevant to the automotive industry, for example, this applies to autonomous driving and hybrid electric vehicles, where 43 and 30% of patents refer to information technologies (Figure 3). In production technologies, information technologies indeed account for nearly 92% of patents involving the human-machine interface, and still a good 68% of patents relating to augmented and virtual reality. In climate and environmental technologies, smart grid technologies involve a very high share of information technologies – 82%.

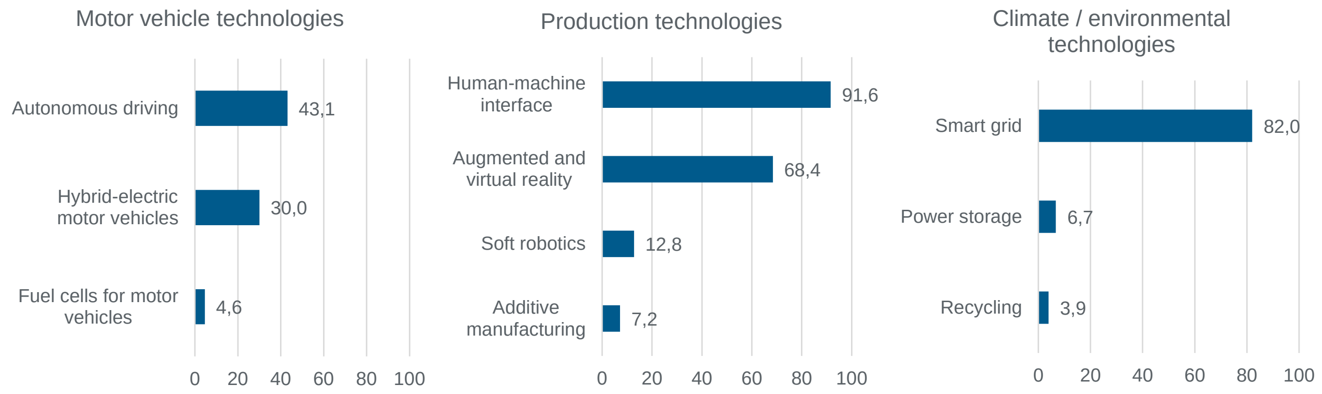
SMEs' digitalisation expenditure is low and growing very slowly

One reason for the relatively low penetration of information technologies into the economy is that small and medium-sized enterprises spend only relatively little on digitalisation. In 2019 a typical SME with digitalisation activities spent only around EUR 21,000 on average on digitalising its operations. SMEs spent just under EUR 18 billion on digitalisation that year.[9] This volume has remained nearly unchanged for years and is only a fraction of investment expenditure on fixed assets such as property, machinery and equipment (EUR 223 billion, Figure 4). Digitalisation expenditure in the SME sector is also low compared with innovation expenditure, which is around EUR 32 billion.[10] This shows that digitalisation in the SME sector is moving in rather small steps.

The KfW SME Panel captures digitalisation expenditure as the amounts which an enterprise spends on the implementation of projects that involve introducing or improving the use of digital technologies in its processes, workflows, products and services and in its contacts with customers and suppliers. This also includes projects aimed at building corresponding skills within the enterprise and implementing new digital marketing and sales strategies.

Figure 3: Share of patents with information technology in other technological fields

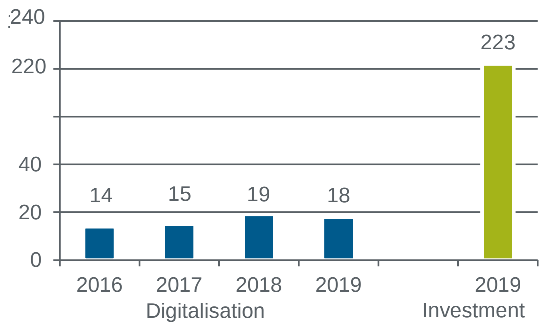
In per cent



Source: Schmoch et al. (2021)

Figure 4: Comparison of SMEs' digitalisation expenditure and investment

in EUR bn



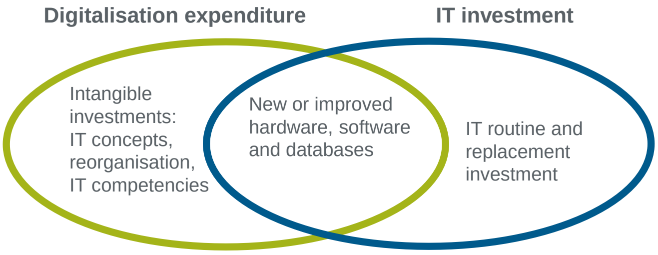
Source: KfW SME Panel, own calculations

Recently digitalisation expenditure in the SME sector is likely to have increased slightly. Digitalisation surged at the beginning of the coronavirus crisis but even as the crisis progressed more small and medium-sized enterprises have reported increasing than decreasing their digitalisation activities. Acute crisis management has likely been the main purpose of the digitalisation activities carried out.[11] At present, however, specific figures are not yet available on how digitalisation expenditure developed over the year 2020.

Digitalisation expenditure is difficult to quantify in international comparison

Nor is it possible to compare digitalisation expenditure figures at international level. That is because no uniform definition has yet been established for digitalisation, unlike for innovation, for example, with the OECD's Oslo Manual and Eurostat.[12] However, the OECD publishes aggregate investment in information technologies for a certain number of countries. In order to better understand what the OECD counts as IT investment, we will first describe the commonalities and differences of IT investment and digitalisation expenditure.

Figure 5: Digitalisation expenditure and IT investment – comparison of concepts



Source: own rendition

IT investment as published by the OECD comprises all investment in computer hardware and telecommunication equipment as well as investment in software and databases.[13] Therefore, it is not congruent with digitalisation expenditure as recorded by the KfW SME Panel. But there are overlaps between digitalisation expenditure and IT investment (Figure 5). Digitalisation expenditure and IT investment both comprise investment in <u>novel</u> or <u>improved</u> hardware and software, telecommunication equipment and databases. IT investment additionally comprises routine and replacement investment which is excluded in digitalisation expenditure as defined by the KfW SME Panel. It only records projects that comprise an initial or improved use of digital technologies. In return, digitalisation expenditure as defined by the KfW SME Panel additionally includes intangible investment such as expenditure on IT strategies, reorganisation in connection with digitalisation and the development of IT skills, for example through basic and advanced training.[14]

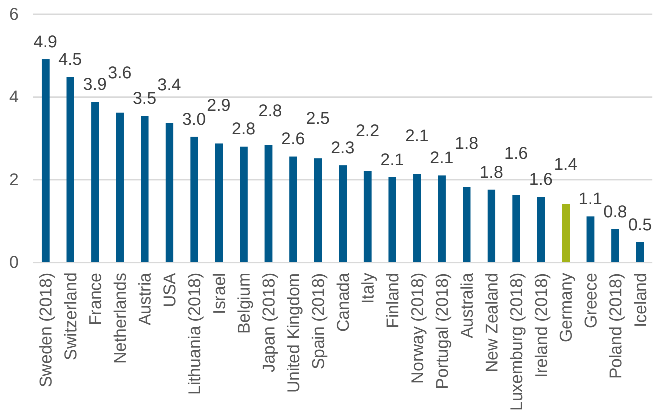
Germany's IT investment is much lower than that of leading countries

According to OECD figures, Germany invested around EUR 49 billion in information technologies in 2019. Assuming the share of the SME sector in aggregate business investment (45%) is the same share as for IT investment, SMEs' IT investment would total around EUR 22 billion. In international comparison, Germany's investment in IT is rather low, at 1.4% of GDP (Figure 6). Sweden tops the list with a share of 4.9%. In other large and highly advanced countries such as

France, the Netherlands, the USA, Japan or the United Kingdom, IT investment in relation to GDP is 1.9 to 2.8 times higher than in Germany, with rates ranging from 2.6 to 3.9%.[15] In order to catch up with other large, highly developed countries, IT investment in Germany would thus have to double or treble to around EUR 100–150 billion. Applied to digitalisation expenditure in the SME sector, as it is measured in the KfW SME Panel, that would mean an increase to EUR 35–50 billion.

Figure 6: IT investment to GDP in international comparison

In per cent



Source: OECD, own calculations

Conclusion

In European comparison, Germany is midrange at best in the use of digital technologies by businesses. The development of such technologies is not among the strengths of the German innovation system either. This is consistent with the fact that IT investment in relation to GDP in Germany lags far behind the levels of other major countries. The country's IT investment volume would have to double or treble in order to catch up with these countries. Applied to digitalisation expenditure in the SME sector, as it is measured in the KfW SME Panel, that would require an increase to EUR 35–50 billion.

There appears to be an urgent need for Germany to position itself more strongly in the application and development of information technologies. For one thing, it is precisely in digital technology fields that new value creation potential is emerging. For another, information technologies – as general-purpose technologies – are also increasingly penetrating traditionally strong domains of the German innovation system such as automotive technologies or production technologies. Unless the digital transformation succeeds, Germany is at risk of losing these strengths in the medium term. Not least, positive effects of digitalisation can also be identified at the level of individual businesses. Enterprises with digitalisation activities achieve better business performance than those without.[16]

However, a number of barriers still stand in the way of increasing digitalisation activities. In order to more effectively tap into the potential of digitalisation, one pathway that needs to be pursued is to continue to make businesses aware of the benefits of digitalisation, particularly from a strategic perspective.[17] Other urgent action is to tackle specific barriers[18], such as the shortage of qualified specialists, lack of skills and difficulties in obtaining finance, and to continue improving the underlying digital infrastructure.

Furthermore, the coronavirus pandemic is threatening to slow down digitalisation activities in the aftermath of the current crisis phase. The experience of this crisis and the higher debt of many enterprises make it more difficult for them to reconcile the conflicting goals of greater crisis resilience and the need to boost investment in competitiveness.[19] This threatens to significantly delay digitalisation projects.

There are many different ways of providing additional financial incentives to implement digitalisation projects. Low-interest loans (with the inclusion of a grand component and the option of partial risk assumption) promote the implementation of digitalisation measures across the broad enterprise sector, R&D support measures promote the development of new digital technologies and, not least, improving the supply of equity finance for start-ups helps new technologies find their way to market quickly. Economic policies must now set the course in the right direction.[20]

[1] Cf. Bresnahan, T. F. and Traijtenberg, M. (1995): General purpose technologies, engines of growth? Journal of Econometrics 65(1), p. 83–108.

[2] Cf. OECD (2020): The Digitalisation of Science, Technology and Innovation: Key Developments and Policies, Paris: OECD Publishing, OECD (2019), Digital Innovation. Seizing Policy Opportunities, Paris: OECD Publishing or Keuper, F. et al. (2013), Digitalisierung und Innovation. Planung – Entstehung – Entwicklungsperspektiven (*Digitalisation and innovation. Planning – Creating – Development Prospects* – our title translation, in German only). Springer, Gabler Verlag.

[3] Cf. Zimmermann, V. (2021): Innovation and digitalisation in enterprises mutually reinforce each other, Focus on Economics No. 338, KfW Research; and Rammer, C.; Füner, L.; Gottschalk, S; Marks; H.; Heimer, T.; Nachtigall, H. and Treperman, J. (2021): Zusammenhang zwischen der Durchführung von Digitalisierungs- und Innovationsvorhaben im Mittelstand (*Correlation between digitalisation and innovation projects in the SME sector* – our title translation, in German only), Leibniz Centre for European Economic Research and technopolis.

[4] Examples of earlier digitalisation waves were the New Economy Boom of the second half of the 1990s, the rise of the PC since the 1980s, and industrial robots since the 1970s.

[5] Cf. DESI (2019); https://ec.europa.eu/digital-single-market/en/desi; last retrieved on 29 January 2021. The current indicator still lists the United Kingdom.

[6] Cf. Federal Ministry of Economics and Technology (2018): Monitoring-Report Wirtschaft DIGITAL 2018 (in German only). Der IKT-Standort Deutschland und seine Position im internationalen Vergleich (*Germany as an ICT location and its position in international comparison* – our title translation, in German only).

7 Cf. Zimmermann, V. (2021): Information technologies are not one of Germany's strengths but of vital importance as technologies of the future, Focus on Economics No. 322, KfW Research and Ulrich Schmoch, U.; Beckert, B.; Reiß, T.; Neuhäusler, P. and Rothengatter, O. (2021): Identifizierung und Bewertung von Zukunftstechnologien für Deutschland (*Identifying and assessing future technologies for Germany* – our title translation, in German only).

[8] Cf. Zimmermann, V. (2021): Artificial intelligence: high growth potential but low penetration in SMEs, Focus on Economics No. 318, KfW Research.

[9] Cf. Zimmermann, V. (2021): KfW SME Digitalisation Report 2020. Digitalisation activity fell before Corona, ambivalent development during the crisis, KfW Research.

[10] Cf. Zimmermann, V. (2021): KfW SME Innovation Report 2020, Coronavirus crisis is slowing down innovation, KfW Research.

[11] Cf. Zimmermann, V. (2021): KfW SME Digitalisation Report 2020. Digitalisation activity fell before Corona, ambivalent development during the crisis, KfW Research and Zimmermann, V. (2021): Innovation and digitalisation in enterprises mutually reinforce each other, Focus on Economics No. 338, KfW Research;

[12] Cf. OECD and Eurostat (2018) (publishers), Oslo Manual 2018. Guidelines for collecting, reporting and using innovation data. OECD Publishing.

[13] Cf. European Commission, International Monetary Fund, OECD, United Nations and World Bank (2009): System of National Accounts 2008, New York, European Commission, IMF, OECD, United Nations, World Bank.

[14] Along the lines of Saam, M.; Viete, S. and Schiel, S. (2016): Digitalisierung im Mittelstand: Status Quo, aktuelle Entwicklungen und Herausforderungen (*Digitalisation in SMEs: status quo, current trends and challenges* – our title translation, in German only), Centre for European Economic Research.

[15] Vgl. https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A; last retrieved on 30 August 2021.

[16] Cf. Zimmermann, V. (2021): Market environment and competition strategies shape innovation and digitalisation activity of small and medium-sized enterprises, Focus on Economics No. 347, KfW Research, forthcoming, and Rammer, C.; Füner, L.; Gottschalk, S; Marks; H.; Heimer, T.; Nachtigall, H. and Treperman, J. (2021): Zusammenhang zwischen der Durchführung von Digitalisierungs- und Innovationsvorhaben im Mittelstand (*Correlation between digitalisation and innovation projects in the SME sector* – our title translation, in German only), Leibniz Centre for European Economic Research and technopolis.

[17] Cf. Zimmermann, V. (2021): Market environment and competition strategies shape innovation and digitalisation activity of small and medium-sized enterprises, Focus on Economics No. 347, KfW Research, forthcoming, and Rammer, C.; Füner, L.; Gottschalk, S; Marks; H.; Heimer, T.; Nachtigall, H. and Treperman, J. (2021): Zusammenhang zwischen der Durchführung von Digitalisierungs- und Innovationsvorhaben im Mittelstand (*Correlation between digitalisation and innovation projects in the SME sector* – our title translation, in German only), Leibniz Centre for European Economic Research and technopolis.

[18] Cf. Zimmermann, V. (2020): How SMEs fund their innovation and investment expenditure – a comparison, Focus on Economics No. 280, KfW Research and Zimmermann, V. (2019): Business Survey 2019. More and more businesses have firm plans for digitalisation, hurdles also more widely acknowledged, KfW Research.

[19] Cf. Zimmermann, V. (2021): Which enterprises have been hit hardest by the coronavirus crisis and what lessons can we learn from it?, Focus on Economics No. 343, KfW Research.

[20] Cf. Köhler-Geib, F. et al. (2021): Emerging stronger from the coronavirus crisis – five areas of action for a sustainable transformation, KfW Research position paper, August 2021.