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, 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.

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. 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. 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

Digitalisation in international comparison: Germany lags far behind in IT investment
report from the year 2018, Germany does not possess any distinct digitalisation-specific strengths. 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. 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 composite 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, 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. 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. 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.
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.

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%. 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

<table>
<thead>
<tr>
<th>Country</th>
<th>IT Investment to GDP (in % of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>4.9</td>
</tr>
<tr>
<td>Switzerland</td>
<td>4.5</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>3.9</td>
</tr>
<tr>
<td>Austria</td>
<td>3.6</td>
</tr>
<tr>
<td>USA</td>
<td>3.4</td>
</tr>
<tr>
<td>Israel</td>
<td>3.0</td>
</tr>
<tr>
<td>France</td>
<td>2.9</td>
</tr>
<tr>
<td>Japan</td>
<td>2.8</td>
</tr>
<tr>
<td>Germany</td>
<td>2.6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.5</td>
</tr>
<tr>
<td>Spain</td>
<td>2.3</td>
</tr>
<tr>
<td>Canada</td>
<td>2.2</td>
</tr>
<tr>
<td>Finland</td>
<td>2.1</td>
</tr>
<tr>
<td>Italy</td>
<td>1.8</td>
</tr>
<tr>
<td>Norway</td>
<td>1.6</td>
</tr>
<tr>
<td>Australia</td>
<td>1.4</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.1</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.8</td>
</tr>
<tr>
<td>Greece</td>
<td>0.5</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0</td>
</tr>
<tr>
<td>Other countries</td>
<td></td>
</tr>
</tbody>
</table>

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.

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. Other urgent action is to tackle specific barriers, 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. 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 grant 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.

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.
Focus on Economics

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.