



Policy Brief #2019/07

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Investment in intellectual capital needs to increase by 35 billion euros per year

In today's world, not only do businesses invest in machinery and buildings, they also increasingly invest in research and development, software and digital skills. Yet German companies are well behind their international counterparts in terms of investment in so-called intellectual capital. This represents a threat to the overall competitiveness of the German economy.

Digitisation is fundamentally changing value-added chains. Processes are becoming increasingly networked – and therefore more complex. These days, not only do businesses need to invest in traditional assets, but also in so-called intellectual capital.

This brief outlines a number of intangible assets that represent as much long-term value for a company as tangible assets do. Research and development (R&D), software, copyrights for artistic work, and mineral exploration are all already regularly reported in national accounting.

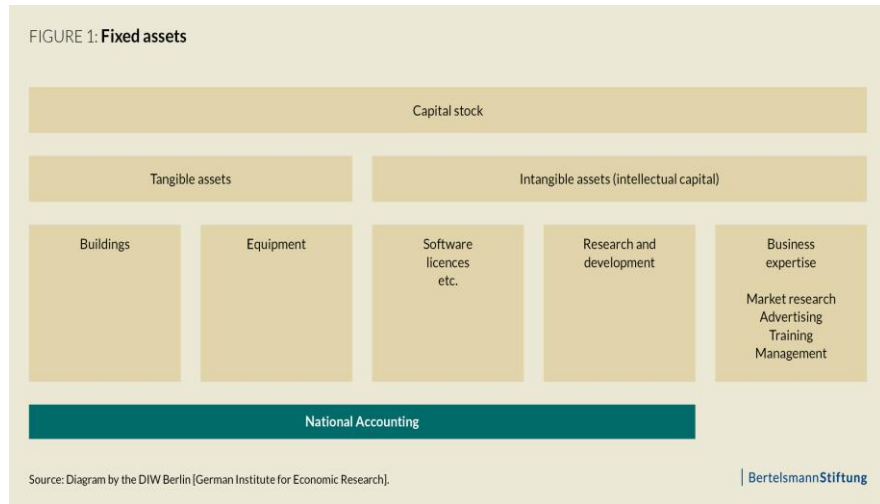
However, investment in business expertise – such as market research, advertising, management and training – is not yet included in national

accounting, but investment in these areas is included under international research projects.

Intellectual capital is growing in importance

Intellectual capital is becoming increasingly important – especially in the wake of increasing digitisation. Investment in intellectual capital is already a key driver of businesses' growth in productivity and their capacity for innovation. Moreover, the spillover effects of intellectual capital can drive overall economic growth, particularly when, for example, the results R&D spread along the value-added chain (Corrado et al., 2012).

According to the DIW Berlin [German Institute for Economic Research], German industrial companies are now investing more in intellectual capital than in traditional assets (Belitz et al., 2018). Indeed, in recent years, German industry has achieved a strong competitive position in the field of knowledge-intensive production.



The term Industry 4.0 embodies the pioneering role of German businesses, for example in the networking of production plants in the mechanical and electrical engineering sectors, and in the automotive industry.

Research-intensive industries account for almost 12 per cent of value added in Germany. Only Korea, where this figure is just over 13.5 per cent, is more specialised. This is primarily due to a strong focus on information and communications technologies. In Germany, the automotive industry makes an above-average contribution to value added (Gehrke and Schiersch, 2019).

German companies are ahead of the international competition in this respect. When it comes to global exports in the technology sector, the only country ahead of Germany (11.6 per cent) is China at 15.1 per cent. The USA, with 11.3 per cent, is the only other country close to matching them. Japan, the next closest competitor, is far behind at 6.2 per cent (Gehrke and Schiersch, 2019).

Yet Germany's current position of strength is under threat. Competition is particularly intense in these export-intensive sectors. Companies have to continually defend their position with innovative products and technologies. Investment in intellectual capital is a crucial part of this.

Our study examines how German businesses are positioned with respect to international competition. For the first time ever, we have per-

formed a comprehensive assessment of the intellectual capital in Germany and compared it with similar economies (France, UK, USA, and the combined weight of Finland, Netherlands and Austria). Firstly, let us consider the components of the intellectual capital coefficient recorded in national accounts. This indicates how much investment was available for the production volumes achieved (in this case, gross value added).

Following the economic crisis, growth in investment in intellectual capital accelerated in most economies (France +22 per cent, Germany +25 per cent, USA +18 per cent, Austria/Netherlands/Finland +29 per cent). As Table 1 shows, looking at the use of all intellectual capital in the economy, Germany was approximately 15 per cent behind the leader, France, in 2017, but at a similar level to the other economies.

Yet an examination of some key areas of the economy reveals that investment by German businesses in intellectual capital is only average. In many sectors they are even behind their international peers.

Industry makes only average use of intellectual capital

In Germany, the manufacturing sector generates around 34 per cent of value added. This puts Germany in a leading position. The automotive and mechanical engineering industries represent a significant amount of this. The two together generate around 35 percent of the total value added in the manufacturing sector.

TABLE 1: Intellectual Capital Coefficients and changes 1997-2017 (index 2007 = 100)

	Coefficient			Index 2007 = 100		
	1997	2007	2017	1997	2007	2017
Total						
DE	0.18	0.20	0.25	89	100	125
FR	0.23	0.24	0.29	99	100	122
UK	0.17	0.14	0.13	115	100	87
USA	0.17	0.20	0.23	85	100	118
AT, FI, NL	0.15	0.18	0.23	82	100	129
Services						
DE	0.08	0.09	0.13	91	100	148
FR	0.17	0.18	0.24	93	100	132
UK	0.20	0.15	0.13	133	100	87
USA	0.13	0.16	0.17	83	100	111
AT, FI, NL	0.11	0.13	0.19	84	100	138
Industry						
DE	0.40	0.44	0.50	92	100	115
FR	0.43	0.52	0.66	82	100	128
UK	0.15	0.24	0.19	65	100	82
USA	0.32	0.44	0.57	74	100	130
AT, FI, NL	0.28	0.36	0.46	78	100	128

Sources: EUKLEMS, Eurostat, OECD; calculations by the DIW.

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On the one hand, this demonstrates just how highly competitive these two sectors are. On the other hand, the high weighting represents a risk, because both sectors face significant challenges. With regard to these challenges, mechanical engineering in particular is investing far too little in intellectual capital and, compared to international companies in the same field, is falling far behind, as illustrated by Figure 2.

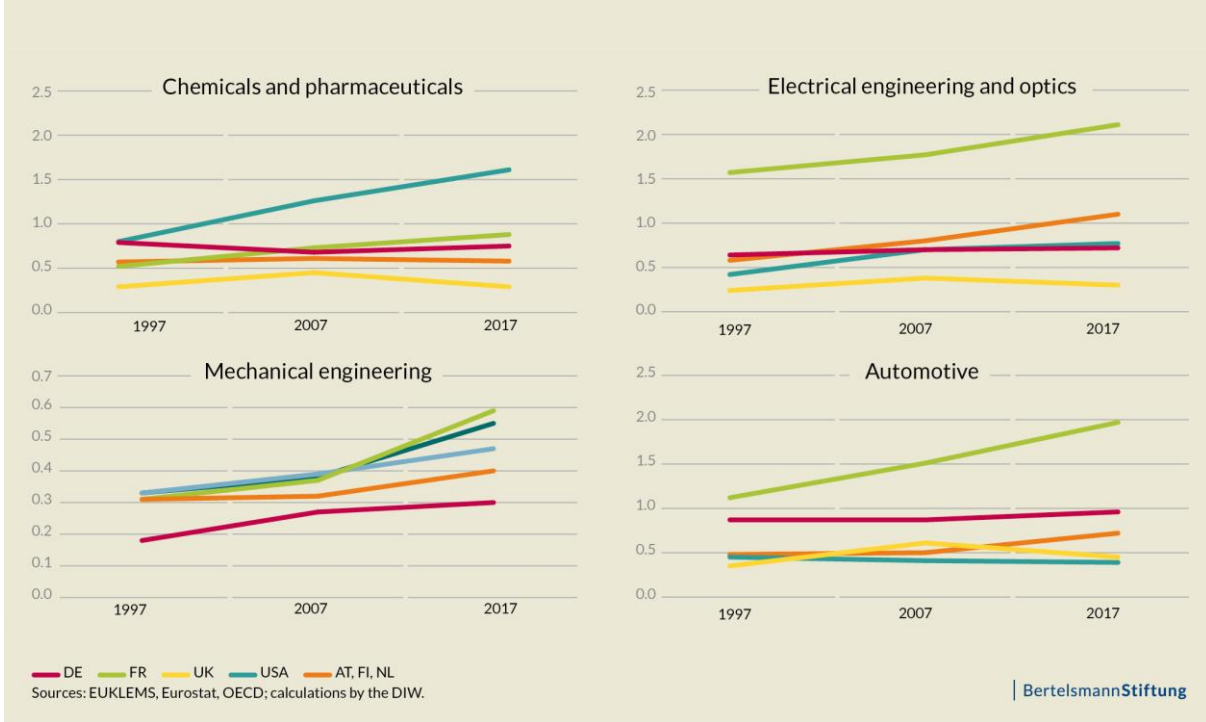
Here, resistance to change appears to remain stronger than the will to change. Medium-sized businesses – which most mechanical engineering companies are – have developed a successful business model over the decades.

Success seems to have tired them out. Yet digitisation sees businesses facing a paradigm shift. Entire value-added chains are changing. Data-driven production is becoming increasingly important. Examination and analysis of the data reveals new areas of business emerging; production is evolving into an industry-related service

(tertiarisation). Moreover, production as a whole can be linked to an Internet of Things, in which machines communicate with one another (machine-to-machine or M2M communication). Given all these challenges – and opportunities – the German mechanical engineering industry appears to be investing far too little in intellectual capital and is increasingly losing access to innovative production technologies, as other studies have shown (see e. g. Rammer and Schubert, 2018).

Comparatively, use of intellectual capital is much higher in the second key industry, automotive engineering. But there is no real momentum to observe here. The use of intellectual capital has barely changed since the late 1990s. It is different in France, where there is a trend for continuous growth in intellectual capital, causing French vehicle manufacturers to pull ahead of their competitors. In that sense, France is much better prepared for the challenges of alternative mobility concepts, new drive systems and autonomous

FIGURE 2: Intellectual Capital Coefficients in selected industrial sectors and countries 1997 – 2017



vehicles.

The outlook for the industrial branches of the chemical and pharmaceutical industries, electrical engineering and optics is also unpromising. Here, German industry ranks in the middle of the field, at best, as illustrated by Figure 2.

Moreover, if the share of intellectual capital not recorded in national accounting is taken into consideration, the picture is even worse. We have used the INTAN-Invest database to examine investment in overall intellectual capital – including components not previously taken into account. And it is precisely with regard to these components – organisational capital, leadership skills, education and further training – where Germany lags behind, around 20 per cent below the average. All these components make up about 50 per cent of investments in intellectual capital as a whole – a significant proportion.

The very low use of organisational capital is particularly concerning. Various studies (e.g. Bender et al., 2018) have demonstrated that business structures, quality of management and employee training and development are important determining factors when it comes to increasing productivity. Companies appear to stick to tried

and tested structures and to be very hesitant about taking on new challenges.

Trailing behind in services

German companies are even further behind their international peers when it comes to applying intellectual capital in the service sectors. In this field, they actually bring up the rear, together with the UK. In France, use of intellectual capital in the service sectors is almost twice as high.

In all the economies we looked at, use of intellectual capital is lower in the service sector than in industry. The use of intellectual capital varies widely across the various branches of the service sector. It is relatively low in retail and transport. It is accorded significantly higher importance in the IT and communications sector, and in corporate services. Overall, however, there has been a notable increase in intellectual capital in just a few service sectors.

German economy underinvests in software and data

In many countries, software and databases are

FIGURE 3: Proportion of investment in value added intellectual capital in selected countries 2015



derstanding and analysing the data that is generated in order to predict potential failures of machine, for example. This requires investment in data analysis methods. German industrial companies are lagging well behind in this respect.

A similar picture emerges for the service sector, where software represents a significantly greater component of intellectual capital than it does in the industrial sector. Nevertheless, German companies invest little in software and databases in comparison to their international competitors. Here, too, German businesses focus on R&D.

Across all sectors of the economy, use of intellectual capital is lowest in Germany. If all components of intellectual capital not included in national accounting are taken into consideration, the use of intellectual capital in Germany is about half that of France, while the United Kingdom invests around 50 per cent more, as illustrated in the

the major components of intellectual capital. In Germany, however, it is R&D. Of all the countries examined in this comparison, German businesses invest by far the least in software and databases, as illustrated in the upper part of Figure 3.

In Germany, investment in intellectual capital is heavily focused on engineering and technology. This is easily explained by the importance of the manufacturing industry.

Yet value-added chains in the manufacturing sector are changing. The ongoing networking of the various stages of the value-added chain amongst themselves makes non-engineering investment in software and databases necessary. Furthermore, the issue is increasingly one of un-

lower part of Figure 3.

Other economies are more modern

In order to predict the future competitiveness of the economy, both the level of capital investment and the modernity of capital stock are crucial.

We have therefore tried to visually depict the modernity of capital stock. The level of modernity indicates the proportion of current investment being ploughed into capital stock. This is particularly relevant for intellectual capital because – unlike buildings, for example – it ages relatively quickly.

Intellectual capital in Germany is far less modern than that of other countries. This is especially true for the service sector. In Germany, investment in

capital stock over the last three investment years accounts for around 80 per cent of capital stock. However, it is 90 to 100 per cent in other countries in the comparison group.

In the German industrial sector, too, the fixed for the average age of intellectual capital is higher than it is in all the other competitor countries. However, Germany is not lagging as far behind the USA and smaller EU countries as it is in the service sector. The UK has by far the most advanced – yet also the smallest – intellectual capital stock in the industrial sector.

This does not at all support Germany’s claim to be one of the most technologically advanced economies. German economic policy needs to review local conditions for investment in all types of intellectual capital.

A comprehensive promotional strategy is required for intellectual capital

In theory, this has already been recognised and, in May, it was decided to increase spending on R&D between now and 2025 from the current level of 3 per cent of GDP to 3.5 per cent.

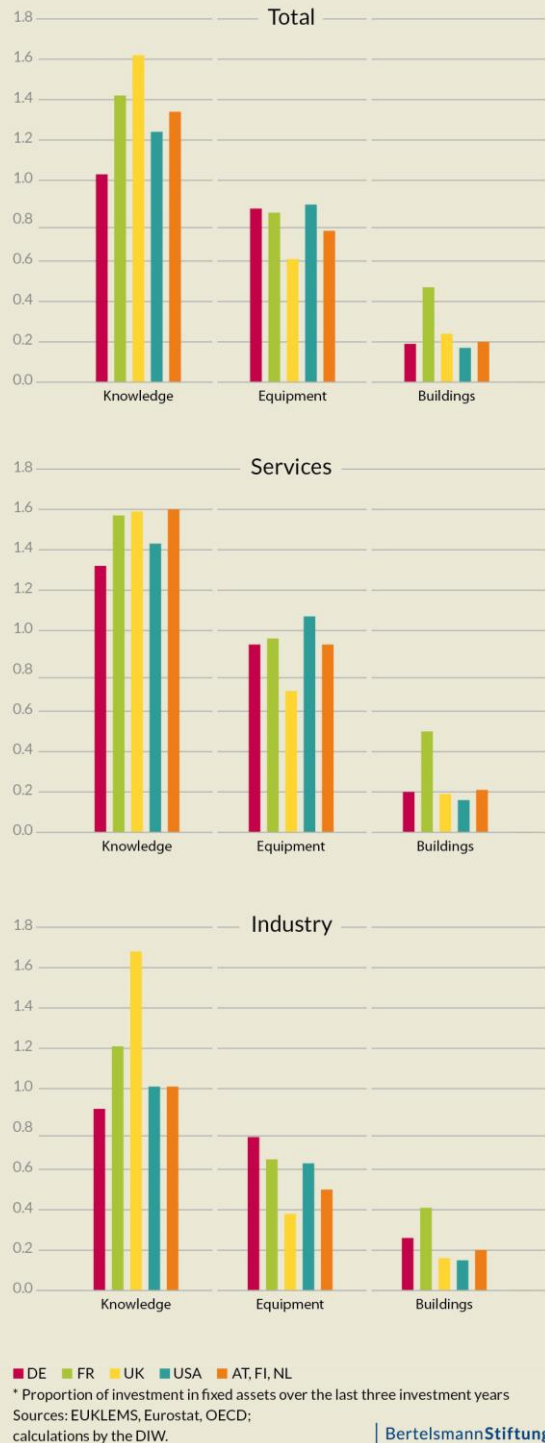
If we assume that the economy continues to contribute around two thirds of spending, businesses will have to increase their spending on R&D from around 2 per cent to 2.5 per cent of GDP.

Yet focusing on R&D alone is not enough. It is only one component of intellectual capital. The German economy is far behind others in terms of the other components – especially business expertise.

In addition to spending on R&D, investment in complementary areas of intellectual capital also needs to grow. Investment needs to grow by 3 per cent. Based on current GDP, businesses therefore need to invest an additional 35 billion euros per year in intellectual capital, including at least 12 billion euros for R&D.

In order to achieve such an increase, German economic policy needs to review local conditions

FIGURE 4: Modernity* by type of asset 2017



for investment in all kinds of capital. Focusing solely on the promotion of R&D, for which tax incentives are currently being devised, is not enough.

R&D is just one component of intellectual capital,

and the full impact will only be felt if it is implemented in the investment process alongside other components, such as new business solutions, training and software.

A possible starting point could be the promotion of high-stakes innovation projects, which require simultaneous investments in different types of intellectual capital. Examples of such projects include collaborative projects, networks and clusters. When it comes to joint R&D projects, companies must adapt their organisational structures to the joint goal and coordinate at managerial and employee levels. All of which can promote the accumulation of intellectual capital within a business in the broader sense.

Companies themselves also need to do more. We have observed a deficit in business expertise. Many medium-sized companies appear to be insufficiently prepared for digitisation. To avoid falling even further behind in this respect, they need to adapt their structures, become more open, and scrutinise their tried and tested processes.

Training and development of employees is another key factor. Germany has a lot of ground to make up here, too. Production processes are constantly evolving and innovation cycles are becoming ever shorter. This calls for the continuous development of employees, particularly in the field of digital skills. Businesses also need to invest more here.

In-depth study

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