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»» Innovation and digitalisation in enterprises mutually reinforce each other

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Digitalisation and innovation projects are regarded as key drivers of technological progress and growth. This paper aims to shed light on the correlation between these activities and their importance for business development.

The definitions of digitalisation and innovation already show commonalities and differences. Both activities involve targeted changes that are designed to introduce something new that improves the economic capability of a business and has project character. Digitalisation, for its part, is restricted to information and communications technologies, while innovation means that its outcomes have to be distinctly different from the previous status quo. Each of these restrictions does not apply to the respective other activity.

Empirical research demonstrates that digitalisation projects undertaken by businesses conducting only such projects are around two thirds the size of those of SMEs implementing digitalisation and innovation projects. In addition, the former are more focused on individual digitalisation steps and simpler projects. By contrast, they are significantly less likely to embark on sophisticated projects such as the digitalisation of products and services, the introduction of marketing and distribution strategies and the digitalisation of workflow.

SMEs that combine digitalisation with innovation, on the other hand, are more likely to invest in the creation of knowledge that is new to the business, for instance by conducting research and development (R&D) more frequently or invest in tangible assets with more state-of-the-art technology.

There are very few differences between the productivity and credit rating of both groups, however. But pure digital transformers achieve slower growth in both turnover and employment than businesses undertaking digitalisation and innovation projects.

Another key finding of the survey is that innovation and digitalisation go hand-in-hand. Digital technologies often form the basis of innovation, for example. On the other hand, it is particularly innovators that make great strides in advancing digitalisation. With a view to the rate at which SMEs are digitalising, that means the declining innovative capacity of SMEs over the past one and a half decades has also been delaying the digitalisation of the sector.

Innovation and digitalisation are generally regarded as key drivers of competitiveness and economic growth. Nevertheless, innovation and digitalisation activities have evolved differently in the past years. During the coronavirus crisis, innovation activity in the SME sector decreased on balance (share of businesses that innovated more minus those that innovated less), while digitalisation activity increased (Figure 1).[1]

Figure 1: Development of digitalisation and innovation activity during the coronavirus pandemic
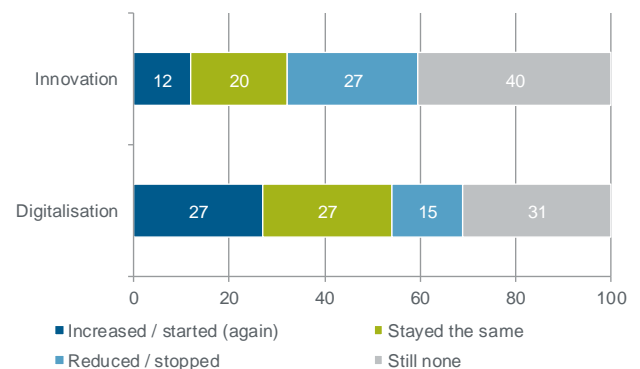
Source: KfW SME Panel, 5th supplementary coronavirus survey (May 2021)

Before the coronavirus pandemic (in the 2017–2019 period), 30% of SMEs completed digitalisation projects. Of these, however, fewer than half (45%) consider themselves innovators. In order to explain the correlation between innovating and going digital, KfW Research commissioned an extensive study with the Leibniz Centre for European Economic Research (ZEW), Mannheim.[2] On the basis of the definitions of innovation and digitalisation, the evaluation of large numbers of business surveys and qualitative business interviews, the study identified the differences and commonalities between innovation and digitalisation.

The definitions already determine commonalities and differences between innovation and digitalisation

The OECD has already defined innovation in the Oslo Manual since the beginning of the 1990s. This definition has been widely accepted in the EU and many other countries. It is also used in the KfW SME Panel. Innovation in enterprises is defined as 'a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)'.[3] Since the Oslo Manual was revised in 2018, it also counts non-technical innovations such as organisational and marketing innovations as innovation.[4]

No uniform definition has yet been established for digitalisation. The Oslo Manual defines digitalisation as the application or increase in use of digital technologies by an organisation. In close alignment with this definition, the KfW SME Panel defines digitalisation as activities aimed at 'renewing the IT structure, making use of new digital applications or digitalising products (including services), interaction with customers and suppliers, as well as measures aimed at building knowledge, reorganising workflows or developing and introducing new digital marketing and distribution strategies in connection with digitalisation'.[5]

Both activities thus involve targeted changes that are intended to improve the economic capability of the business, contain something that is new from the perspective of the enterprise, and have project character. In addition, digitalisation often constitutes the technological basis that makes innovation possible in the first place.[6] Thus, digital data represent important input in innovation processes and digital technologies make it possible to develop innovative products and services, improve efficiency, create new forms of interaction with customers and business partners and accelerate innovation cycles.

But there are also significant differences in the definitions. For example, while innovation is defined on the basis of the outcome of activities, digitalisation refers to the objective and the activities leading to it. Other key differences lie in the fact that digitalisation projects are not limited in their importance or scope. Innovation projects, on the other hand, are expected to produce outcomes that are noticeably different from the previous status quo. Not least, innovation is defined independently from any technology involved, while digitalisation is restricted to the use of information technologies.

Digitalisation and innovation therefore do not fully coincide in many small and medium-sized enterprises. Rather, there are innovations that are not based on digital applications (such as a new pharmaceutical active substance or the introduction of a new advisory service). On the other hand, there are digitalisation activities that are unrelated to innovation (for example upgrading digitalised processes to state-of-the-art information and communications technology).

### Businesses that digitalise and innovate compared with pure digital transformers

On the basis of these definitions, business surveys can explore what links exist between innovation and digitalisation. The first step was therefore to identify commonalities and differences between enterprises that have carried out only digitalisation projects and those that have completed both digitalisation and innovation projects.[7]

SMEs with innovation and digitalisation projects are larger and older and operate in other sectors …

The study found that, at the level of business structure, SMEs that implement digitalisation and innovation projects at the same time are significantly larger (49 vs. 25 employees) than businesses that carry out digitalisation projects only

(Figure 2). Moreover, they are also slightly older on average (39 vs. 36 years). With a total share of 29%, the former are more likely to be manufacturers (compared with 15%) and less likely to be construction firms, at 9% (vs. 19%). These findings are typical of those obtained for innovative enterprises in comparison with enterprises with digitalisation projects.[8]

### Figure 2: Size, age and sector
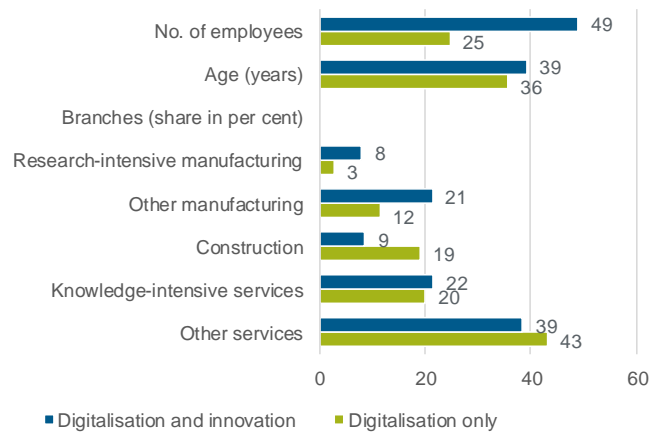
Source: Rammer et al. (2021)

… but are hardly any different to digital transformers in their economic capability

However, there are hardly any differences with respect to the fundamental economic capability of enterprises (Figure 3): The productivity – measured as annual turnover per employee – of enterprises that carry out only digitalisation projects but no innovation projects is EUR 323,000, only slightly higher than for businesses with innovation as well as digitalisation projects (EUR 309,000). The credit rating of those that digitalise only, on the other hand, is slightly weaker, with 239 points.

Figure 3: Economic capability
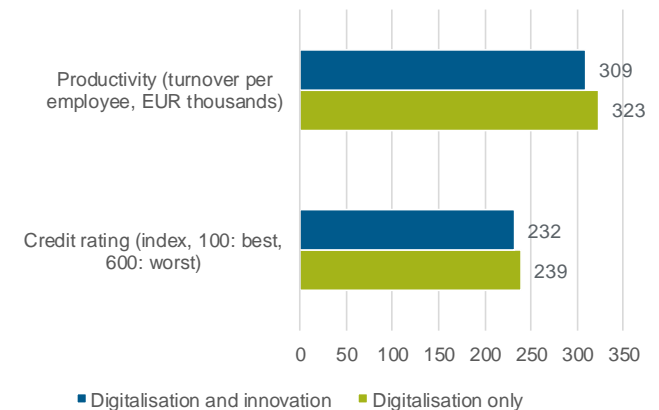
Source: Rammer et al. (2021)

For the capital expenditure ratio the value is 1.0 percentage point higher for enterprises that actively digitalise without also innovating (Figure 4). At the same time, this group has a much lower export ratio, which can be attributed to the different sectoral structure, among other things.

Figure 4: Comparison of capital expenditure and international sales
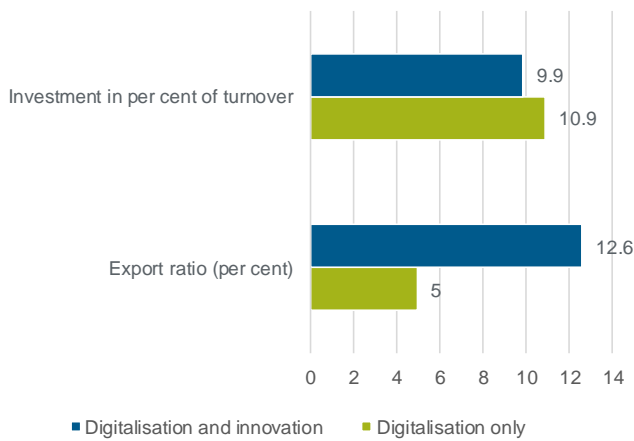
Source: Rammer et al. (2021)

**Eliminating structural effects using statistical methods**

The further investigations eliminate the influence of these and other structural features with the aid of statistical methods. In the following we perform a causal analysis using the entropy balancing method.[9] It allows observable differences in digitalisation and innovation activities to be attributed exclusively to whether or not a business has completed digitalisation and/or innovation activities.

Digitalisation activities are more varied in enterprises that also innovate

Small and medium-sized enterprises that undertake innovation and digitalisation projects spend more on digitalisation than pure digital transformers and also implement more varied digitalisation projects (Figure 5). At EUR 54,000, average annual digitalisation expenditure is just under two thirds higher than for digital transformers that do not innovate. This also applies relative to the company's turnover: Based on annual turnover, digitalisation expenditure is 1.42% for digital transformers that innovate, while this percentage is 0.85% for digital transformers that do not innovate.

However, the former also implement each of the surveyed digitalisation projects more often than non-innovating digital transformers. This applies particularly to sophisticated projects such as the digitalisation of products and services, the introduction of digital marketing and distribution strategies and the digitalisation of workflow. Here the relevant proportions in the group of digital transformers that innovate are around 75% higher than among non-innovating digital transformers. SMEs with innovation and digitalisation projects on average carry out around 2.4 of the surveyed digitalisation categories simultaneously, while this rate is only 1.7 for non-innovating digital transformers (including the category 'Other').
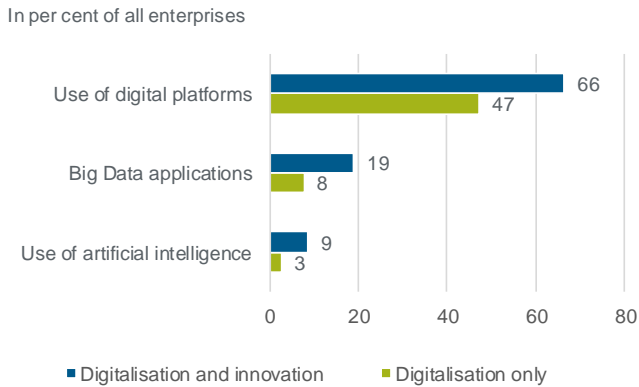
Figure 5: Digitalisation activities
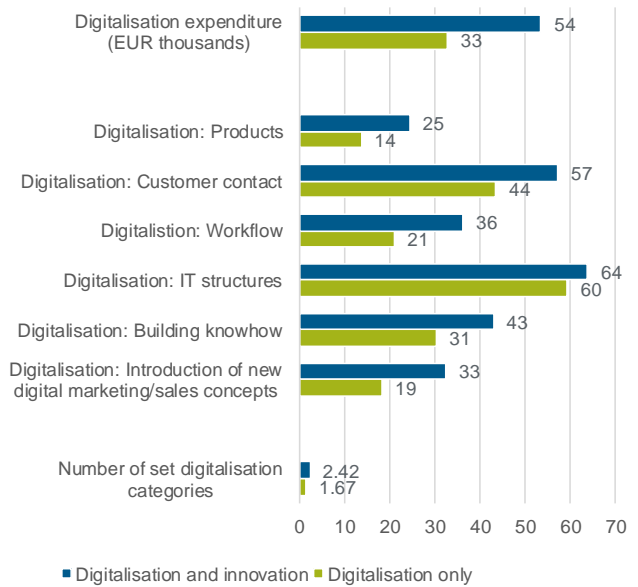
Source: Rammer et al. (2021)

SMEs that also innovate are more likely to use sophisticated digitalisation applications

SMEs that combine digitalisation with innovation have also been shown to use more sophisticated digitalisation applications more frequently than non-innovating digital transformers (Figure 6). Thus, enterprises in this group are more than twice as likely to use big data applications (19%) than non-innovating digital transformers. In the use of artificial intelligence, that share is in fact three times higher. This is likely due to the fact that both types of application place high demands on a company's expertise. In addition to programming skills, they typically require mathematical-statistical knowledge as well, as a high proportion of users develop the applications further.[10] Businesses that innovate are more likely to possess such expertise than others.

Digital transformers that innovate are also more likely to use digital platforms that are less demanding compared with the applications mentioned thus far[11]. The willingness and ability to tap into 'new things' for the company is thus reflected in the innovation behaviour itself as well as in the adoption of new digital possibilities.

Figure 6: Use of digital applications

In per cent of all enterprises

	Digitalisation and innovation	Digitalisation only
Use of digital platforms	66	47
Big Data applications	19	8
Use of artificial intelligence	9	3

■ Digitalisation and innovation ■ Digitalisation only

Source: Rammer et al. (2021)

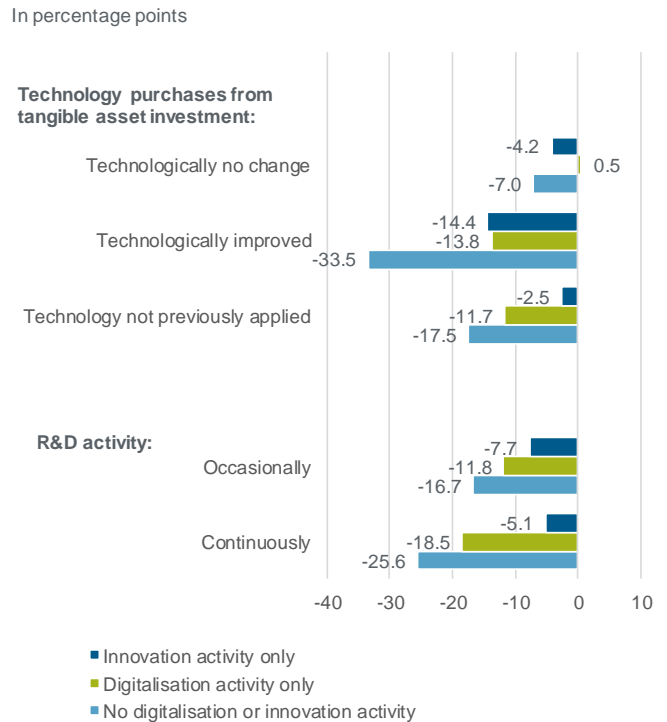### Creating and integrating new knowledge into the business

In a second step, the study examined how both groups generate new knowledge for their enterprise on the basis of the Mannheim Innovation Panel. In addition to the previous surveys, comparisons were undertaken with non-innovating enterprises without digitalisation activities and pure innovators. In the following analyses, structural effects were also removed from the findings of the surveys using regression methods.[12]

Pure digital transformers are less likely to acquire tangible assets whose technological level is different to what they have previously used than enterprises which combine digitalisation and innovation (Figure 7). This applies to completely new as well as to improved technologies (grey bar). They are roughly as likely to acquire improved technologies as exclusive innovators (blue bar). By comparison, enterprises with no innovation and digitalisation activities are less likely to invest in all three types of tangible assets.

Pure digital transformers are also less likely to conduct research and development activities (R&D) of their own than SMEs with innovation and digitalisation activities. This applies above all to the implementation of continuous R&D.

In this way, SMEs that combine digitalisation with innovation generate new in-company knowledge more often than non-innovating digital transformers, not only by acquiring tangible assets but also by conducting own R&D. In the groups that were analysed, companies with innovation and digitalisation activities play an unmistakable pioneer role in the incorporation of new knowledge. Pure innovators rank in between the two groups mentioned thus far. By contrast, businesses without innovation and digitalisation activities rank last in conducting R&D and in acquiring improved or completely new technologies. This finding suggests that creating knowledge that is new to the business is a prerequisite for innovating in particular.

Figure 7: Creating new knowledge within the enterprise – deviations compared with enterprises that engage in digitalisation and innovation
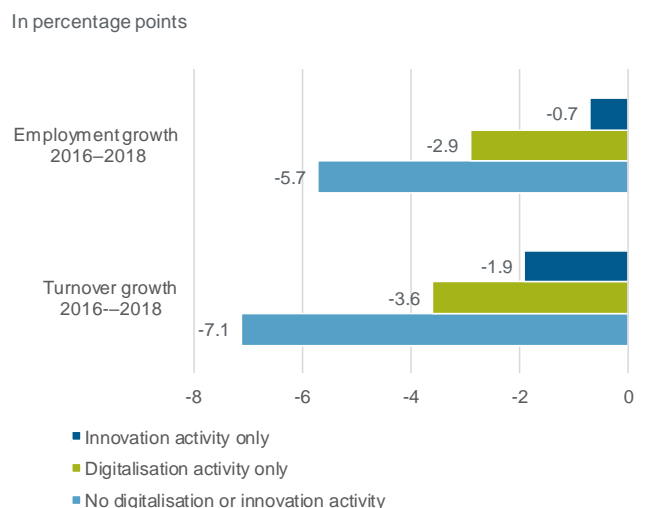
In percentage points

Technology purchases from tangible asset investment:

	Innovation activity only	Digitalisation activity only	No digitalisation or innovation activity
Technologically no change	-4.2	0.5	-7.0
Technologically improved	-14.4	-13.8	-33.5
Technology not previously applied	-2.5	-11.7	-17.5

R&D activity:

	Innovation activity only	Digitalisation activity only	No digitalisation or innovation activity
Occasionally	-7.7	-11.8	-16.7
Continuously	-5.1	-18.5	-25.6

■ Innovation activity only
■ Digitalisation activity only
■ No digitalisation or innovation activity

Source: Rammer et al. (2021)

Digital transformers that innovate grow the fastest

Finally, Figure 8 shows growth in workforce and turnover in the four groups of enterprises studied. In each group, turnover grew slightly more strongly than employment. Digital transformers that innovate top the ladder for both turnover and employment growth. Pure digital transformers lag far behind this group. SMEs that only innovate, in turn, lie between these two groups. Enterprises without innovation and digitalisation projects grow at the slowest pace.

Figure 8: Growth in turnover and employment – deviations compared with enterprises that engage in digitalisation and innovation

In percentage points

	Innovation activity only	Digitalisation activity only	No digitalisation or innovation activity
Employment growth 2016–2018	-0.7	-2.9	-5.7
Turnover growth 2016–2018	-1.9	-3.6	-7.1

■ Innovation activity only
■ Digitalisation activity only
■ No digitalisation or innovation activity

Source: Rammer et al. (2021)

In-depth interviews with enterprises confirm quantitative findings of the study

In-depth interviews with small and medium-sized enterprises also revealed that many see a broad overlap between innovation and digitalisation. Nonetheless, enterprises also distinguish between digitalisation steps that do not constitute an innovation and innovations that have no relevance to digitalisation.

Where businesses identify differences between innovation and digitalisation projects, it is often that the degree of novelty of digitalisation projects tends to be lower from the point of view of the market environment and that the projects often aim to upgrade or complement existing products and services as well as processes. Digitalisation is often seen as an 'aid' or a modernisation project, or as making use of modern tools. The strategic importance is often regarded as rather low. Enterprises are more likely to see the source of value added of – extensive – digitalisation projects in its importance to the business model, while in innovations it mostly consists in the technological solution.

Conclusion

The aim of the study was to establish the correlation between digitalisation and innovations and to demonstrate its importance for the development of enterprises. As surveys contain little information at project level, the study mainly involved comparing enterprises that exclusively carry out digitalisation projects and those that combine digitalisation projects with innovation.

The key findings were that, on average, pure digital transformers are smaller and more likely to operate in service sectors and construction. Their digitalisation projects are smaller, more focused on individual digitalisation steps and often less sophisticated. The in-depth interviews carried out confirm these findings.

These enterprises invest less in new knowledge than companies that combine digitalisation and innovation. This applies both to engaging in own R&D and to investing in new technologies as part of investing in tangible assets. However, with regard to their productivity and credit rating these enterprises have similar economic capability as SMEs that combine digitalisation and innovation. At the same time, however, pure digital transformers grow more slowly than enterprises with digitalisation and innovation projects.

In addition to providing insight into the characteristics of digitalisation projects and the companies that implement them, this study has thus confirmed again that in many small and medium-sized enterprises digitalisation moves forward in small steps. This applies in particular to businesses that do not innovate at the same time. This is a concern given the high importance of digitalisation as a technology of the future.[13]

The analysis also underscores the fact that innovation and digitalisation should not be regarded in isolation but mutually reinforce each other. On the one hand, digital technologies often form the basis of innovation. On the other hand, it is particularly innovators that make great strides in advancing digitalisation. This indicates that the existence of a broad basis of SME innovators is also a prerequisite for achieving fast progress in digitalisation.

[1] 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), KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

[2] Cf. Rammer, C. et al. (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). Report to KfW Group.

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

[4] The new definition has been used in the KfW SME Panel since the 2019 survey. Cf. Zimmermann, V. (2021), KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

[5] Cf. Saam, M. et al (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), Mannheim: ZEW.

[6] 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.

[7] This analysis is based on the surveys of the KfW SME Panel in the years 2017 to 2019.

[8] This confirms the older findings of Zimmermann, V. (2018): Determinants of digitalisation and innovation behaviour in the SME sector, Focus on Economics No. 236, KfW Research.

[9] Cf. Hainmueller, J. (2012): Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies. Political Analysis 20(1), 25–46.

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

[11] Cf. Zimmermann, V. (2020): Which SMEs use digital platforms?, Focus on Economics No. 303, KfW Research.

[12] This aspect is examined with the aid of the innovation survey of the ZEW. In it, the ZEW captures digitalisation activities as follows. They comprise activities in the area of software and databases (internal or externally sourced programming activities, development and maintenance of databases, systematic analyses of large data quantities), artificial intelligence (use of AI methods) and the use of platforms, open-source software, social networks and crowdsourcing. The concept of digitalisation is thus much more closely and stringently geared to information-processing and data use than the one used in the KfW SME Panel, while aspects of information and communication technology hardware procurement and the use of digitalisation technology in production, communication and administration are not explicitly captured.

[13] 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. 332, KfW Research.