

Types of SMEs in the innovation system: activities, constraints and successes

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

The present study explores the innovation activities, the constraints that emerge in the process and the positioning of six different types of small and medium-sized enterprises in Germany's innovation system. It is set against the backdrop of a declining share of innovative SMEs and the great importance of innovating for an enterprise's long-term competitiveness. As small and medium-sized enterprises differ significantly in their innovation activities and are impacted by innovation constraints to varying degrees – which is important for determining economic policy measures to strengthen innovative capacity –, the analysis distinguishes between several types of businesses. The key findings:

Companies that continuously undertake research and development (R&D) dominate innovation activity – even though they make up only one ninth of the SME sector, in other words, a small group. They pursue the most ambitious innovation strategies, with 37% of these enterprises focused on tapping into new markets and groups of customers and 35% targeting the introduction of new products. They also invest the most in their innovation activities, achieve the bulk of innovation successes and have the highest business performance in terms of profit margin. These enterprises thus account for 69% of SMEs' innovation expenditure, 54% of their turnover with product innovations and 43% of cost savings through process innovations.

Innovative small and medium-sized enterprises without own R&D currently represent 37%, a group nearly three times as large. Their innovation strategies are less ambitious and their innovation efforts accordingly less pronounced. Overall, their innovation achievements are also much less significant than those of enterprises with R&D activities. Nevertheless, their share in turnover from product innovations and cost reductions achieved with process innovations is important, at 34 and 42%, and even increased during the period under review – even though this group, in particular the group of the companies with product innovations, was on the decline during the period under review and the share it represented in the recipients of innovation support fell disproportionately in favour of companies that continuously undertake R&D.

The share of SMEs impacted by innovation constraints has increased strongly from 37 to 63% since the mid-2000s. This applies to innovative enterprises without R&D in particular. Nevertheless, enterprises that undertake great efforts to innovate continue to be the ones most likely to encounter

constraints to their innovation activities. The share of impacted SMEs decreases from the group of enterprises that continuously undertake R&D through innovators without R&D to those that are not geared towards innovating at all.

The analysis allows two different approaches to be derived for economic policy measures to strengthen innovative capacity: First, easing the shortage of skilled personnel in all of the groups studied will be particularly important. All actions that improve the supply of skilled workers in the German labour market indirectly constitute innovation support measures.

Second, improving the funding situation is an important starting point for many businesses with and without own R&D. The special role of businesses that undertake continuous research activities suggests that comprehensive incentives should be provided to ensure that existing R&D capacity is durably maintained and companies commence R&D activities.

Besides, enterprises without R&D should receive support in developing capacity for conducting innovation activities. In addition, strengthening strategic capabilities can increase the innovative capacity of businesses with a weak orientation towards innovation.

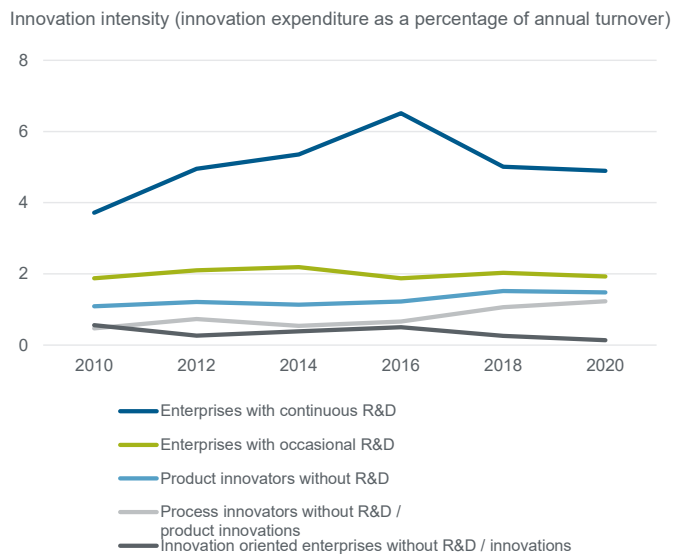
Finally, strengthening crisis resilience can be a starting point for the further development of innovation policy. Diversification within the business should therefore be promoted in a targeted manner. This can range from tapping into new technologies, user groups or markets through new forms of sales and distribution and production strategies to new organisational models.

Innovating is a key mechanism for businesses to position themselves in the market. It helps them to adapt to a changing environment and become more competitive or at least hold their own against rivals and thus secure their business success into the future.¹ Accordingly, a number of studies have identified positive effects of innovation on business performance.²

However, the SME sector is not a monolithic block with respect to its innovation activities but characterised by broad heterogeneity. Thus, the innovation strategies of small and medium-sized enterprises vary greatly. They range from the relatively small group of technological pioneers to the large group of enterprises that contribute to the diffusion of

technologies across the economy through incremental innovations and the adoption of new technologies.³

Figure 1: Intensity of innovation expenditure in different types of innovative SMEs



Source: Rammer et al. (2022).

The different innovation strategies imply that SMEs' innovation activities vary in intensity, that they use different resources for this and that innovative achievements ultimately differ in their magnitude as well. KfW Research commissioned an extensive study with the Leibniz Centre for European Economic Research (ZEW) in Mannheim to investigate what types of enterprise groups exist in the SME sector in terms of innovation activity, how these groups perform as innovators, what innovation constraints they face and what importance these groups have within Germany's innovation system.⁴ It is important to distinguish between the various types of innovators because economic policy support must be geared to the heterogeneity of these groups in order to strengthen innovative capacity in all segments of the SME sector. The key findings of this study are presented in the following.

Six different types of innovators in the SME sector

On the basis of input and output indicators for innovation activity, the study identified six different types of small and medium-sized enterprises. These six groups are:

- Enterprises with continuous in-house research and development (R&D) activities
- Enterprises with occasional in-house R&D activities
- Product innovators without in-house R&D
- Process innovators without in-house R&D and without product innovations
- Enterprises without in-house R&D and without innovations but with an innovation orientation
- Enterprises without in-house R&D, without innovation and without an innovation orientation

These groups differ in the degree of importance they attach to innovation activity, among other things. One indicator that can be used to measure this is innovation intensity, that is, the ratio of innovation expenditure to annual turnover.

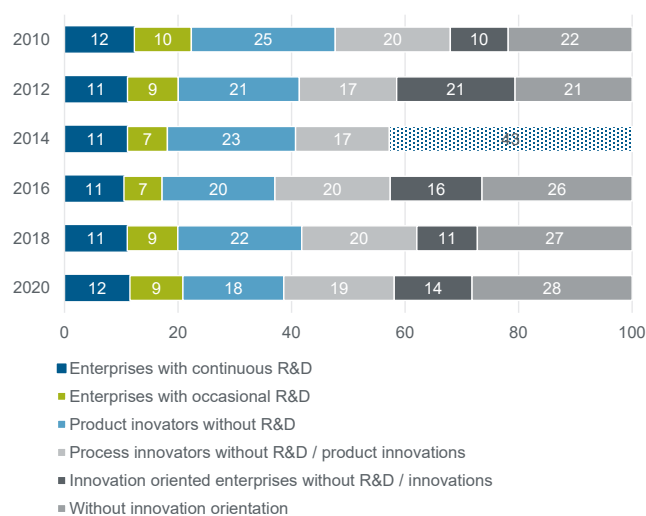
On average over the years 2010 to 2020, innovation intensity has been the highest by far in the group of enterprises with continuous in-house research, at 5.0% (Figure 1). It is followed by the other types of innovators in descending order. Enterprises with occasional research rank second at 2.0%, followed by product innovators⁵ without R&D at 1.3%, some of which also generate process innovations. Process innovators without research or product innovations rank fourth at 0.8% and enterprises that have an innovation orientation but are currently not innovating rank fifth at 0.3%.⁶ The reason these enterprises have not innovated lately may be that they have a narrow range of products and longer product cycles. Furthermore, a portion of these enterprises still have ongoing and discontinued innovation activities, that is, they have worked or are working on innovations that have not (yet) been introduced. The sixth group, enterprises not involved in innovation at all, obviously does not spend money on innovation and is therefore not shown in the figure.

Over the 10-year period under review, innovation intensity grew more strongly in the group of enterprises with continuous R&D than in all other groups. By contrast, the gaps between enterprises with occasional R&D and product and process innovators without own R&D narrowed slightly over time because innovation intensity in enterprises with product or process innovations but without own R&D grew moderately. Enterprises with innovation orientation but currently without innovations exhibited a declining innovation intensity across the period under review.

Those with continuous R&D activity accounted for 12% of SMEs in the group covered by the innovation survey of the ZEW in 2020 (see box Database at the end of this paper). Their share remained unchanged from 2010 (Figure 2). The share of enterprises with occasional R&D was only slightly behind at 9%. For the most part, this group also developed steadily overall since 2010. By contrast, the group of product innovators without own R&D fell sharply from 25 to 18% in the 10-year period under review. Enterprises with process innovations but without own R&D and without product innovations account for a nearly unchanged proportion of around one fifth of SMEs. Finally, innovation-oriented enterprises⁷ made up 14% and SMEs without innovation orientation 28% of enterprises. The combined share of enterprises that have not generated any innovations thus grew from 32 to 42% in the 10-year period of observation. The decline in product innovations without R&D played a significant role in this.⁸

Figure 2: Distribution of types of innovative SMEs

In per cent



Note: For the year 2014 the group of innovation-oriented enterprises cannot be distinguished from those without innovation orientation.

Source: Rammer et al. (2022).

Innovation orientation increases with the size of the enterprise

We describe these six types of innovators in more detail below. They differ significantly in average enterprise size (Figure 3). SMEs with continuous R&D are the largest and had an average of just under 100 employees over the observation period. Enterprise size decreases in each further group. On average, the smallest enterprises are found in the group of businesses with no innovation orientation, which have just under 25 employees.

A descending order can also be found in the proportion of employees with a tertiary degree. Enterprises with continuous R&D activities on average have the highest rate of 25%, while those without innovation orientation have the lowest – 11%. This finding underscores the great importance of tertiary qualifications for generating innovations.

What is also of importance for interpreting business performance and the impact of the individual groups of barriers to innovation is that enterprises with continuous R&D are significantly more likely to generate new-to-market (product) innovations, that is, original new product innovations (39%) than the group of enterprises with occasional R&D (22%) and product innovators without R&D (14%). Enterprises with continuous R&D also rank first for cost reductions achieved with the aid of process innovations, although the gap to

enterprises with occasional R&D is not very wide (27 vs. 23%). Among product innovators without R&D there is roughly the same share of enterprises with cost-reducing process innovations as the group of process innovators that undertake no R&D and have no product innovations (13 vs. 12%). This shows that there are many enterprises among the product innovators that also improve their processes. Overall, these findings underscore the high importance of R&D for developing and successfully introducing innovations with a high degree of novelty or rationalisation effects.

Profit margin falls with declining innovation orientation

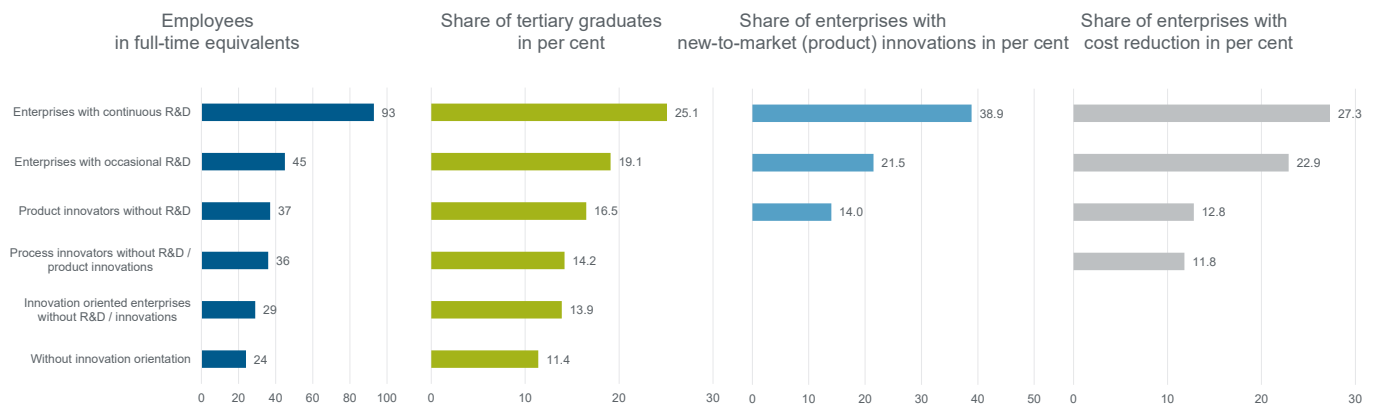
The six groups also differ substantially in a number of performance indicators (Figure 4). They exhibit a descending order in their profit margin, defined as profit before taxes in per cent of annual turnover. In other words, enterprises with continuous R&D activities on average have the highest profit margin – 5.4% – across the 10-year period under review. Profit margin declines continuously across the different types of innovators to 4.2% among enterprises with no innovation orientation.

However, there is no clear correlation for sales productivity – defined as annual turnover per employee. Here, the first five groups exhibit very similar rates, which is likely attributable to different input ratios, among other factors. Enterprises with no innovation orientation, however, also have much lower sales productivity. Overall, this finding shows that innovations are very important for generating productivity gains.

The export ratio, on the other hand, is clearly linked to the intensity of innovation efforts, even though the group of enterprises with an innovation-oriented strategy (but currently without R&D and innovations) exhibits a slightly higher rate of 13% than the group consisting of process innovators without any R&D nor product innovations (11%). This is likely because product innovations are more important for German enterprises to access foreign markets than price advantages from more efficient processes.

These findings generally underscore that enterprises with high innovation orientation – especially those that undertake R&D – generate new-to-market product innovations and achieve cost reductions more often than other enterprises. This has a positive effect on key business performance figures such as profit margin and success in foreign markets.

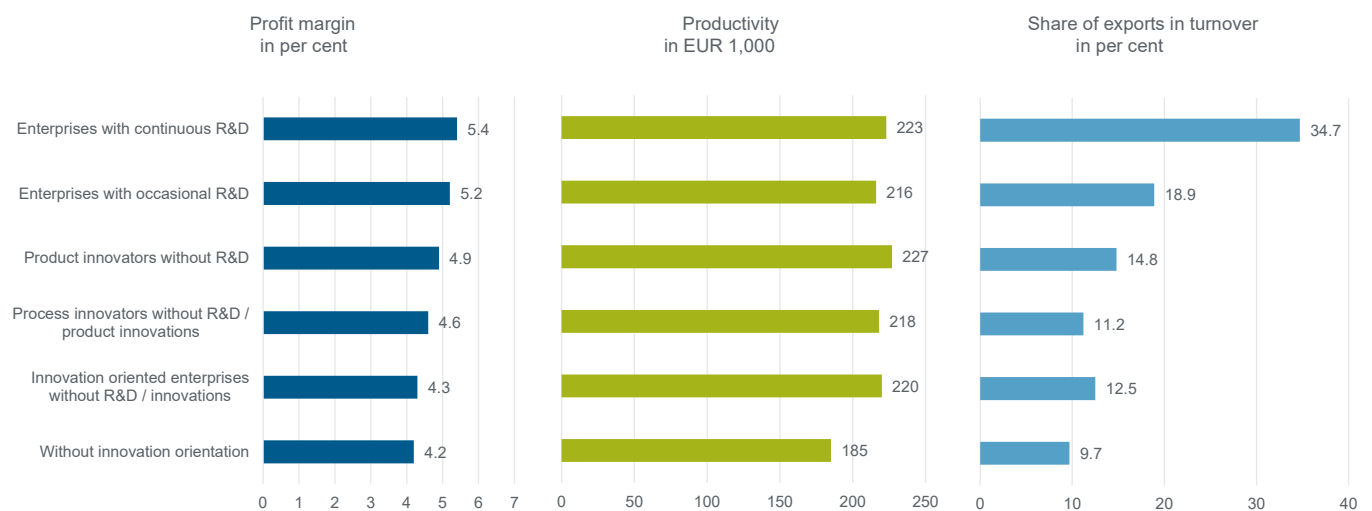
Figure 3: Characteristics of types of enterprises



Note: Average of the years 2010 to 2020, groups 5 and 6 without reference year 2014.

Source: Rammer et al. (2022).

Figure 4: Performance indicators of types of enterprises



Note: Average of the years 2010 to 2020, groups 5 and 6 without reference year 2014.

Source: Rammer et al. (2022).

Competition strategies of different types of SMEs

In order to provide a more detailed characterisation of the enterprise types in regard to innovation activity it is helpful to undertake an analysis of the competition strategies they pursue. The analysis of their competition strategy provides insight into what position they aspire to within the innovation system. It can help understand why some types of innovators are more likely to face obstacles than others and can identify weaknesses in their innovation activity. With respect to the competition strategies of enterprises, ten possible approaches can be distinguished. Here, two strategy pairs each constitute opposing strategy options, such as generating new products vs. improving existing products, or aspiring to become a quality leader vs. a price leader.

Particularly in enterprises with continuous R&D activities, developing new products and tapping into new markets are part of the competition strategy

Enterprises with continuous R&D focus particularly on quality leadership, customer-specific offerings and product improvements (Figure 5). Introducing products that are new to them (35%) and tapping into new customer groups and markets (37%) plays a lesser role by comparison. However, the more

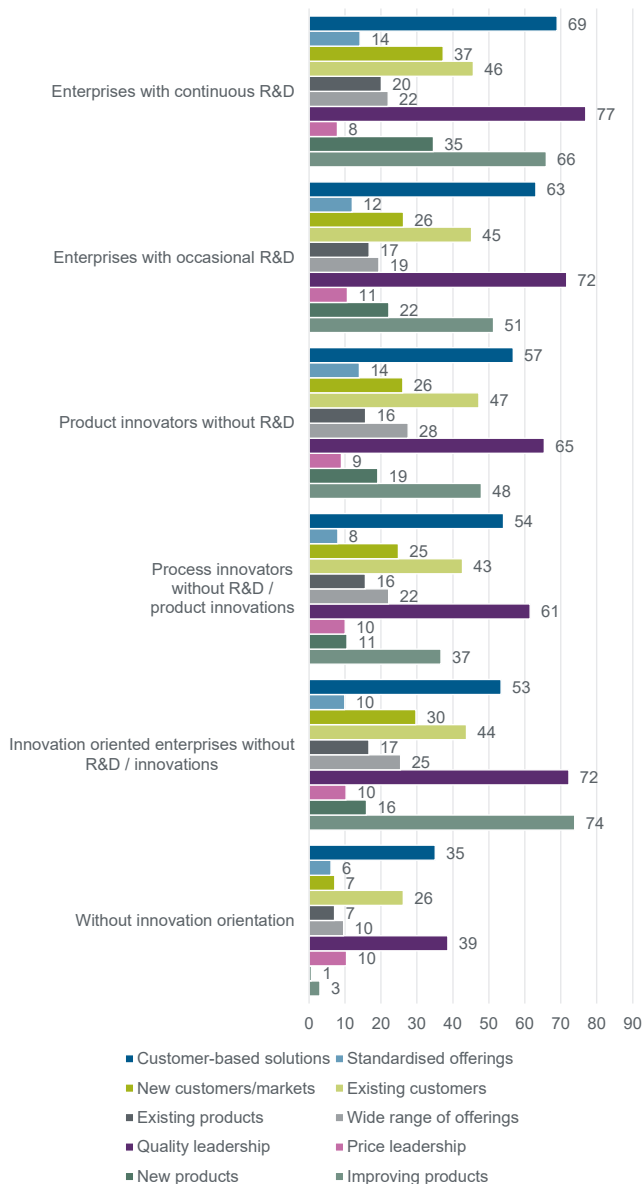
frequent mention of these two strategies sets this group apart from the remaining five. Enterprises with continuous R&D are thus more likely to pursue particularly ambitious competition strategies than other types of innovators.

Companies with occasional R&D are also quality leaders, make customer-specific offerings and product improvements as their three most important strategic approaches, although these are less likely to be of high importance to them than to enterprises with continuous R&D activities. Compared with those that undertake continuous research, they are less likely to focus on tapping into new markets and customer groups.

Enterprises with product innovations but without in-house R&D have quite similar competition strategies as the group of enterprises with occasional research activities. However, introducing new products is a strategy that is of high importance to a slightly lower share of these enterprises, at 19%, than in the group that undertake occasional research (22%). This finding confirms that own R&D activities are an important driver for the introduction of new products.

Figure 5: Competition strategies of different types of innovative SMEs

In per cent



Note: Strategies that are of high importance to the enterprise, average over the years 2018 and 2020

Source: Rammer et al. (2022).

Enterprises with process innovations but with no in-house R&D nor any product innovations have lower shares of nearly all competition strategies than the group of product innovators without in-house R&D. This can be interpreted to mean that these enterprises have less pronounced competition strategies.

The group of enterprises with no in-house R&D nor any innovations but with innovation orientation exhibit the highest percentage for the strategy of product improvement. However, that is also because this strategic orientation was used to distinguish this group from enterprises with no innovation orientation. The frequent mention of quality leadership and the development of new groups of customers and markets demonstrates that these enterprises definitely possess a certain degree of innovative potential. The findings generally

suggest that a considerable number of enterprises in this group are non-innovators only temporarily, for instance because they introduced an innovation just recently or because long product cycles do not require continuous innovation.

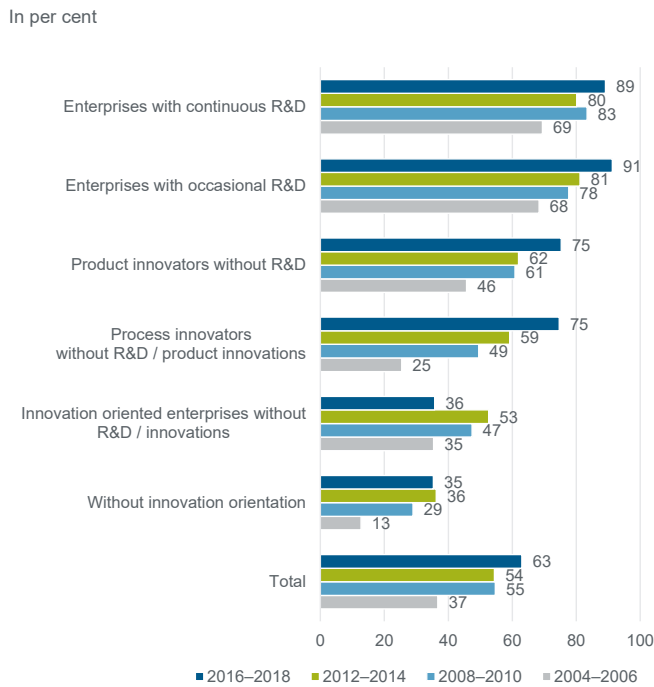
A very different strategy pattern is indeed evident in the group of enterprises without innovation orientation. Being a quality leader and offering customer-specific solutions are the two most important strategies here as well. But these strategies are of high importance for only 39 and 35% of enterprises in this group. Their focus on existing customers is significantly more distinct than the focus on new customers or markets. In relative terms, being a price leader is more important in this group than in the other groups. The generally lower shares for all ten strategies indicate that a larger portion of enterprises do not pursue any clear competition strategies and that the enterprises mostly conduct 'business as usual'. Earlier studies already identified this lack of an explicit competition strategy as a weakness in some subsegments of the German SME sector.⁹

The more an enterprise is geared to innovating, the more constraints it faces

The higher risk and more ambitious innovation strategies associated with own R&D activities mean a higher share of enterprises in the two groups of enterprises conducting R&D facing constraints to innovation (Figure 6). For the latest period for which data on innovation constraint is available (2016–2018), the share of enterprises facing constraints among those conducting occasional research is even slightly higher, at 91%, than among those with continuous research activities (89%). Product innovators without in-house R&D and pure process innovators follow right behind, with 75% reporting that they faced at least one innovation barrier. By comparison, at 36%, enterprises with innovation orientation but currently with no R&D nor any innovations are significantly less often affected by innovation constraints. That share is on a similar level of 35% among enterprises without innovation orientation.

The more frequent occurrence of constraints among enterprises with pronounced innovation activities is attributable to the fact that these enterprises pursue more ambitious strategies and more extensive innovation activities. That increases the odds of encountering hurdles and problems. Without a doubt, constraints hamper and prevent innovation activities. But often they also reflect the fact that the affected enterprises are pursuing particularly ambitious, risky innovation activities that aim to generate real novelty. Thus, constraints usually do not prevent innovation activities entirely. After all, frequently affected enterprises spend high amounts on innovation despite the constraints and carry out R&D systematically. But that also requires them to undertake additional efforts to overcome them. Enterprises that have limited funds to innovate are then unable to optimally fund their individual projects, for example, or have to contend with implementing only a small number of projects. Constraints can also lead to reduced revenue from innovation efforts, for example when market introduction is delayed.

Figure 6: Development of enterprises affected by innovation constraints over time



Note: Enterprises impacted by constraints causing them to put off innovation, discontinue activities already commenced or extend the delay of ongoing innovation activities, constraints from legislation/regulation 2016–2018: innovation hampered or prevented.

Source: Rammer et al. (2022).

Innovation constraints increased particularly for enterprises without R&D

A comparison over time shows that constraints have become significantly more widespread. Over the survey period, the strongest increase in the share of enterprises with innovation constraints was found among pure process innovators (+50 percentage points). Product innovators without R&D had the second highest increase (+29 percentage points). In both groups with own R&D activities, a large share of enterprises reported constraints already in the first survey period, so that the increase of 20 percentage points (continuous R&D) and 23 percentage points (occasional R&D) is not that pronounced. The group of enterprises without an innovation orientation also exhibited a 23 percentage point increase in the prevalence of constraints. Across the overall period of observation, no increase in the impact of innovation constraints was exhibited by enterprises with an innovation orientation but currently without R&D nor innovation activities.¹⁰ Thus, innovators without own R&D in particular faced an increase in innovation constraints over the period under review. That is likely a major reason that these groups of innovators shrank and, hence, innovation activity decreased throughout the SME sector¹¹.

The spread of constraints among small and medium-sized enterprises increased at a particularly high rate in all six groups during the periods of 2004–2006 and 2008–2010. The financial and economic crisis with the deep recession in the year 2009 played a decisive role. Between the 2008–2010 and 2012–2014 periods, however, no further growth was identified. Nonetheless, a further increase in enterprises facing innovation constraints can be observed in the 2012–2014 period in

the three groups that are less geared to innovation. On the other hand, a sharp rise occurred in almost all groups between 2012–2014 and 2016–2018. Overall, the wider prevalence of innovation constraints in the current period indicates that innovating has become significantly more difficult for small and medium-sized enterprises compared with the mid-2000s.

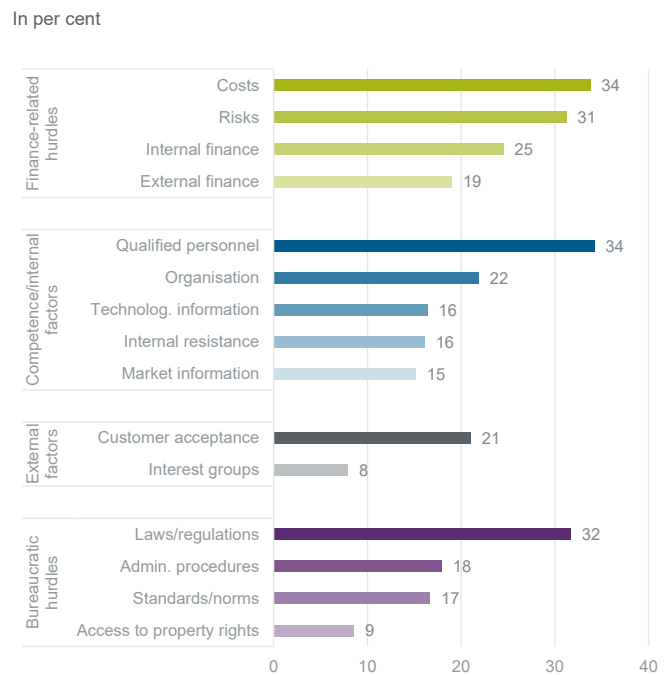
Skilled labour shortages and high costs are the most frequent constraints against innovation for SMEs

The shortage of skilled workers and high costs are among the main constraints in the SME sector, with mentions of 34% each (Figure 7). The shortage of skilled labour is also the innovation barrier that has become most prominent, increasing by 24 percentage points on the 2004–2006 period.

Further financing-related constraints such as high risk and lack of (in-house or external) funds are also mentioned often (31% as well as 25% / 19%). The financial crisis of 2008 led to very sharp increases in funding-related constraints. The corresponding shares roughly doubled. The spread of this barrier has not grown further since then. Difficulties in organising innovation activities were mentioned by 22% of small and medium-sized enterprises. That means a further capacity-related barrier also occupies a top position.

Enterprises also frequently mention laws and regulations as a barrier. In interpreting this factor, however, it must be borne in mind that a direct comparison with other constraints is only partially possible because it is captured differently.¹² Even so, a good one fifth of SMEs reported lack of customer acceptance or lack of demand as a barrier to innovation.

Figure 7: SMEs impacted by individual innovation constraints in 2016-2018



Note: Enterprises impacted by constraints causing them to put off innovation, discontinue activities already commenced or extend the delay of ongoing innovation activities, constraints from legislation/regulation 2016–2018: innovation hampered or prevented.

Source: Rammer et al. (2022).

Skilled labour shortage is a particularly important barrier for enterprises continuously performing R&D

For enterprises with continuous R&D activities, lack of skilled labour (59%) high costs (54%) and high risk (45%) are the most important barriers to innovation. In comparison with the remaining groups of enterprises, the shortage of skilled workers plays a particularly large role here (Figure 8). This indicates the high need for human capital in this group of enterprises.

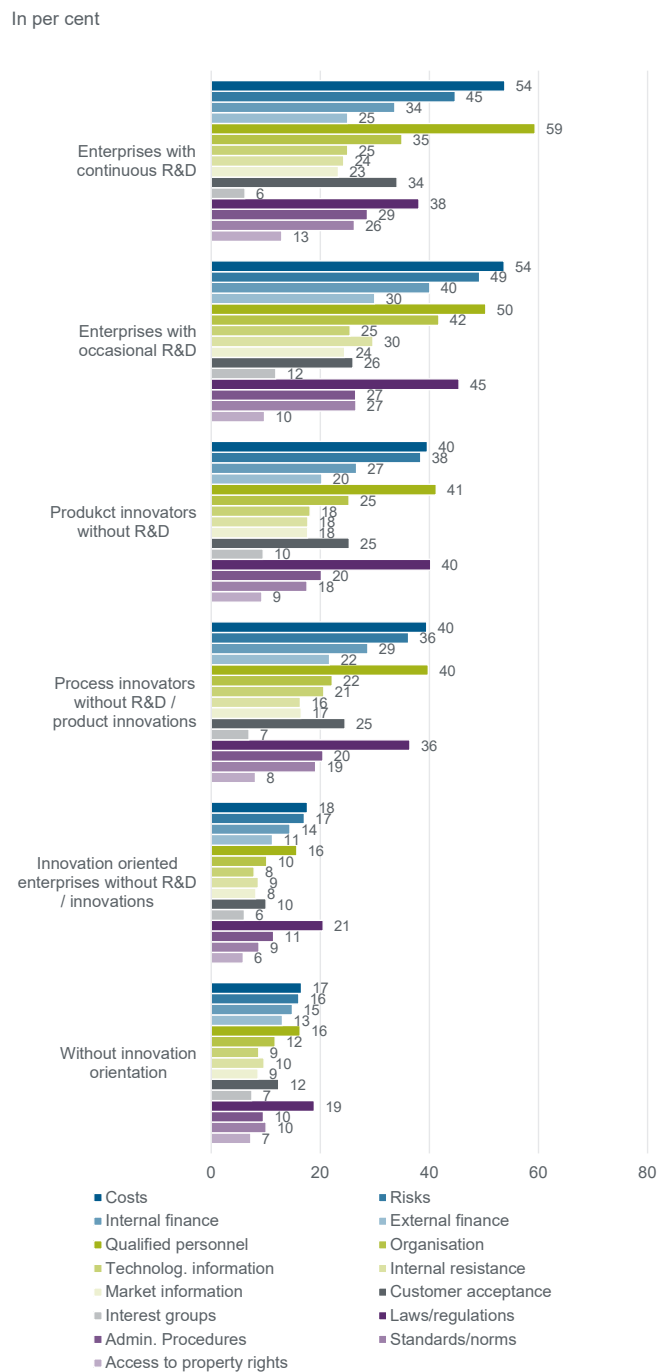
Other major constraints are mentioned significantly less often. Organisational problems, lack of in-house funds, constraints from legislation and regulations as well as lack of customer acceptance are next on the list and nearly on a par (34 and 35%). Relative to the barriers mentioned most frequently, lack of in-house or external funds, internal resistance or resistance from groups of interest are less important than in other groups of enterprises.

High costs and risks, but also organisational problems, hamper enterprises with occasional R&D to a particular degree

High costs (54%), skilled labour shortages and high risk (50% and 49%) are also the most frequently mentioned constraints to innovation in the group of enterprises with occasional R&D activities. High risk hampers innovation activities relatively more often in these enterprises than in all other types of enterprises. This may be attributable to insufficient in-house R&D capacity for effectively managing the risk inherent in R&D activities. At the same time, lack of customer acceptance plays less of a role as a barrier. The likely reason for this is that many of these enterprises focus on customer-specific solutions, so that R&D is conducted not systematically to develop own innovations but only in response to specific enquiries from customers.

Lack of access to property rights also plays less of a role here than in enterprises with continuous R&D activities. This may be due to the fact that enterprises in this group already pursue innovation strategies more often in which the focus is not on generating technological innovations but on the incremental further technical development of products and processes. By contrast, laws and regulations (45%), lack of in-house and external funds (40 and 30%) and organisational problems (42%) play a relatively larger role. This is likely a reflection of the fact that enterprises with only occasional R&D activities are not systematically preoccupied with developing innovations and therefore less likely to have routines in place for effectively managing the challenges involved with each new innovation project.

Figure 8: Degree to which the types of enterprises were impacted by innovation barriers in 2016-2018



Note: Enterprises impacted by constraints causing them to put off innovation, discontinue activities already commenced or extend the delay of ongoing innovation activities, constraints from legislation/regulation 2016-2018: innovation hampered or prevented.

Source: Rammer et al. (2022).

Enterprises without R&D are generally less affected by innovation barriers

The skilled labour shortage, high costs and risks are also among the most important constraints in the group of product innovators without own R&D. Laws and regulations are also mentioned at nearly the same rate. But with values around 40%, the mentions are lower overall than among enterprises with R&D activities. These factors are followed by lack of in-house funds, problems with organisation and lack of customer acceptance, with rates between 27 and 25%. Laws and regulations in particular are mentioned relatively more often as an important innovation barrier than for the other types of enterprises. Internal resistance as well as standards and norms are barriers with rather little importance – unlike in the other groups.

The profile of constraints faced by enterprises with process innovations but without in-house R&D and without product innovations is almost no different from that of product innovators without R&D. In this group, financing barriers and

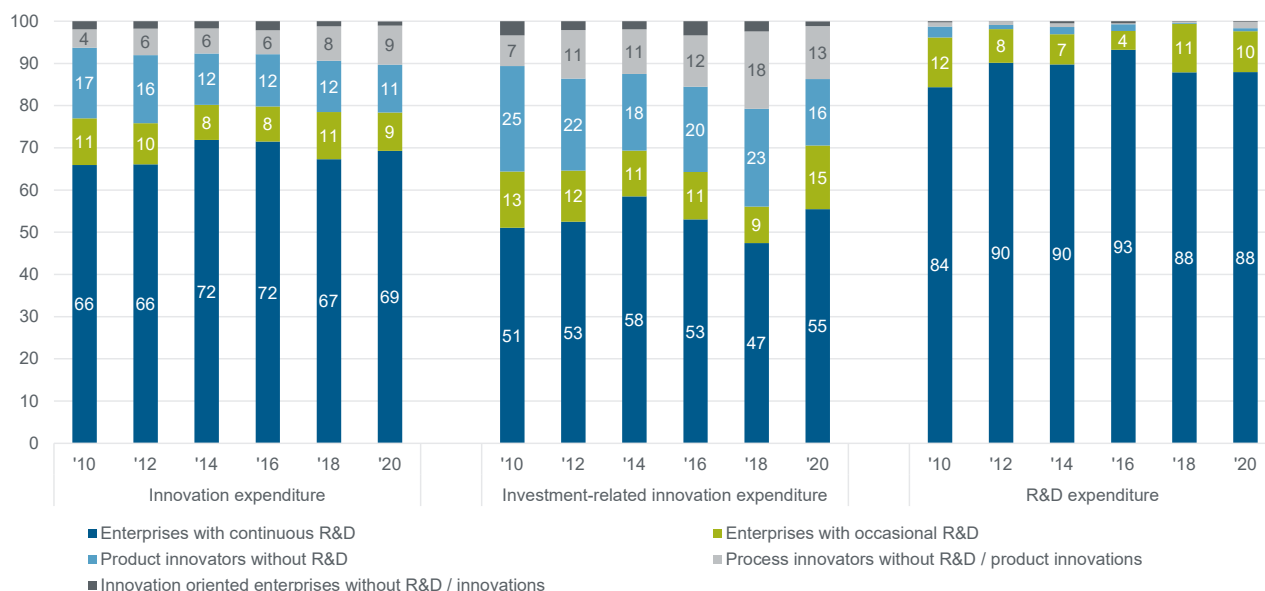
lack of technological information have a marginally higher relative importance in direct comparison with other barriers.

Enterprises that do not innovate nor have a focus on innovating face no pre-eminent single constraints

Enterprises without any in-house R&D or innovations but with an innovation-oriented strategy have a much lower constraint profile than enterprises with R&D activities and innovators. The same applies to the group of enterprises with no innovation orientation. This means that in these two groups it is not so much that individual constraints impede innovation efforts particularly often but that most innovation constraints occur with similar frequency. Compared with the other four groups, the following constraints are slightly more important, although they are generally not dominant: in-house resistance, lack of market information, lengthy administrative procedures, standards and norms, lack of access to property rights and resistance from groups of interest.

Figure 9: Distribution of innovation expenditure by SMEs by type of enterprise 2010–2020

In per cent



Source: Rammer et al. (2022).

Enterprises with continuous research generate the bulk of innovation efforts in the SME sector

Finally, below we will adopt a change of perspective that can help describe the contribution of individual types of innovation to the innovation system and their share in innovation promotion. Measured by SMEs' total innovation expenditure, the group of enterprises with continuous research contributes by far the highest volume. During the 2010–2020 period, that group accounted for more than two thirds (69%) of total innovation expenditure by SMEs in the group covered by the survey of the ZEW (Figure 9). Their share in R&D expenditure is even a substantially higher 89%. The extensive and ambitious innovation effort undertaken by these enterprises – particularly with regard to the creation of new knowledge – is corroborated primarily by the fact that only around 12% of SMEs are in this group. Their share in total investment expenditure on innovation (i.e. expenditure on fixed assets

and software in connection with innovation activities) is also a high 53% but significantly lower by comparison.

The group of enterprises with occasional R&D – which at currently 9% of SMEs is only marginally smaller than the group of those with continuous research – on average accounts for 10% of total innovation expenditure of SMEs, 9% of R&D expenditure and 12% of investment expenditure. Their share in the key indicators of innovation activity thus roughly matches their share in the number of enterprises.

On average over the period under review, however, the significantly larger group of product innovators without R&D (currently 18%), accounts for a share of only 13% of total innovation expenditure in the SME sector, which is primarily composed of the high innovation-related investment expenditure (21%). This group accounts for around 1% of all

R&D expenditure of the SME sector. That expenditure represents the costs of R&D contracts awarded to third parties.

The group of process innovators without R&D or product innovations, which currently make up 19% of SMEs, on average contribute 7% to overall innovation expenditure, 1% to R&D expenditure and 12% to innovation-related investment expenditure. This type of enterprise, too, thus makes a disproportionately low contribution to SME innovation activity in comparison with its share in the SME sector.

The comparatively high shares of both innovator groups without own R&D in innovation-related investment expenditure reflect the fact that their innovations are based not so much on own creative processes but are largely made possible by the purchase of technology, such as new types of machinery or software. The group of enterprises with innovation orientation but with no R&D or innovations plays a negligible role for all key indicators investigated here.

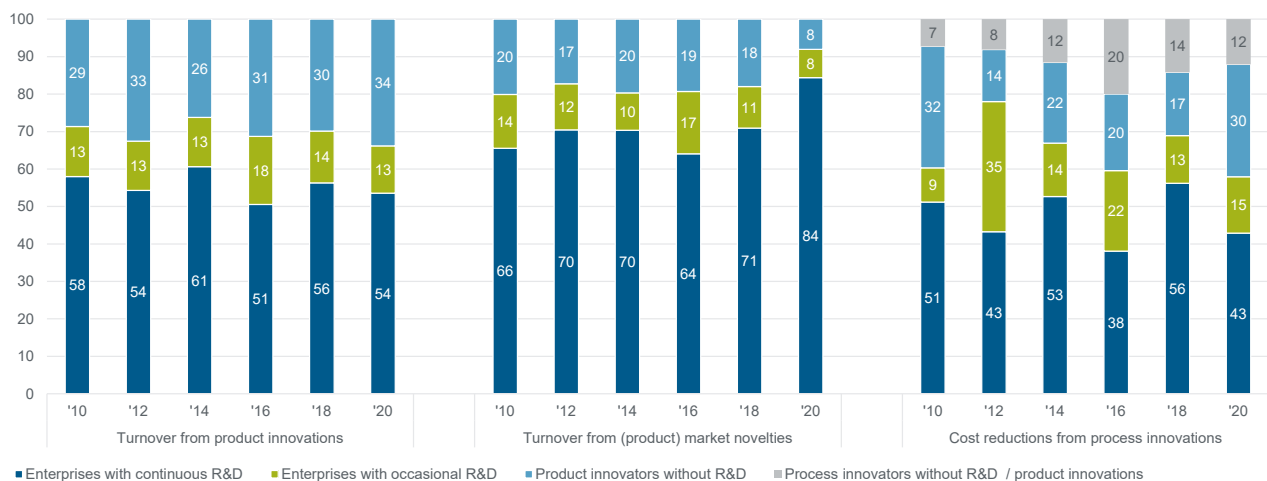
Innovative enterprises without R&D also have notable innovation successes

The differences between the individual types of innovators are less pronounced with regard to their innovation successes, such as turnover with product innovations or cost reduction through process innovations, than to their inputs to the innovation process.

What is hardly surprising is that enterprises with continuous R&D activity, above all, have very high innovation successes. This group of enterprises thus accounted for 71% of turnover achieved on average with new-to-market innovations during the years 2010–2020 (Figure 10). The shares are lower for overall turnover generated with product innovations and the level of cost reductions achieved, but still dominant with average shares of 56% and 47%, respectively.

Figure 10: Distribution of innovation successes achieved by SMEs by type of enterprise 2010–2020

In per cent



Source: Rammer et al. (2022).

Across the entire period under review, product innovators without R&D contributed a notable 30% to total turnover with product innovations, 17% to turnover with new-to-market innovations and 23% to cost reductions in the SME sector. The share of turnover with product innovations achieved by this group of enterprises even increased from 29 to 34% during the period under review, although the share of this group in the number of small and medium-sized enterprises is on the decline. The average values for the success indicators investigated are higher than those achieved by enterprises with occasional R&D, although these account for only around half as many enterprises at the current margin.

Finally, SMEs without R&D contribute an average of 35% overall to cost reductions through process innovations. After a sharp drop in the year 2012, that share also grew from 39 to 42% in the period under review, bucking the trend for the share of these two groups in all SMEs. Thus, innovative small and medium-sized enterprises with no R&D activities make a significant contribution to the aggregate economic innovation success of the SME sector despite their comparatively low

innovation expenditure. The group of product innovators with no R&D plays a particularly important role in this.

SMEs account for one third of the input into the innovation process of German business

The contribution made by the types of innovators investigated can be quantified not just in relation to the SME sector but to the business sector overall. With regard to the key innovation indicators of German business as a whole, large enterprises play a crucial role – as they do in other countries. The contributions of the types of innovators investigated here are therefore significantly lower from an aggregate economic perspective. Nonetheless, SMEs currently still represent a considerable portion of innovation activity, currently accounting for 32% of innovation spending and 35% of R&D expenditure.

With regard to innovation successes, enterprises with continuous R&D activities generate 17% of total economic turnover with product innovations and achieve 11% of cost reductions through process innovations. Both groups of innovators without R&D combined account for 11% of turnover

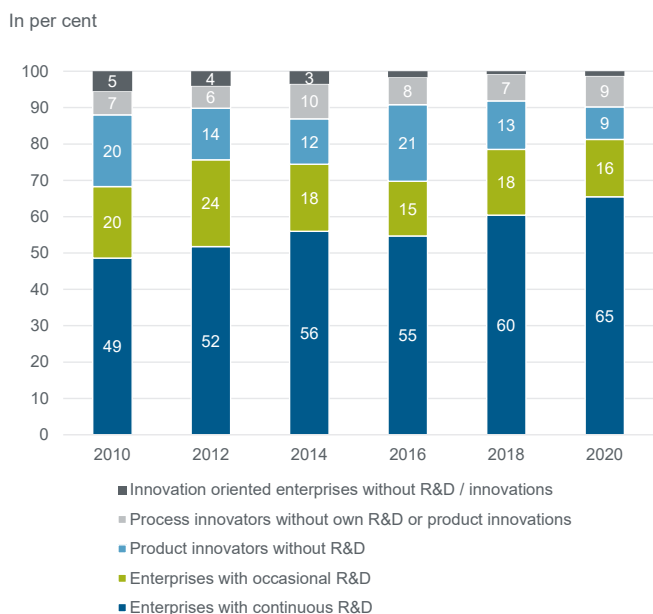
with product innovations and 11% of cost reductions through process innovations.

SMEs that focus exclusively on generating process innovations, however, account for only 3% of cost reductions across the economy. Their overall economic importance, for example with regard to productivity gains across the economy (for which cost reduction can be used as an indicator) is therefore very moderate. This is probably because, in the absence of own development activity, this group relies on using existing technologies and methods which hold only limited rationalisation potential. Past studies had already demonstrated that even when acquiring technologies by investing in fixed assets, enterprises that do not have a distinct innovation orientation are much less likely to adopt what they regard as new or at least improved technologies than those with a distinct innovation orientation.¹³ At the same time, it must be taken into account that most enterprises in this group operate in the services sector, where SMEs can realise cost reductions as part of process innovations to a limited extent only.

Innovation promotion is increasingly concentrated on enterprises with continuous R&D activities

In positioning the individual types of innovators in the innovation system, a further aspect is to what extent they are included in public innovation promotion schemes. It became evident here that, at 40% on average across the period under review, enterprises with continuous R&D activities are more likely than others to receive innovation funding from public agencies. This applies to only around 5% of product innovators without in-house R&D and only 3% of enterprises in the group of process innovators without R&D or product innovations.

Figure 11: Composition of small and medium-sized enterprises that receive innovation promotion by type of innovator 2010–2020



Source: Rammer et al. (2022).

In the past decade, the composition of SMEs that received innovation promotion funds clearly shifted towards the group of enterprises with continuous R&D. Whereas in 2010 just

under half the supported SMEs belonged to that group, in 2020 it was nearly two thirds (Figure 11). Innovation promotion has thus focused increasingly on this group of enterprises.

What has declined most of all was the share of product innovators with no in-house R&D (from 20 to 9%) and enterprises with occasional R&D activity (from 20 to 16%). The share of process innovators with no in-house R&D and no product innovations fluctuated between 6 and 10%. The share of enterprises without R&D or innovations but with an innovation orientation also declined from a low level (from around 5 to roughly 1%). Thus, on the current margin innovative SMEs without R&D accounted for only just under one fifth of enterprises receiving innovation promotion. By contrast, they have significantly higher shares in innovation successes, with a good one third of turnover with product innovations and a good two fifths of cost reductions.

Conclusion

The present study explores the innovation activities and constraints of different types of innovative enterprises in the SME sector and their positioning in the German innovation system.

Types of innovators in the SME sector

The key findings of the investigation are that SMEs that continuously undertake R&D dominate innovation activity even though they represent only a good one ninth of the group of SMEs, a small share of the sector. These enterprises pursue the most ambitious innovation strategies, invest the most in their innovation activities, generate the bulk of innovation successes and have the highest business performance as measured by profit margin, for example.

Innovative small and medium-sized enterprises without own R&D currently represent just under two fifths, a group nearly three times as large. Their innovation strategies are less ambitious and their innovation efforts accordingly less pronounced. Overall, their innovation achievements are also much less significant than those of enterprises with R&D activities. Nevertheless, their share in turnover achieved with product innovations and cost reductions achieved with process innovations is important, at 34 and 42%, and even increased during the period under review, even though this group – which includes enterprises with product innovations, in particular – was on the decline during the period under review. At the same time, the share which it represented in the recipients of innovation promotion fell disproportionately to only just one fifth in favour of companies that continuously undertake R&D.

Innovation constraints

Over the past one and a half decades, the impacts of constraints to innovation have grown in almost all groups of enterprises. This applies to the group of innovators without R&D to a particular degree. That means it has become significantly more difficult for small and medium-sized enterprises to innovate during the past one and a half decades.

What has not changed, however, is that enterprises with R&D activities are the ones most likely to be impacted by constraints. This is probably because they are more likely to encounter barriers and difficulties due to their more ambitious

competition strategies and more extensive innovation activities. Innovation constraints prevent and hamper innovation, but they are also an indicator of intense innovation activity.

Capacity and financing-related constraints top the list of innovation barriers in the SME sector. The shortage of skilled labour and the high cost of innovating are the most frequent obstacles. However, organisational problems as well as high risks and difficulties in obtaining finance are also mentioned often. For enterprises with continuous R&D activities, difficulties in obtaining finance play less of a role than other constraints.

At the current margin, laws and regulations also rank notably higher than other constraints. Because this constraint is captured differently, however, it can be compared with the other constraints to a limited extent only. It is therefore necessary to continue monitoring how this constraint develops in the future.

Conclusions for economic policy

It makes sense to address the identified constraints when considering economic policy measures that may be adopted to strengthen innovative capacity in the SME sector. In line with the findings of the study, it will be particularly important to ease the shortage of skilled labour in all of the groups investigated. Thus, all actions that improve the supply of skilled workers in the German labour market indirectly constitute innovation support measures. These measures may extend from the school classroom (for example by reducing secondary school dropout rates and improving knowledge of basic skills by supporting students with learning difficulties) through occupational and academic education to migration policy (by focusing migration on workers with skills that are in high demand in Germany).

Lack of access to suitable innovation finance is another major constraint against more innovation. This mainly affects enterprises that are already actively innovating and – including those with occasional R&D – those that are particularly innovative. After all, they often have more good innovative ideas than they can realise with the available funds. In all enterprise groups investigated, lack of in-house funds are a disproportionately frequent constraint among all the constraints which enterprises face. This could be addressed by expanding the level of R&D and innovation promotion in the context of tried and tested promotional measures. The special role of businesses that undertake continuous research activities suggests that comprehensive incentives should be provided to ensure that businesses maintain their existing R&D capacity. The research grant introduced in 2020 can be a very effective instrument for this.¹⁴

Other promotional approaches could consist in low-threshold promotional modules for the target group of innovation-oriented enterprises without R&D. Innovative enterprises without R&D in particular were increasingly confronted with constraints to innovation in the past one and a half decades. At the same time, their share in innovation promotion dropped at a disproportionately high rate during the period under review, so that they are currently clearly underrepresented compared with their contribution to the SME innovation system.

In order to encourage R&D activities, measures should be adopted that primarily address the specific prerequisites that must be fulfilled for commencing R&D. This includes the scientific-technical skills of the workforce, the strategic capabilities of the enterprise and the ability to cooperate with academia as well as with business partners and customers.

Another approach is to support the development of capacities for conducting innovation activities in small and medium-sized enterprises. That should benefit enterprises without own R&D most of all. The primary aim here is to increase the availability of staff who are able to design and drive innovation projects. Important aspects here include promoting continuing education schemes around innovation management and more closely integrating innovation aspects into vocational education and training.

In addition, strengthening strategic capabilities can increase the innovative capacity of businesses. Enterprises without an innovation orientation are the main target group here. Many small businesses with well-established but not very innovative business models often give little attention to the aspect of strategic business development because their day-to-day business is the main priority. Approaches aimed at improving strategic capabilities include, among other things, awareness raising campaigns that highlight specific role models and best-practice examples, consolidating low-threshold information offers for SMEs on innovation strategies and innovation management, continuous monitoring and further development of the quality of advisory services in existing advisory programmes and infrastructures. Helpful approaches can also be the explicit inclusion of strategic aspects in the context of innovation promotion, such as an innovation audit that can be used on a modular basis and accounted for as a reimbursable cost.

Finally, strengthening the crisis resilience of SMEs can be a starting point for the further development of innovation policy. The past years have been marked by several crises that have been unlike traditional cyclical economic crises, and that have in part considerably affected and continue to affect the foundations for business activities. They have been exacerbated by further disruptions caused by climate change and demographic change. That means enterprises need to find ways to quickly respond to changing conditions and adapt their business activities. Innovation policy can support them, for example with promotional formats that specifically support diversification in enterprises, that is, the development of new offerings and business approaches that complement existing business activities and position enterprises more broadly, making them less vulnerable to individual abrupt changes in their business environment. This can range from tapping into new technologies, user groups or markets through new forms of sales and distribution and production strategies to new organisational models. The use of digital technologies in particular will likely play a very important role in this.

Database for the survey

The ZEW Mannheim has been investigating innovation activity in the German business community together with the Institute for Applied Social Sciences (infas) and the Fraunhofer Institute for Systems and Innovation Research (ISI) on behalf of the German Federal Ministry of Education and Research (BMBF) annually since 1993. Germany contributes the ZEW innovation surveys to the Community Innovation Surveys (EIS) of the European Commission every two years. They cover businesses with five or more employees in the producing industry and selected services sectors. Agriculture and forestry, fishery, construction, motor vehicle dealerships/repairers, retail, hospitality, real estate,

business management, veterinary services, rental, educational and health services, public administration, consumer-related and cultural services do not form part of the innovation survey.

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¹ Cf. Griliches, Z. (1979): Issues in assessing the contribution of research to productivity growth; *Bell Journal of Economics* 10 p. 92–116; Georgellis, Y. et al. (2000): Entrepreneurial action, innovation and business performance: The small independent business, *Journal of Small Business and Enterprise Development* 7(1), p. 7–17 or Renko, M. et al. (2009): The Effect of a Market Orientation, Entrepreneurial Orientation, and Technological Capability on Innovativeness: A Study of Young Biotechnology Ventures in the United States and in Scandinavia; *Journal of Small Business Management* 47(3), p. 331–369.

² Cf. for example Zimmermann, V. (2021). Innovationen steigern Wachstum und Produktivität und verbessern die Qualifikationsstruktur der Beschäftigten in mittelständischen Unternehmen (*Innovation boosts growth and productivity and improves the structure of workforce qualifications in small and medium-sized enterprises* – our title translation, in German only), *Focus on Economics* No. 361, KfW Research; Bartelsman, E.J. et al. (2019), Productivity, technological innovations and broadband connectivity: firm-level evidence for ten European Countries. *Eurasian Business Review* 9(1), p. 25–48; D'Attoma, I. and Pacei, S. (2018), Evaluating the effects of product innovation on the performance of European firms by using the generalised propensity score. *German Economic Review* 19(1), p. 94–112; Coad, A. et al (2016), Innovation and firm growth: Does firm age play a role? *Research Policy* 45 (2), p. 387–400; Zimmermann, V. (2014): Innovation und Beschäftigung. Die Beschäftigungswirkung verschiedener Arten von Innovationen in expandierenden und schrumpfenden mittelständischen Unternehmen (*Employment and innovation. The employment effect of different types of innovation in expanding and contracting SMEs* – our title translation, in German only), *Journal of Business Economics, ZfB-Special Issue* 4/2013: p. 131–149.

³ Cf. Zimmermann, V. (2012): To be the Leader of the Pack? Innovation strategies in the German SME sector. *Focus on Economics* No. 11, KfW Economic Research

⁴ Cf. Rammer, C. et al. (2022): Drivers and Barriers for Innovation in the German SME sector, ZEW – Leibniz Centre for European Economic Research.

⁵ According to the current standard definition by the OECD and Eurostat as presented in the fourth edition of the slow Manual, innovating includes generating organisational and marketing innovations. Cf. OECD and Eurostat (2018) (publishers): *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg.

⁶ 'Innovation orientation' was measured on the basis of (a) the existence of (ongoing, discontinued or completed) innovation activities without any product or process innovations having been introduced, and (b) high importance attached to the competitive strategies of 'introducing entirely new products' or 'improving existing products' (for the reference years 2016, 2018 and 2020) and 'introduction of new or improved products' or 'improving the quality of existing products' (reference year 2012) and very pronounced competence in the area of 'detecting new customer needs', 'developing new technical solutions', 'incentive systems for employees to develop new ideas', 'rapid implementation of ideas up to market introduction' or 'rapid response to innovations by other enterprises' (reference year 2010).

⁷ It is impossible to make any clear statements on trends because the measurement scale for this group has not been consistent over the years.

⁸ This corroborates the studies conducted on the basis of the KfW SME Panel which also identified a decline in innovation activity, particularly across the breadth of SMEs that do not undertake any R&D. Cf. Zimmermann, V. (2021): KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

⁹ Cf. Astor, M. et al. (2016): *Innovativer Mittelstand 2025 – Herausforderungen, Trends und Handlungsempfehlungen für Wirtschaft und Politik* (*Innovative SMEs in 2025 – challenges, trends and recommendations for action for business and policy-makers* – our title translation, in German only), Berlin: Federal Ministry for Economic Affairs and Energy.

¹⁰ For this group, however, it must be taken into consideration that the definition of this group was not uniform over time. The comparison over time is therefore of very limited informative value. A comparison of the values for 2008-10 and 2016-18, which are based on very similar definitions of this group, points to a decline in the prevalence of innovation constraints.

¹¹ Cf. Zimmermann, V. (2022): KfW SME Innovation Report 2020: Coronavirus crisis is slowing down innovation, KfW Research.

¹² There are plans to publish the findings relating to this innovation barrier in a separate study.

¹³ Cf. Zimmermann, V. (2021): Innovation and digitalisation in enterprises mutually reinforce each other, *Focus on Economics* No. 338, KfW Research.

¹⁴ Cf. Rammer, C. (2021), *Ansätze zur Verbesserung der administrativen Umsetzung der Forschungszulage, Ergebnisse einer Befragung des VDMA* (*Approaches to improving the administrative implementation of the research grant, findings of a survey by the VDMA* – our title translation, in German), Mannheim: Leibniz Centre for European Economic Research.