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»» SMEs face a wide range of barriers to innovation – support policy needs to be broad-based

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The distinguishing features of small and medium-sized enterprises (SMEs) are not only their size and the economic sector they belong to. They also pursue a wide range of innovation activities and consequently face different barriers to innovation.

Enterprises that do not pursue pioneer strategies face barriers to innovation particularly often. Different barriers to innovation predominate in different SME groups, with financing problems affecting primarily small and young SMEs and businesses pursuing growth strategies. Bureaucratic obstacles, in turn, mainly affect companies in the construction industry. For a further group of SMEs, organisational and skills problems in combination with financing difficulties and high market risk are the most widespread barriers to innovation. These are often companies in traditional 'low-tech' sectors, craft industries and businesses with a low level of profitability. The two groups mentioned last are also characterised by the fact that they usually bring forth incremental innovations.

The heterogeneity of the SME sector and the diversity of obstacles to innovation suggest that innovation support for SMEs should be broad-based as well and comprise both financial and non-financial support. It is particularly in enterprises whose innovations are not based on their own R&D, but emerge primarily from the normal work process and through interaction with customers and suppliers that the availability of skilled workers, organisational problems and lack of technological expertise constitute key obstacles to developing innovations. Major building blocks that promote innovation include measures aimed at training and upskilling staff, support for the development of innovation management systems, and the transfer of scientific-technical knowledge – in addition to continuous improvements to the financing situation.

Small and medium-sized enterprises (SMEs) are regarded as guarantors of growth and employment. SMEs' innovation activity – a key source of competitiveness – has declined in the past years, however. The proportion of innovators among SMEs (companies with a turnover of up to EUR 500 million)

fell from 43 % between 2004 and 2006 to 29 % between 2012 and 2014.[1] The share of innovation expenditure by enterprises with fewer than 500 employees also dropped from 42 % in 1995 to 22 % in 2014.[2]

SMEs' innovation activity has developed in different ways. The proportion of innovators remained comparatively steady in the R&D intensive manufacturing sector (e.g. engineering, electronics, pharmaceuticals) over the past ten years. But innovation momentum has declined particularly among the small enterprises and companies in the construction and services sector and in the less R&D-oriented industries of the manufacturing sector. In other words, innovators have been lost precisely in those segments that conduct R&D more rarely and bring forth innovations at irregular intervals.

This development itself indicates that, contrary to what is often assumed, SMEs are anything but a homogeneous group. Besides their size and the branch of industry to which they belong, SMEs differ substantially particularly in the focus of their innovation activities. For example, just under two fifths of innovators conduct R&D activities of their own occasionally or continuously. That also means that around three fifths conduct no R&D at all. Their innovation strategies and goals also differ. Two thirds use their innovations to develop individual customer solutions. One fourth of them aim to be the technological leaders in their respective industry. Equally as many SMEs state that they merely respond to their competitors' innovations.[3]

It stands to reason that SMEs include diverse types of innovators that also face barriers to innovation of different intensity. The Institute for Small Business Economics at the University of Göttingen (ifh Göttingen) and KfW Research have therefore examined together what obstacles hamper the innovation activity of various groups of SMEs (see Box 2 for methodology).[4] The analysis focused on the less R&D-active segments of the SME sector, where the innovative output has fallen most sharply since the middle of the last decade. Digitalisation was addressed in a separate study. The analysis allows the SME sector to be classified into four typical groups.

SMEs with a strong focus on R&D

Features of cluster 1: SMEs with a strong focus on R&D

Large and older SMEs
R&D-intensive manufacturing (e.g. pharmaceuticals, production of data-processing equipment, engineering), knowledge-based services (e.g. law firms, tax accountants, management consultancy, IT and information service providers)
High profitability
Investment goals: innovation and R&D
Innovation goals: Pioneer roles in technologies and for products and services

Cluster 1 primarily comprises R&D-active enterprises. This cluster includes roughly 24 % (extrapolated) of the surveyed SMEs. These are mainly larger and older enterprises. With an average of 72 employees, they are significantly bigger than the enterprises in the other clusters (Table 1).

The average company age is also the highest, at 40.6 years. Importantly, the enterprises in this cluster are characterised by a high profit margin. These characteristics should explain why barriers to innovation affect them less than average. Furthermore, this cluster has more R&D-intensive manufacturing and knowledge-based service enterprises (Figure 1).

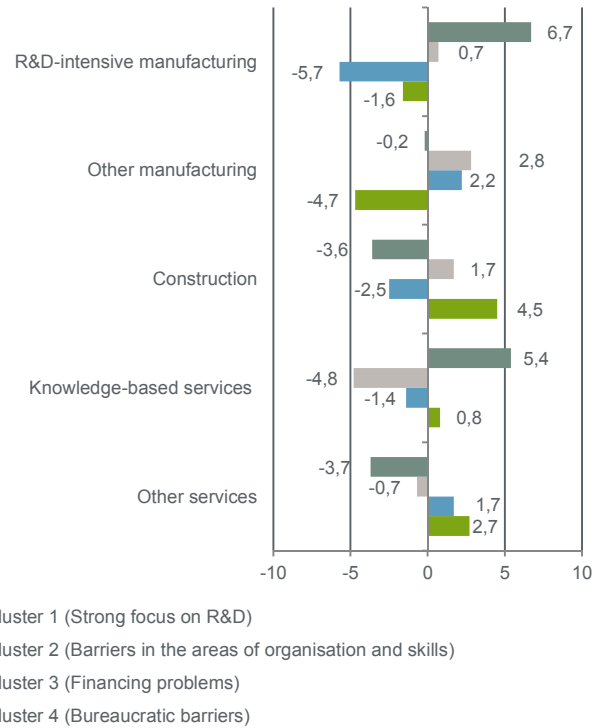### Table 1: Business size, age and profit margin by SME cluster

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	All
Number of employees	72.1	41.2	34.7	48.2	48.9
Age	40.6	37.6	30.3	38.3	36.5
Profit margin in per cent[5]	4.8	2.2	2.8	5.2	3.6

Source: KfW SME Panel 2011, own calculations.

As was to be expected from their frequent R&D activity, enterprises whose investment goals are more often explicitly stated as innovation and R&D are concentrated in the first cluster (Figure 3). Companies in this cluster also aim for pioneer roles in modern technologies, new products and services more frequently than others. This confirms that enterprises in this first cluster can be allocated to the 'science, technology and innovation (STI)' mode (Box 1).

Figure 1: Concentration of economic sectors on SME clusters

Variance of the proportions of economic sectors from the sample share of the respective SME cluster in percentage points

- Cluster 1 (Strong focus on R&D)
- Cluster 2 (Barriers in the areas of organisation and skills)
- Cluster 3 (Financing problems)
- Cluster 4 (Bureaucratic barriers)

Source: KfW SME Panel 2011, own calculations

Box 1: Two modes of bringing forth innovations
It is reasonable to distinguish between very R&D-intensive and less R&D-intensive segments because each segment brings forth innovations in different ways. Economic literature therefore distinguishes between two different modes of bringing forth innovations.

The first mode is based on conducting R&D. Innovations primarily emerge in the framework of systematic and formalised work by in-house R&D departments. This activity generates new scientific-technical knowledge. This new knowledge forms the basis for innovations created by the respective enterprise. Partnerships with research facilities also contribute to innovations. This R&D-intensive mode falls under the label 'science, technology and innovation (STI) mode'.[6]

In contrast, the second mode is based on experience-based skills acquired through 'learning by doing, using and interacting' (DUI mode). In generating innovations, informal processes of learning and understanding dominate here given the key importance of application-related skills. Innovations result from the normal production process or in close interaction with customers and suppliers. The ability to bring forth innovations therefore is strongly based on application-related and employee-based experiential knowledge acquired over the years.

Innovations that emerge in this manner are often incremental and very specific problem solutions. They are frequently tailored to specific needs in the course of gradual optimisations.

These two modes obviously represent theoretical extremes. In practice, enterprises must be capable of combining various forms of learning and knowledge in order to successfully generate innovations.

The STI mode is relatively easy to capture by asking whether the enterprise conducted R&D of its own. This is much more challenging for the knowledge component "application-related, employee-based experiential knowledge". To obtain answers the survey examined whether a company primarily conducted activities that can be attributed to the skilled crafts. This seems appropriate because the crafts sector can be expected to be dominated by an experience-based learning and innovation mode.[7] It is precisely the master-apprentice learning relationship that is typical of the skilled crafts, in which the apprentice develops particular skills under a guided learning-by-doing approach, which is regarded as a showcase example of how experiential knowledge is transferred.[8]

SMEs facing barriers to innovation in the areas of organisation and skills

Features of cluster 2: SMEs facing barriers to innovation in the areas of organisation and skills

Older companies
Traditional 'low-tech' sectors: other manufacturing (e.g. food industry, manufacture of metal products, rubber and synthetic products), construction
Crafts enterprises
Low profitability
Investment goals: rationalisation and cost reduction
Innovation goals: incremental innovations

For enterprises in cluster 2 the main barriers to innovation activity are at the level of organisation and skills. These include lack of technological expertise, lack of relevant market information and a shortage of skilled workers. Financing difficulties and market risk also constitute obstacles to innovation in this cluster. An extrapolated 17 % of SMEs are in this group.
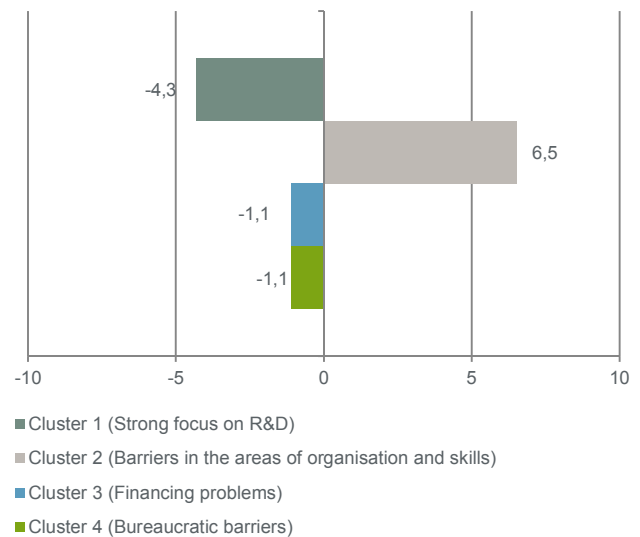
This group of companies has the lowest profit margin (2.2 %) which, among other reasons, is probably a consequence of problems in the area of organisation and skills. It can be assumed that these internal difficulties adversely affect business success, which probably gives rise to their financing difficulties as well.

The businesses in this cluster are slightly older than the sample average and are often found in less R&D-intensive manufacturing and more often in construction (Figure 1).

Problems with organisation and skills are therefore widespread particularly in the sectors that comprise a large number of rather more traditional industries.

Figure 2: Skilled crafts and cluster assignment

Variance of the proportion of skilled crafts from the sample share of the respective cluster in percentage points

- ■ Cluster 1 (Strong focus on R&D)
- ■ Cluster 2 (Barriers in the areas of organisation and skills)
- ■ Cluster 3 (Financing problems)
- ■ Cluster 4 (Bureaucratic barriers)

Source: KfW SME Panel 2011, own calculations

Cost reductions and rationalisation are important investment goals, which may indicate the preponderance of price pressure in this segment. Businesses in this cluster seek to evade such pressure through incremental innovation activity. Consequently, their most important innovation strategies consist in specialisation, customer-specific solutions and flexibilisation of products and services.

Cluster 2 also includes a comparatively high number of SMEs that primarily operate in the skilled crafts sector (Figure 2). Innovations here often result from the normal work process and through interaction with customers and suppliers. Application-related and employee-based experiential knowledge is likely to be their most common source of innovation. The high importance of problems in the areas of organisation and skills in this cluster underscores the particular learning and knowledge conditions under which innovations are brought forth here (Box 1).

SMEs facing financing problems as barriers to innovation

Features of cluster 3: SMEs with financing problems

Young and small enterprises
Less research- and knowledge-intensive segments of the manufacturing and services sector
Below-average profitability
Growth orientation

Financing problems are the main obstacle to innovation for businesses in cluster 3. These businesses represent the biggest group, at 37 %. Small and young businesses tend to be more abundant in this cluster. This finding impressively underscores the structural disadvantages these companies face in financing innovations. Since young and small businesses per se constitute a higher risk9 and often request low amounts from the point of view of potential lenders, obtaining external financing for innovations is a particular challenge for these enterprises.

Businesses in this cluster also tend to achieve low profit margins. This, too, reduces their ability to finance innovations from internal or external funds. Financing problems are therefore most common in this group.

In contrast, cluster 3 is not marked by any single innovation strategy or individual, specific targets. However, investments undertaken by these enterprises are directed strongly at increasing turnover and expanding (and renewing) their product range. This is consistent with the fact that the enterprises in this cluster are small and young businesses. Investments aimed at increasing turnover and introducing new product lines are probably an expression of a drive towards growth, which is often hampered by financing problems in this cluster.

SMEs facing bureaucratic barriers to innovation

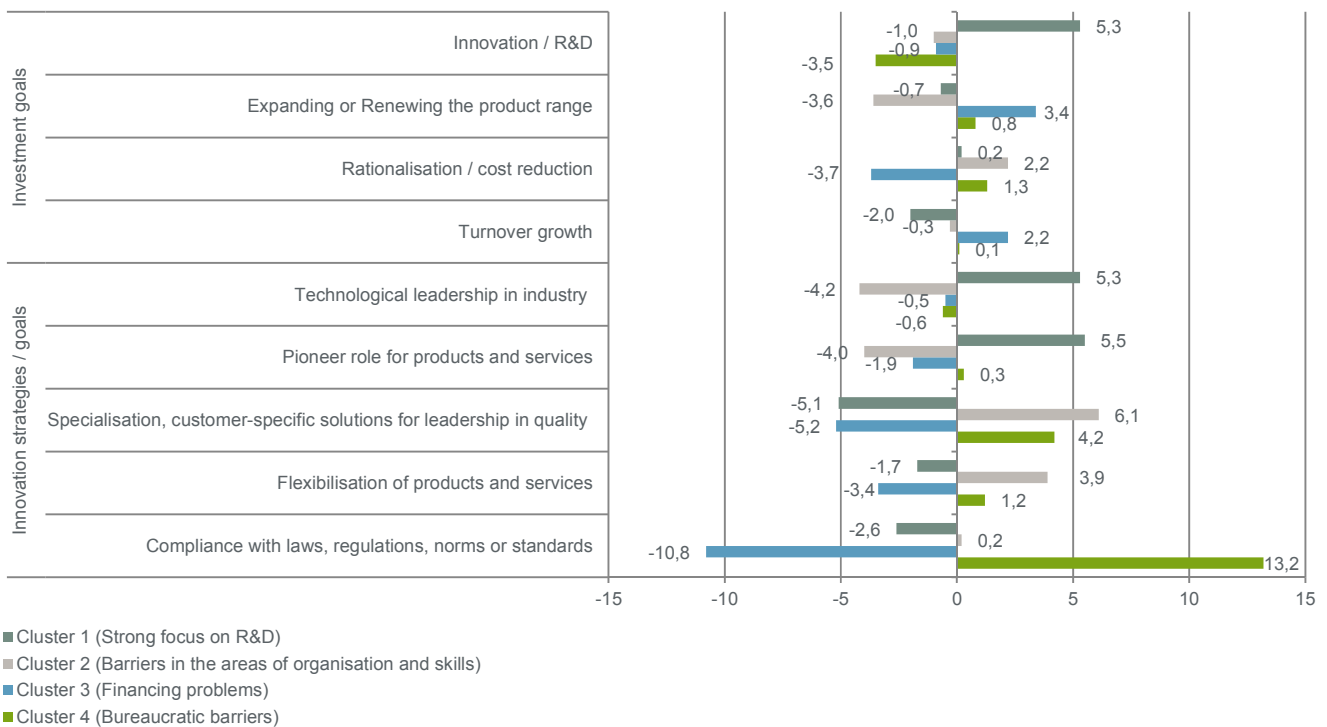Features of cluster 4: SMEs facing bureaucratic barriers to innovation

Older companies
Construction
High profitability
Investment goals: rationalisation and cost reduction
Innovation goals: incremental innovations

Finally, bureaucratic barriers are the main problem for enterprises in cluster 4 (22 %). They include obstacles that originate in legislation, legal requirements and standards, as well as lengthy administrative and approval procedures. The affected businesses tend to be older and their size corresponds with the sample average. This cluster mainly includes construction firms. Bureaucratic obstacles are no surprise here as construction activity in particular is subject to a strict legal and regulatory framework.

Similarities exist between clusters 2 and 4 with respect to investment and innovation targets. Cost reductions and rationalisation are important investment goals for these enterprises as well. Incremental innovation activity is also prevalent in this cluster. Specialisation, customer-specific solutions and flexibilisation of products and services are the most important innovation strategies.

Figure 3: Investment / innovation goals and strategies by cluster assignment

Variance of different enterprise characteristics from the sample share of the respective cluster in percentage points

- Cluster 1 (Strong focus on R&D)
- Cluster 2 (Barriers in the areas of organisation and skills)
- Cluster 3 (Financing problems)
- Cluster 4 (Bureaucratic barriers)

Source: KfW SME Panel 2011, own calculation

A significant difference between the businesses in these two clusters consists in the fact that the innovation target 'compliance with laws, regulations, norms or standards' makes it very likely for them to belong to cluster 4. This may seem surprising at first glance because enterprises in this cluster also perceive the legal and regulatory framework as a major obstacle. However, it has to be noted that legal requirements may also provide incentives for innovation. Environmental regulations that encourage the development of ecologically safe products and processes are one example.

Conclusion

The above analysis examined the innovation obstacles faced by SMEs. The focus was on SME segments not characterised by a pronounced R&D orientation. The analysis shows that enterprises that do not pursue any pioneer strategies are affected particularly often by obstacles to innovation. In line with the broad diversity of the SME sector, various innovation obstacles exist in a variety of constellations. Thus, financing problems primarily affect small and young enterprises and companies pursuing growth strategies. The next two groups of businesses, in turn, are characterised by incremental innovations. Bureaucratic obstacles to innovation are particularly significant for construction enterprises. A further group which includes businesses from traditional 'low-tech' segments and the skilled crafts sector is affected primarily by problems at the level of organisation and skills combined with financing problems and market risk.

Given the heterogeneity of the SME sector and the diversity of obstacles to innovation, innovation support for SMEs must be broad-based as well and comprise both financial and non-financial support. This allows different support offerings to address the main innovation obstacles faced by various SME groups (Table 2). Obstacles in the area of organisation and skills play an important role particularly in enterprises whose innovative output is based on application-related and employee-based experiential knowledge. The demographic trend is likely to further exacerbate the skills shortage. Measures aimed at mobilising, training and upskilling workers are therefore very useful. In addition, the competence-related obstacles demonstrate that more traditional SME-dominated segments in particular need support in incorporating external scientific-technical knowledge.

Moreover, innovative SMEs can compensate the lack of in-house R&D to a certain degree by structuring their learning and innovation processes more systematically.[10] Support in implementing an adequate, employee-oriented innovation management system should therefore be another important approach to removing skills-related barriers to innovation. ∎

Table 2: Approaches to promoting innovation in less R&D-active segments of the SME sector and main-target enterprises

	Reducing financing obstacles	Reducing obstacles in the area of organisation and skills (e.g. skills shortages, transfer of scientific and technical knowledge, innovation management)	Reducing bureaucratic barriers
Age of company	Young enterprises	Older enterprises	Older enterprises
Size of enterprise	Small enterprises		
Economic sectors	Less research- and knowledge-intensive segments of the manufacturing and services sector	Enterprises from traditional low-tech segments	Construction
Skilled crafts		Crafts enterprises	
Strategic orientation	Enterprises with growth strategies	Incremental innovators	Incremental innovators

Box 2: Dataset and methodology

The analysis is based on the 11th survey wave of the KfW SME Panel. This survey explored the significance of ten different innovation obstacles on a five-point scale for the period 2008–2010. The 2011 survey also included a range of additional information that permitted a more in-depth classification of innovation obstacles in the specific context of the surveyed businesses. The survey included enterprises with fewer than 500 employees that introduced product or process innovations within the enterprise from 2008 to 2010. The survey was also limited to enterprises in which specific obstacles to innovation activity led to longer implementation periods, reduced scope or aborted innovation projects, or in which innovative ideas did not even reach the implementation phase.

In a first step the ten surveyed barriers to innovation were combined into closely correlated clusters of variables with the aid of a factor analysis. The factor analysis arrived at the conclusion that the surveyed barriers to innovation can be clustered into four barrier factors (Table A-1). Factor 1 clusters the barriers to innovation into "prohibitively high innovation costs" and internal or external funding difficulties.

The generic term "funding problems" was therefore selected for the first barrier factor. Factor 2 ("problems in the areas of organisation and skills") combines competence-related obstacles: organisational problems, lack of technological expertise, lack of relevant market information, and a shortage of skilled workers. Factor 3 ("bureaucratic barriers") comprises barriers to innovation due to legislation, legal requirements and standards as well as lengthy administrative and approval procedures. Finally, factor 4 ("market risk") refers to the market environment of innovative SMEs. Here, high innovation costs are associated with high commercial risk and lack of relevant market information. The proportion of variance in the sample explained by the factor analysis was 69.7 %.

In a second step, a cluster analysis was conducted to identify the relevance of these clusters of barriers, particularly in less R&D-active segments of the SME sector. The estimated factor values of the four clustered barrier factors as well as the information on the enterprises' R&D activity were used as cluster variables. The cluster analysis was based on the information provided by 1,663 enterprises. A classification into four groups of SMEs can be made (Table A-2).

Table A-1: Factor analysis: Importance of innovation barriers for SMEs

Principal components factor analysis, varimax-rotated factor loadings

	Factor 1	Factor 2	Factor 3	Factor 4
Prohibitively high costs	0,522	0,042	0,006	0,569
Uncertainty about economic success	0,118	0,046	0,076	0,823
Lack of internal funding sources	0,920	-0,010	-0,037	0,113
Lack of appropriate external funding sources	0,913	-0,002	0,060	-0,002
Lack of skilled workers	0,082	0,666	0,204	-0,167
Legislation, legal requirements, and standards	-0,023	0,072	0,896	0,065
Lengthly administrative / approval processes	0,046	0,050	0,903	0,046
Lack of market information	-0,125	0,472	0,244	0,520
Lack of technological expertise	-0,047	0,739	0,058	0,319
Organisational problems	0,008	0,776	-0,011	0,009
Generic term	Financing problems	Barriers in the area of organization and skills	Bureaucratic barriers	Market-risk
Explained variance (in percent)	19,9	18,3	17,4	14,2

Note: N=1.711; Barlett-Test: Chi^2=4.497,6; P<0,000; Kaiser-Meyer-Olkin-Kriterium: KMO=0,635

Source: KfW SME Panel 2011, own calculation

Table A-2: Cluster solution

Means

	Total	Cluster 1	2	3	4	Chi^2(3)
Barriers to innovation (factor values)						
Factor 1: Financial problems	-0,01	-1,03	0,36	0,90	-0,36	921,2***
Factor 2: barriers in the area of organization and skills	-0,01	-0,04	1,12	-0,70	-0,36	803,5***
Factor 3: Bureaucratic barriers	-0,01	-0,69	0,05	-0,51	1,28	871,3***
Factor 4: Market risk	0,01	-0,24	0,30	0,03	-0,05	54,4***
R&D participation						
Own R&D	0,59	0,66	0,57	0,55	0,57	11,9***
Sample share in Percent		25,4	24,5	27,1	23,1	

Note: Standardized factor values (mean=0, standard deviation=1). Negative values mean that the importance of the barrier in the corresponding cluster in less than in the other three clusters. A value near 0 means an average importance and positive values indicate an above-average importance.
*** signifikant at the 1% level (Kruskal-Wallis-Test)

Source: KfW SME Panel 2011, own calculation

[1]Cf. Zimmermann, V (2016): KfW SME Innovation Report 2015. Germany's innovation performance remains low despite slight increase. KfW Research, Frankfurt.

[2] Cf. Rammer, C.; Aschhoff, B.; Crass, D.; Doherr, T. Hud, M.; Köhler, C.; Peters, B.; Schubert, T. and F. Schwiebacher (2016): Innovationsverhalten der deutschen Wirtschaft (*Innovation behaviour of German industry*). Indikatorenbericht zur Innovationserhebung 2015, Mannheim (*Indicator report on innovation survey 2015)*, Mannheim (in German).

[3] In relation to the entire SME sector. Cf. Zimmermann, V (2016): KfW SME Innovation Report 2015. Germany's innovation performance remains low despite slight increase. KfW Special Publication. KfW. For a more in-depth analysis of SMEs' innovation strategies cf. Zimmermann, V. (2012): To be the Leader of the Pack? Innovation strategies in the German SME sector. KfW Economic Research. Focus on Economics No. 11, November 2012.

[4]Cf. Thomä, J. and V. Zimmermann (2016): Innovationshemmnisse im Mittelstand. Eine empirische Analyse unter Berücksichtigung des Handwerks (*Barriers to innovation in SMEs. An empirical analysis which includes the skilled crafts*). Göttinger Beiträge zur Handwerksforschung No. 6. Göttingen (in German).

[5]Median.

[6] Cf. Jensen, M. B.; Johnson, B.; Lorenz, E. and B. A. Lundvall (2007): Forms of knowledge and modes of innovation. Research Policy 36(5): 680–693.

[7] Cf. Thomä, J. and V. Zimmermann (2013): Knowledge protection practices in innovating SMEs. Journal of Economics and Statistics, 233 (5/6): 691–717.

[8] Cf. Polanyi, M. (1958/1974): Personal knowledge: Towards a post-critical philosophy. Chicago.

[9] Cf. Müller, S. and J. Stegmaier (2014): Economic failure and the role of plant age and size. First evidence from German administrative data. IAB Discussion Paper 13/2014.

[10] Cf. Rammer, C.; Czarnitzki, D. and A. Spielkamp (2009): Innovation success of non-R&D performers: substituting technology by management in SMEs. Small Business Economics 33(1):35–58.