



Innovation: More than Research and Development

Growth opportunities on different innovation paths

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Summary

On all levels of economy and society innovations are perceived as key success factor to economic growth and employment. Often it reads as follows: Increased research and development generates technologically innovative products, enabling companies to achieve competitive advantages and gain market shares, which eventually leads to economic growth and employment.

This coherence has many times been empirically proven and was again confirmed by the *Manufacturing Performance Survey 2003*. At the same time the survey also revealed that other promising innovation strategies can be pursued: Companies that achieve innovative breakthroughs by intelligent product-service combinations or innovative techno-organisational processes also are superior to their competitors in regards to employment growth.

This indicates that innovation can be more than just research and development. Innovative companies contributing to economic growth and employment can also be found in industrial sectors that are not as dedicated to research. They too ought to be appreciated and supported in their innovation efforts correspondingly.

Introduction

Innovation as motor of economic growth and employment

Germany, a country poor in raw materials, having high labour costs and high manufacturing standards as well as a capable and thereby cost-intensive infrastructure, can only achieve competitive advantages by permanently generating innovations. In the medium term companies neglecting innovations will hardly be able to economically survive in Germany. Innovations remain to be the impulse for economic growth and employment.

Given Germany's weakness in economic growth in the last few years, intensified innovation efforts are seen as the main instrument for making progress on the macro economic and on the micro economic level. The Federal Government's attempts of this its innovation initiative, to improve the general conditions for innovations and stimulate the willingness for innovations, have to be seen against this background.

In discussions on broadening innovation efforts the term "innovation" is, in general, closely linked to research and development (R&D): An increase in R&D activities is to result in innovative products, able to stand a chance on global markets. There is sufficient empirical evidence that R&D intensive companies are more competitive with their products. They thereby open up growth opportunities for themselves which remain unreachable for companies less involved in R&D.

R & D intensive companies are leading in growth

Data from the *Manufacturing Performance Survey 2003* (cf. box on p. 12) again confirms this correlation: On average, companies manufacturing piece goods invest about 6 percent of their turnover in R&D. However, companies with a poor R&D quota of less than 2 percent barely set any growth impulses. On average these companies each merely added about 3 new jobs between 2000 and 2002. At the same time companies dedicated to R&D, with a quota of at least 6 percent, scarcely added an average of 8 employees. Companies highly engaged in R&D were therefore able to realize employment growth above average.

Innovation strategies focussing on R&D are evidently generating economic growth. However, the innovation initiative of the Federal Government also made it clear that innovation can be more than developing new products. Innovation advantages facilitating growth can as well be accomplished through innovative manufacturing processes or new business models. Hence, the question, of whether an innovation strategy simply focussing on R&D is the only

possible way to go in Germany, will be discussed in the following by successively examining the questions stated below:

- Are there other profitably growing innovation fields beyond R&D based product innovations and what do they look like?
- What rates of employment growth are realistic in these innovation fields?
- What industry, size or manufacturing conditions characterize companies achieving growth on alternative innovation paths?

Importance of other innovation paths?

Growth through innovative product-service combinations

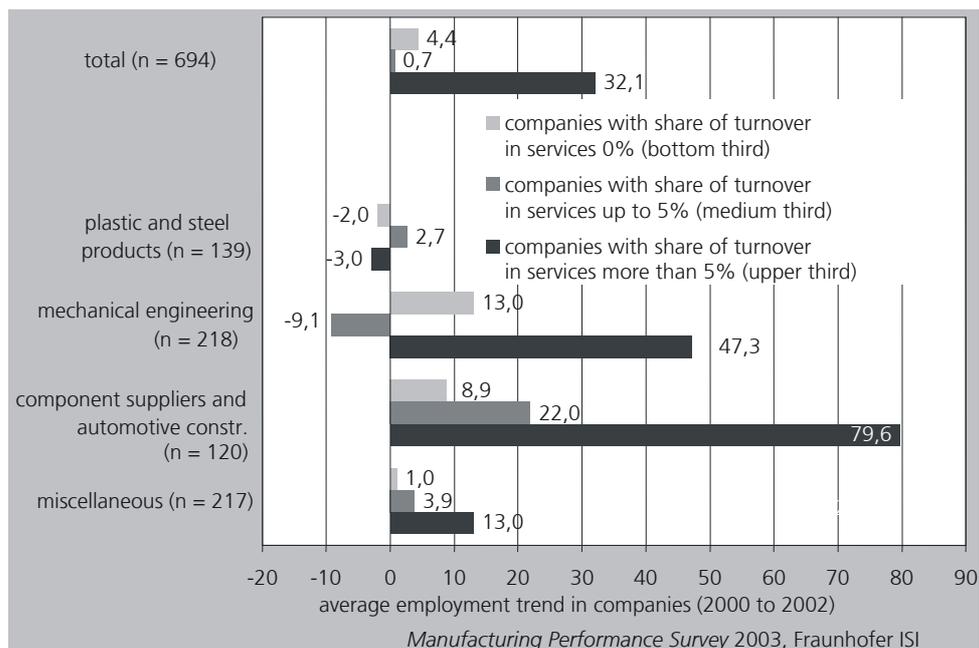
In some markets German industry is confronted with the fact that a more expensive product is no longer competitive just because of its superior product technology. One reason for this is that, meanwhile, international competitors are able to convert technological progress into innovative products just as fast. At the same time, innovative technology has lost some of its significance in particular markets as opposed to complete solutions.

Against this background companies have begun to define innovation in a wider sense: They have redesigned the services they offer in such a way as to offer customers a whole package of complementary services on top of the industrial product itself. In this combination the product and the accompanying services present a new quality of problem solution. These additional services can be performed before product sales, as for instance demand analyses or engineering services, during product sales and before product use as in the case of financial services or launch support or after product sales, to accompany the use of the product e.g. through telephone support, modernisation or build-and-operate models. To these companies, innovation means expanding their traditional core competencies, solving the customer problem not only technologically but in every respect to come up against their competitors. The turnover generated by such services is an adequate indicator for the extent to which companies pursue this innovation path.

Innovation path product accompanying services

In terms of the German industry altogether, the service turnover amounts to an average of 7.4 percent according to the underlying data of this survey. The average value only slightly changes when differentiating industrial companies by size or branch of business. This evidently shows that the innovation strategy "to develop innovative product-service-combinations" is not an industry or size dependent phenomenon.

Figure 1:
Development of
employment of
companies with
different service
turnover



The top third of companies with the most intensive service focus created more than 30 new jobs each

To which extent this innovation strategy is successful, can be seen by comparing the employment trends of companies which show extensive activity to those of companies which show rather poor activity in the service sector. When contrasting the employment trend of companies with no or insignificant service turnover with the third of companies realising more than 5 percent of turnover through services, the following can be noted: Between 2000 and 2002 the former were able to keep the number of employees stable. On the other hand, companies with a high service turnover reported increasing employment figures. An average of 32 new jobs was additionally created per company.

These figures clearly show that the innovation path "development of innovative product-service combinations" makes a difference for economic growth and employment. Companies that drove their innovation efforts into this direction of new business models were indeed successful in the market and therefore able to increase their number of employees.

Growth by innovative organisation

Occasionally companies pursue the approach of realising innovative organisation concepts, thereby offering their customers more flexibility and efficiency in order to gain a competitive advantage. This innovation strategy relies on structures and processes optimised to meet market demands. It tries to enable a leading position through innovative organisational solutions.

Ever since the contribution of innovative organisation concepts to a company's productivity was perceived – at the latest during the debate on lean production – the implementation of organisational innovations in industrial companies came out of the back seat. Among these organisational innovations we find structural organisation concepts such as the separation of manufacturing into customer or product specific segments, the reduction of central departments, the decentralisation of planning, managing and monitoring functions or the creation of cross-departmental development teams. Moreover, operational organisational innovations like task integration, simultaneous engineering, the introduction of teamwork or the realisation of zero-buffer-principles are to be noted. Last but not least novelties in human resources management as for instance the implementation of regular appraisal interviews or the realisation of programmes designed for continuous improvement deserve mentioning.

When evaluating to which extent companies have put such organisational innovations into effect every company can be placed on a scale from 0 to 100 points. 0 points meaning that a company has not realised any of these organisational elements, 100 points meaning that all organisational innovations have not only been introduced, but are also widely spread throughout the company.

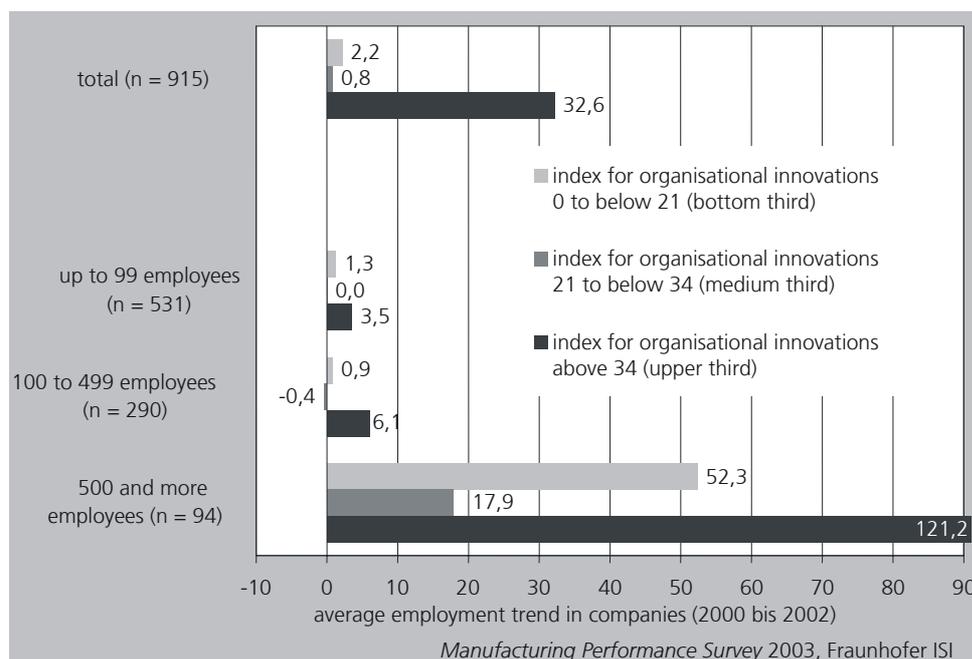


Figure 2:
Employment trend of companies with varying usage of organisational innovations

Innovative organisation enables employment growth for small and large companies

As analyses revealed, the index measuring the extent of organisational innovations (see above) values at an overall average of 30 points. When dividing companies into "hardly organisational innovative" (values below 20), "averagely" (value range 21 to 34) and "strongly innovative" companies (values above 34) again a close connection to growth potential is evident: Companies ranked "hardly organisational innovative" or "averagely" barely achieved any employment growth between 2000 and 2002. At the same time, companies that deployed organisational innovations to a great extent were able to add an average of 33 jobs each.

This correlation between a leadership in organisational innovations and employment growth is independent from the company's size. Companies, no matter what size, that notably implement organisational innovations are always superior in regards to growth. So the innovation path "organisation", too, bears an option for companies to convert advantages into growth on the market.

Growth with innovative process technology

Innovation path technological processes

The use of innovative production technology marks a third innovation path beyond R&D. This approach aims at implementing process innovations as soon as possible by investing in modern production facilities. This measure enables highly qualified employees to work at full capacity and saves volume of work, in order to guarantee a more efficient manufacturing at higher speed and quality than competitors. This strategy has a positive impact on employment as soon as the gain of market share overcompensates for the savings that are generated by the reduction of workforce through the use of innovative process technologies.

Process innovations in the industrial manufacturing of piece goods are currently based on a broad spectrum of technologies: information technologies such as electronic procurement, the use of teleservice, of simulation software, of PPS/ERP-systems, of supply chain management or CAD/CAM-technology all aim at optimising administrative, planning and managing processes. New machinery and equipment, as for instance CNC-machining centres, industrial robots and handling systems, automated material flow systems or assembly stations can improve the direct manufacturing processes.

When evaluating companies by the number of innovative process technologies they apply and by how far they exploit the potential of these, on a scale ranging from 0 to 100, the average is 17 points. Since the process innovations outlined above are not entirely of use for all companies this figure must not immediately be interpreted as an indicator for low innovation. More important seems the fact that a differentiation by "little" (less than 9.5 points), "medium" (9.6 to 20.5 points) and "highly" (more than 20.5 points) innovative companies, regarding process technology, reveals the growth potential of innovative companies: While there is hardly any increase of jobs noticeable in the group "little innovative in regards to process technology", the very active companies employ an average of 14 additional workers.

With innovative technological processes rationalisation effects can be overcompensated by growth

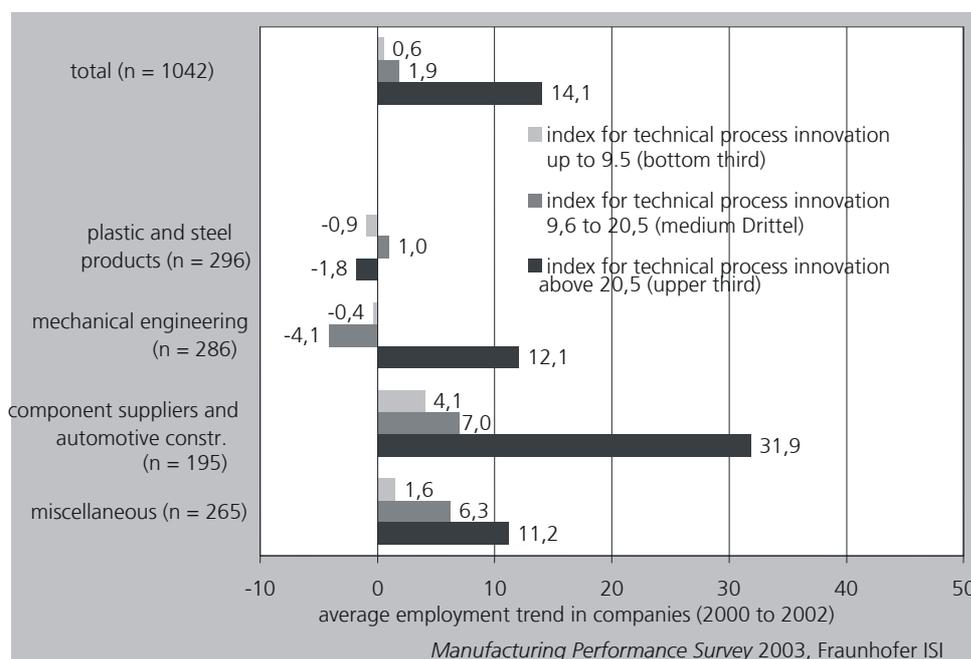


Figure 3: employment trend of companies with varying use of technological process innovations

The generally higher growth rate of companies using innovative process technology is largely independent of company size and industry affiliation. However, it is strongly pronounced within the automotive construction and component supplier industry. With a healthy overall growth in this sector between 2000 und 2002 companies using innovative process technology were able to add an average of 32 employees to their workforce.

Mainly, process innovative automotive companies are growing

Do focussed innovation strategies pay off?

As shown in the previous paragraphs, there are indeed different innovation paths that enable a higher-than-average employment growth. However, we have not yet scrutinised whether companies do "only" rank among the top third in a single innovation field or whether they also focus on other fields. This

means that a possible mixture of innovation strategies still affects the data surveyed so far.

**Five types of
focussed
innovation
strategies**

For companies it is surely just as important as interesting to know what growth potential focussed (i.e. "pure") innovation paths promise and which companies successfully focus on these paths. To answer these questions the following five company types with focussed innovation strategies were formed:

**No distinct
focusing**

Type 1 ("no distinct innovation focus") comprises companies which do not rank among the top third of any of the four innovation fields (R&D based product innovations, innovative product-service-combination, organisational or technological process innovations). As expected this category shows the lowest employment growth. On average each company adds 0.9 jobs between 2000 and 2002.

**Research and
development**

Type 2 ("innovation focus R&D") consists of companies which solely rank among the top third regarding R&D quotas (at least 6 percent). In all other fields (innovative product-service-combination as well as organisational or technological process innovation) they are not listed in the top third. Between 2000 and 2002 these companies hire an average of 8.4 additional employees. Therewith they possess a significantly higher increase in employment than companies of type 1 respectively the average of all surveyed companies.

**Product-service-
combination**

Type 3 ("innovation focus product-service-combination") includes companies which only rank among the top third with respect to their share of turnover generated by product accompanying services (more than 5 percent). In the remaining fields (R&D-based product innovations as well as organisational or technological process innovations) they are not to be found among the top third of companies. Between 2000 and 2002 companies of this category averagely add 17.9 jobs; once again a distinctly higher employment growth per company.

**Process
modernisation**

Type 4 ("innovation focus process modernisation") comprises companies which rank among the top third concerning organisational as well as technological process innovations (measured against the respective index figures $> 0,34$ and $> 0,21$). Thereto they apply a minimum of R&D input (e.g. with an R&D quota of more than 2 percent they do not rank among the bottom third), but do not belong to the top third of companies in terms of innovative product-service-combinations. With an average of 18.1 newly added jobs between 2000 and 2002 they show an employment growth comparable with type 3.

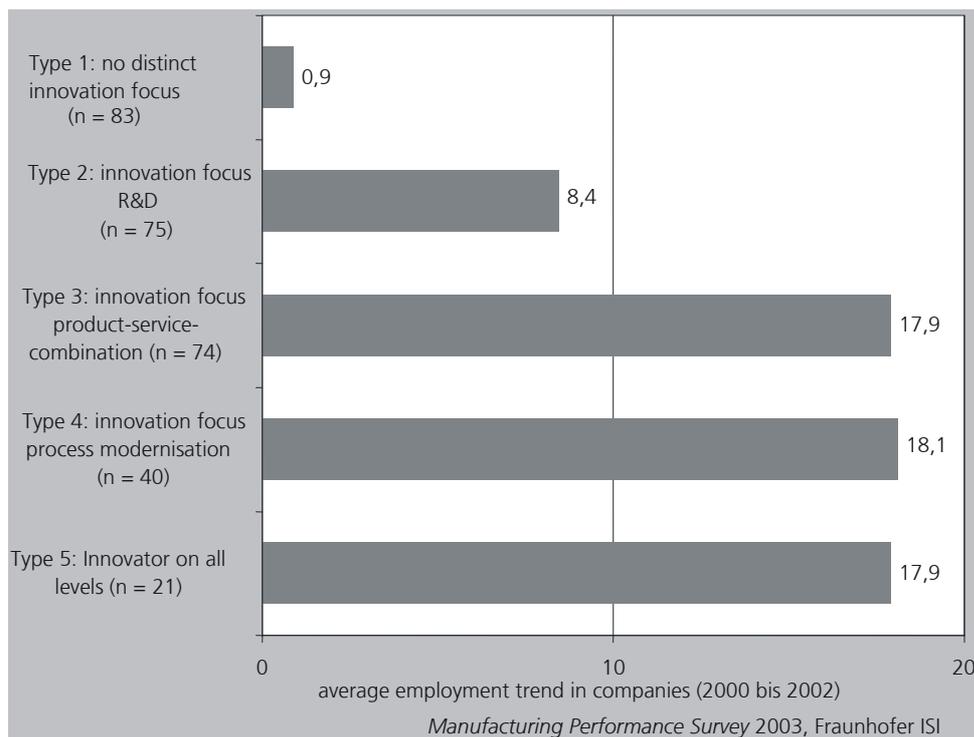


Figure 4: Employment trends of different company types with focussed innovation strategies

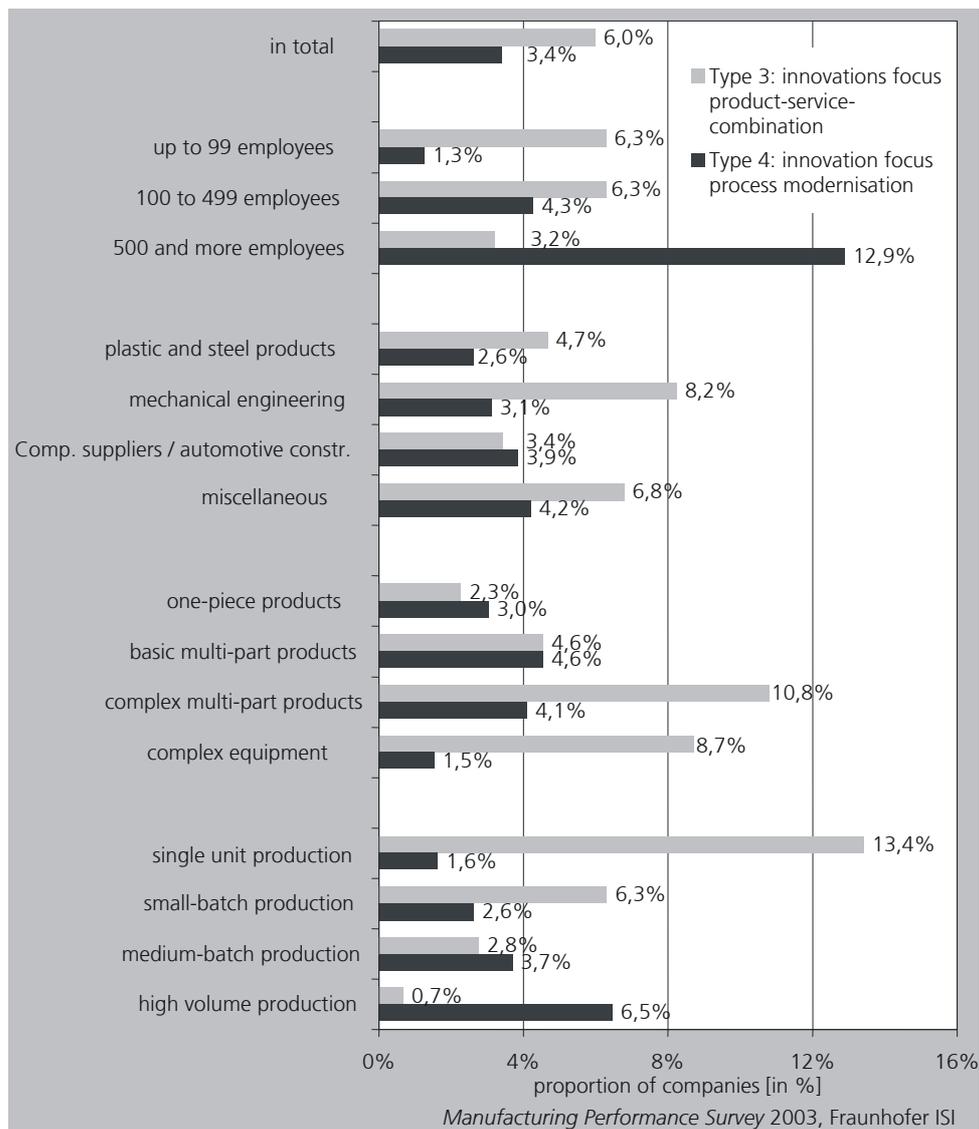
Type 5 ("innovator on all levels") takes into account companies which are to be found among the top third of all stated innovation fields (R&D-based product innovations, innovative product-service-combinations, organisational and technological process innovations). These few companies, which are broadly based innovative at the sharp end, add an average of 17.9 new jobs between 2000 and 2002. Therewith they have an employment growth just about as high as companies of types 3 and 4, though not a significantly higher one. Due to the low number of cases these figures should be handled with caution.

Broadly based innovator

The data given on average employment growth leads to the assumption that in particular the innovation paths "innovative product-service-combination" (type 3) and "organisational and technological process innovation" (type 4) offer growth potential for manufacturing companies beyond the "classic" R&D based product innovation focus. These two innovation strategies are being pursued by 6 percent respectively 3.4 percent of the surveyed companies. Especially for mechanical engineering companies (8.2 percent), manufacturers of complex products and equipment (10.8 respectively 8.7 percent) and single unit manufacturers (13.4 percent) innovative product-service-combinations seem to present an interesting and paying innovation target. For large companies, however, this innovation path seems to be less promising.

Product-service-combination interesting especially for single unit production of complex products

Figure 5:
Structure of companies focussing on "product-service-combination" respectively "organisational and technological process innovation"



Process innovations do fit especially with large companies and batch production

Organisational and technological process innovations are rather favoured by large companies with 500 and more employees (12.9 percent), by companies of the sector automotive construction and component supplies (3.9 percent) as well as by large batch production (6.5 percent) or by other sectors (4.2 percent). With repetitive production processes their manufacturing conditions seem to offer sufficient "critical mass" to realise distinct efficiency advantages through organisational and technological innovations. The specific size and production structures of a company have to be taken into account, not only in this but in all categories, when interpreting the average employment growth.

Conclusions

The results presented form a first attempt of empirically fortifying "innovation paths that promise economic growth" beyond a R&D-based strategy, which merely aims for product innovations. At the same time they give reason to possibly design innovation initiatives on a broader basis. In case one seeks to open up all growth potentials inherent to innovations, it might be advisable to at least complement an exclusive focus on R&D. Neither innovative business models nor the realisation of innovative organisational solutions nor the implementation of innovative process technologies originate from the research laboratories of the companies. In these cases other departments are demanded, whose contribution to the innovation success of a company was possibly underestimated up to now. However, their activation might set free additional growth impulses.

A one dimensional understanding of innovation as research based development of high-tech products does probably not meet the demands of the variety of economically promising innovation strategies. Alternative innovation paths and their rational combination may very well provide a basis for international competitiveness.

Product-service-combinations and process improvements are independent and promising innovation paths

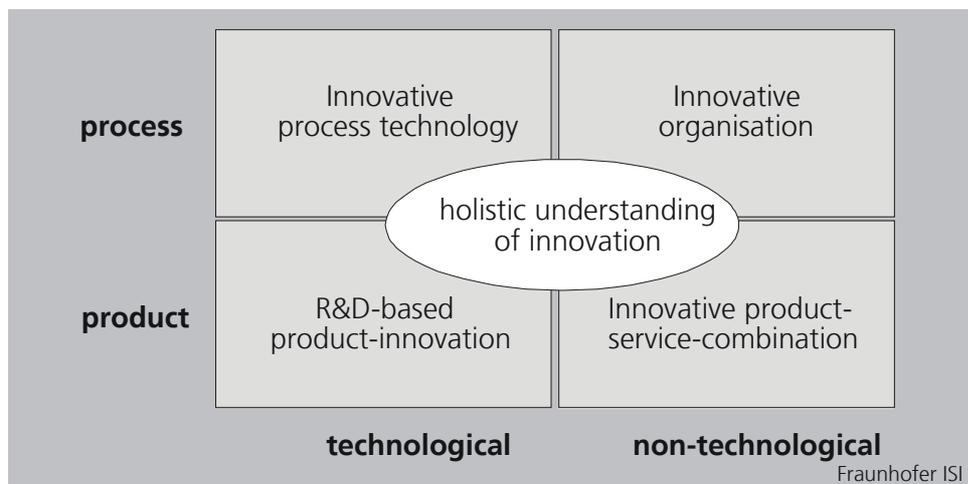


Figure 6: Matrix of a holistic understanding of innovation

In view of our current status of knowledge an adequately broad concept of innovation is yet best described by a matrix. One axis distinguishes between product and process innovations. The other axis distinguishes between technological (technical) and organisational (non-technical) innovations. In addition to traditional R&D-based innovation activities, the innovative fields of action "technological modernisation of value added processes", "introduction of organisational innovations" and "new business models for complementing the product offer by innovative services" result from this portfolio breakdown.

Broader understanding of innovation is necessary

Innovation initiatives should also consider innovation paths beyond R&D

According to their general conditions and strategies companies should carefully select the innovation fields where activities may unfold the greatest contribution to competitiveness and to the development of growth potential. By considering activities in further innovation fields the importance of R&D is by no means decreased. For innovation initiatives in public sectors it seems important to thoroughly examine the correlations which were merely outlined above. Possibly this may provide indications on how measures supporting innovation and growth can be applied in an even more demand and efficiency oriented way.

The Manufacturing Performance Survey 2003

Since 1993, every two years the Fraunhofer Institute for Systems and Innovation Research has been undertaking a survey issuing innovations in manufacturing. It addresses companies of the steel and electronics industry as well as (since 2001) companies of the chemical and plastics processing industry of Germany. Object of investigation are pursued production strategies, application of innovative organisational and technological concepts in production, matters of human-resource allocation and qualification as well as questions concerning management of production modernisation. At the same time performance indicators as productivity, flexibility, process quality and last but not least the return on sales are measured. With this information the survey can draw conclusions in regards to modernity and productive efficiency of key sectors of Germany's manufacturing industry.

The bulletin at hand is based on data of the 2003 survey. For this purpose 13,259 companies were addressed in autumn of 2003. By December 2003 1.450 companies had returned a usable questionnaire (rate of return 11 percent). The responding companies form a representative cross-section of core areas of the manufacturing industry. The chemical industry accounts for 10 percent, manufacturers of rubber and plastic products account for 10 percent, manufacturers of steel products for 23 percent and mechanical engineering holds a share of 28 percent. The bulletins published so far can be found on the internet at:

http://www.isi.fraunhofer.de/pi/mitteilung_pi.htm.

Should you be interested in special analyses of the new data pool, please contact:

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