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Research Report

The long road to closed cycle management: So far, environmental protection in the capital equipment producing industry has aimed primarily to reduce the production-related emissions

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The long road to closed cycle management

So far, environmental protection in the capital equipment producing industry has aimed primarily to reduce the production-related emissions

Carsten Dreher, Elna Schirrmeister

Summary

In the 1990s, recession and high unemployment meant that environmental protection was no longer a domain of action in the foreground of discussion, although the urgency of making industrial activities sustainable remains as great as ever. For this very reason, the Fraunhofer ISI has been analysing the environmental protection activities of the capital equipment producing industry.

Results of the analysis indicate that the managers questioned in the survey attribute great importance to closed cycle management approaches. This positive attitude is not yet reflected, however, in terms of concrete management. Thus only about one firm in seven offers its customers the facility of taking back used products. Management concepts that support closed cycle management, such as Life Cycle Costing or ecological audits, are even less widespread. Nevertheless, an examination of firms' aims indicates that these concepts will become increasingly important within the next few years. Traditional investments in equipment for reducing environmental pollution of clean air, clean water and clean earth continue to be the most frequently named measures. The average performance indicators of firms actively engaged in environmental protection are well up to, and in some cases better than, the average for firms as a whole.

Introduction

In past years, German industry undertook substantial efforts for environmental protection and sustainable management. In the seventies and eighties it was particularly the German manufacturers of environmental technology who profited from this pioneer market, which was also supported by legislation. In the age of the New Economy, however, interest appears to focus somewhat less on issues of sustainable management and environmental protection. Despite this it is still as urgent as ever to make processes and offers environmentally friendly. Because of this situation, the Fraunhofer ISI has been investigating the following questions in its survey *Innovations in Production 1999*, in which 1 442 firms in the German capital equipment producing industry participated:

- What is the attitude to closed cycle management of the plant managers?
- Which producers of capital equipment take back products, machines and components?
- Has the idea of environmental protection already been integrated into management concepts?
- What triggers the firms' investment in environmental protection?
- What is the business situation of firms that are active in environmental protection?

Closed cycle management from the managers' viewpoint

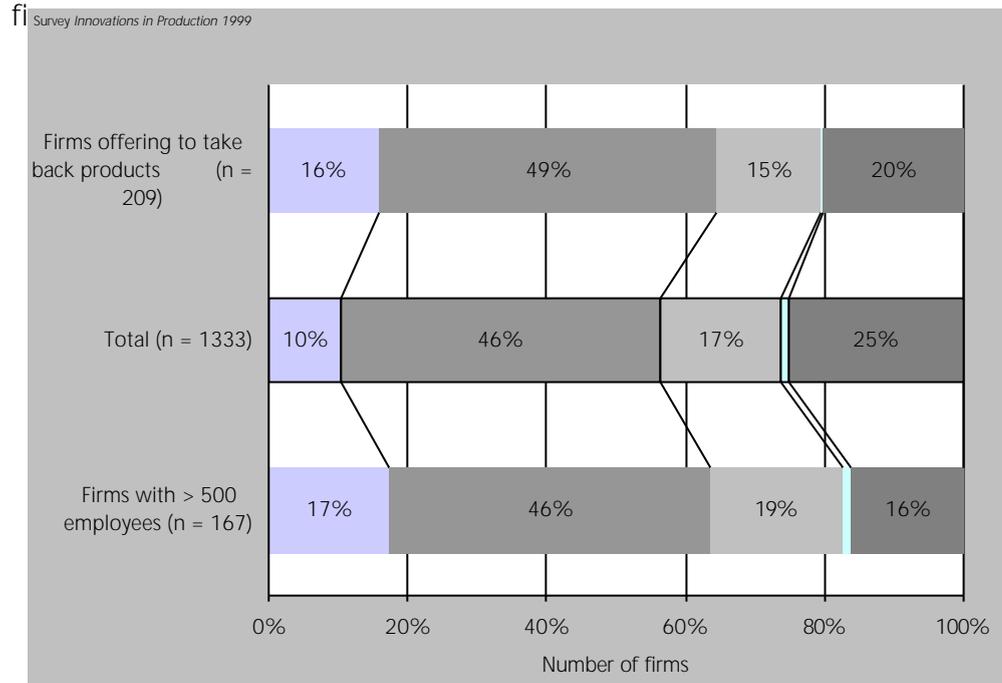
When introducing environmental protection measures, it is often the conviction of individual managers which is decisive. This holds true particularly for concepts whose economic usefulness for the firm is difficult to demonstrate in the short term. In the survey, managers and operating managers of firms were asked for their assessment of the importance of closed product cycles for the future of German industry. 10 per cent of those questioned considered that closed product cycles will be essential in future and 46 per cent regard the concept as "mainly positive". One quarter of survey participants felt they could not make an assessment, 17 per cent have mixed feelings about closed cycle management and only 1 per cent see it as a bad investment.

Closed product cycles are seen as an important concept and are mainly regarded positively

In view of the small percentage of firms taking back their used products, and the critical general public discussion, for instance about the 'grüner Punkt' (the waste recycling scheme operating in Germany at present), the small percentage of managers with a negative attitude is surprising. The managers of large firms appear to have considered closed cycle management somewhat more often than the managers of small and medium-sized firms. Only 16 per cent of

participants in large firms felt that they were not in a position to make an assessment, compared with 26 per cent in small firms. At the same time a higher than average number of managers in large firms consider that closed product cycles are an indispensable development, whereas there are scarcely any size-related differences for the responses "fairly positive", "mixed feelings" or "bad investment". In the group of firms offering their customers the facility of taking back used products, which have thus already gained initial experience with closed cycle management, the assessment is somewhat more positive and shows a deviation from the average similar to the group of large

Closed cycle concepts from the managers' viewpoint

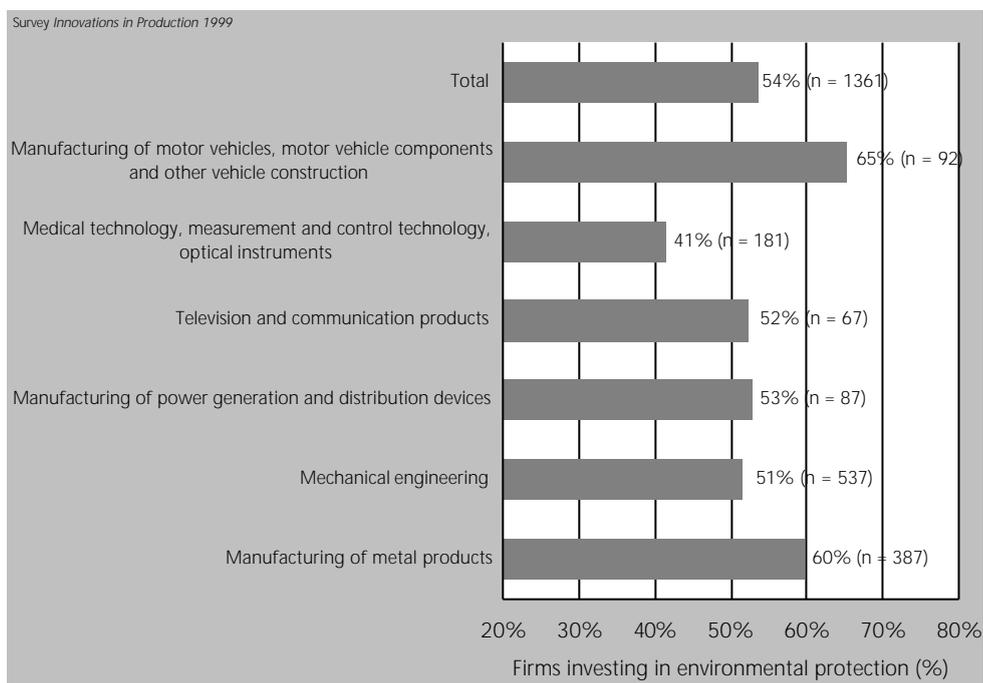


The managers' responses show that a positive, but generally still hesitant, assessment of closed cycle management predominates. These results are supported by the additional interviews carried out by ISI. It was found that enterprises are tending to adopt a 'wait-and-see' attitude and are beginning to move into closed cycle management only very slowly, and only with niche strategies. Both the qualitative and quantitative results show that, up to now, a fundamentally new orientation of firms' strategies can only be observed in exceptional cases.

Investments in environmental protection

The classic form of environmental protection activity is to invest in emission-reducing or emission-avoiding technologies. 54 per cent of the firms in the survey have invested in environmental protection in the last two years. 85 per cent of firms with more than 500 employees, 43 per cent of medium-sized firms (100 to 500 employees), and only about 42 per cent of firms with less than 100 employees stated that they had made investments of this kind during the last two years. It should be born in mind here that the general investment volume of large firms per year is much higher than for small firms, meaning that more continuous investments in environmental protection can be made.

In the last two years, more than half the firms have invested in environmental protection



Investments in environmental protection in the capital equipment producing industry

A breakdown into subsectors of the industry shows that in the last two years particularly manufacturers of automobiles, automotive parts and other vehicle construction have invested in environmental protection. The high percentage of firms in this branch which have invested in protecting the environment is only partly a result of the larger average firm size in this subsector, the number of small and medium-sized automobile manufacturers making investments is also above average. Another branch with a high proportion of investing firms is metal products, with almost 60 per cent of firms. This subsector is characterised by many small firms. The numerous investments in environmental protection in this branch arise from the production techniques, which lead to particularly heavy environmental pollution. The proportion of investing firms among manufacturers of medical technology, and measuring, control and regulating

regulating technology was comparatively low at 41 per cent, lying clearly below the 54 per cent average for all branches.

End-of-pipe investments still predominate

Two basic strategies can be distinguished in investments in environmental protection measures: investments which only take effect after emissions have been generated (such as e. g. filter equipment) are referred to as 'end-of-pipe' technologies. Investments in so-called 'production-integrated' environmental protection measures intervene by prevention in the formation of pollution. 44 per cent of firms in the survey engaging in environmental protection investment stated that they were pursuing both strategies; almost 50 per cent stated that they were investing only in end-of-pipe technologies; and only 7 per cent were exclusively pursuing investment in production-integrated environmental protection. Thus no clear move away from traditional end-of-pipe environmental investments and towards production-integrated strategies can be identified. The rationalisation potentials offered by the combination of industrial and ecological modernisation measures in production-integrated environmental protection are not being fully exploited.

Legal requirements are no longer the main drivers of environmental measures

In past years, legal requirements were often the main trigger for investments in environmental protection. This no longer applies to the investments made over the last two years. More than half the firms (54 %) made these investments entirely on their own initiative, almost 20 per cent mentioned both their own initiative and legal requirements, and only 17 per cent of firms gave legal requirements as their only reason for investing. External impulses, for instance from environmental consultants, were nearly always mentioned only in combination with other reasons (10 % in combination; 2 % external impulse only) and played hardly any part for firms investing in environmental protection.

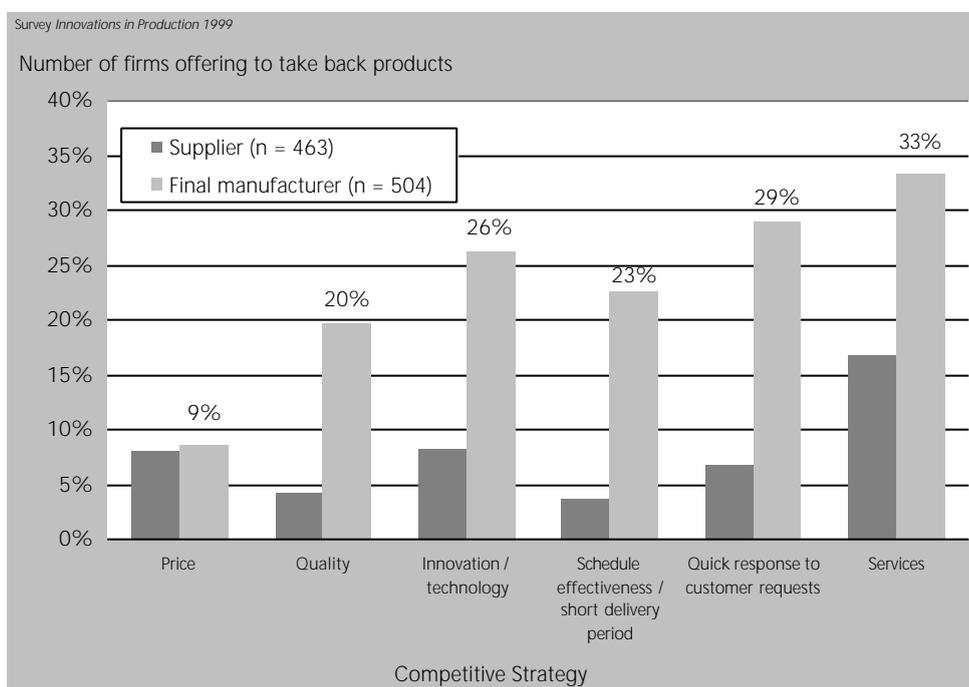
Taking back used products by manufacturers

15 % of firms in the survey offer to take back their own products from their customers

As well as environmental protection investments, the closing of material and use cycles is regarded as a central approach in sustainable management. The debate in the last few years has therefore focused on manufacturers taking back their own products. This service is offered far less by the capital equipment production industry than by the consumer goods industry, which has also been a focus of public discussion. Of the firms in the survey, only 15 per cent stated that they offered their customers the facility of taking back the products they had manufactured. Unlike other branches (e.g. the packaging industry), there are indications that in the capital equipment producing industry, retrologistics and offers of taking back complex products make more sense economi-

cally and ecologically than for simple products. The producer's detailed knowledge of the product implies efficient repair and modernisation possibilities for complex products. Moreover, the position in the value-added chain is important. 23 per cent of final product manufacturers offer to take back their own products; by contrast, with suppliers of product components this dwindles to a mere 5 per cent. The component supplier is dependent on the manufacturer of the final product, and the closing of the cycle at a higher level of value-added appears more rewarding than at the level of component production.

A firm's competitive strategy influences not just product design, but the firm's total offer; thus a connection can also be expected between competitive strategy and whether or not a firm offers to take back its own products.



Product return offers depend on a firm's competitive strategy

- Among the firms in the survey competing mainly via their prices, their reliable delivery and their product quality, only c. 10 to 13 per cent offer a used product return facility.
- By contrast, firms with an emphasis on adapting products to customer requirements, on innovations or on services, offer a 'closed loop' product cycle slightly more often (17 % to 24 %).

These results appear to be largely independent of firm size effects.

These analyses confirm the interview results which indicate that the possibility of keeping ones customers and gathering information from the use phase of the product are the most important reasons for firms in offering this return

facility. The higher-than-average number of offers of this kind from firms which see new technologies as their most important competition factor show that closed product cycles do not constitute a barrier to innovation.

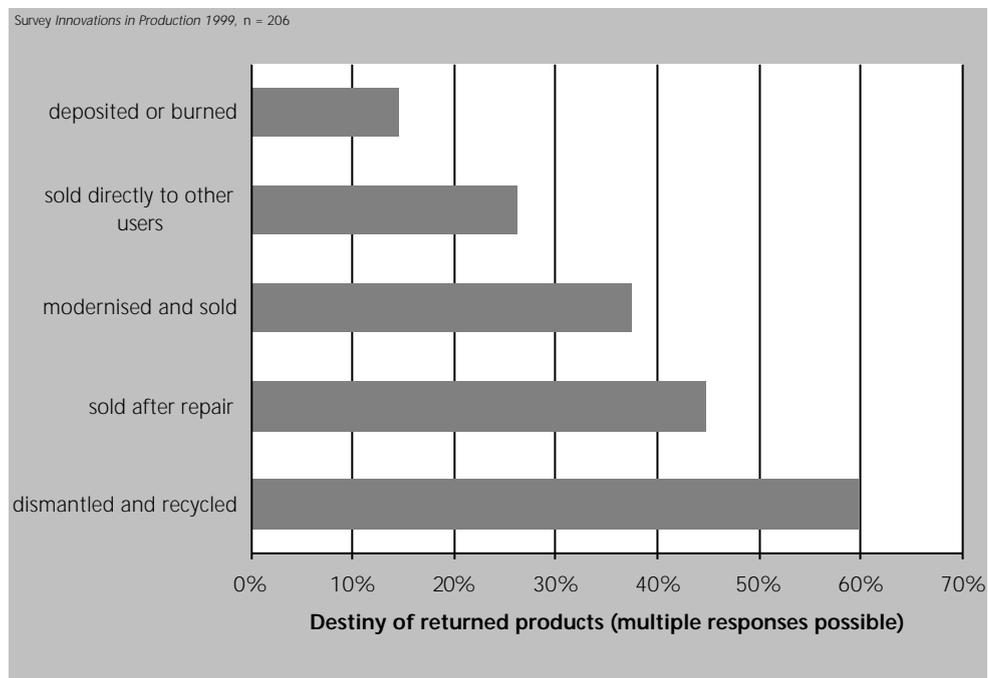
5 % of production volume is taken back by producers

In the relatively few firms offering to take their products back, the proportion of products taken back is often negligibly small relative to the total production volume. Only 15 of the 199 firms with a product return facility take back more than 50 per cent of their products, and three quarters of the total production volume of returned products in the survey is accounted for by 5 firms only. If this is related to all the firms (c. 1,400) in the survey, it yields a product return / production volume ratio of 5 per cent, with a slightly higher ratio of 7 per cent for the group of producers of final products. If the manufacturer's product return facility is to expand beyond a 'niche' strategy and achieve broader realisation, the decisive factor will be to establish the product return strategy as an important component of marketing strategy within firms, and to organise the offer in such a way that it is a source of additional usefulness for customers.

Use and recycling of returned products

There are various possibilities for re-use and recycling of the returned products.

When products are taken back, material recycling predominates and waste disposal is reduced



The firms in the survey most often disassemble and recycle the returned products. 27 per cent of firms concentrate only on this possibility and recycle 100 per cent of the products they have taken back. Re-sale of the products following repair is offered by 45 per cent of the firms with a product return facility, and re-sale following modernisation is offered by 37 per cent. Only about a quarter of firms resell products directly to other users. A small number of firms dispose of the returned products in landfills or incinerate them. The results of the survey show that by taking back the products, disposal and incineration are largely avoided. This is at least valid with the present volume of returned products, even if ecological aspects are possibly not the decisive motive for introducing a product return facility.

Management concepts

An important element on the way to closed cycle management is for firms to take an integrated view of their own processes and procedures, as well as evaluating the environmental impacts and costs of their own products over their whole life cycle. Through these instruments sustainable management can become a component of management decisions. 12 per cent of the firms in the survey have undergone ecological audits in accordance with DIN ISO 14001 or EMAS. Most of these firms began in the last five years; just under 30 per cent of firms undergoing ecological audits (n=163) had their first audit in 1999. Compared with the results of the 1997 survey, the percentage of firms undergoing ecological audits has doubled. Despite the strong dynamics of audit implementation, the quadrupling of the audit rate to 25%, which could have been expected on the basis of firms' targeted goals in 1997, has not yet been reached. In the next two years the strong dynamic trend can be expected to be sustained, since according to the goals targeted by firms in 1999 an increase to almost 45 per cent can be expected. Because of their positive experiences, just under 30 per cent of firms who have already undergone ecological audits are already planning to extend them.

12 % of firms have undergone an ecological audit in accordance with DIN ISO 14001 or EMAS

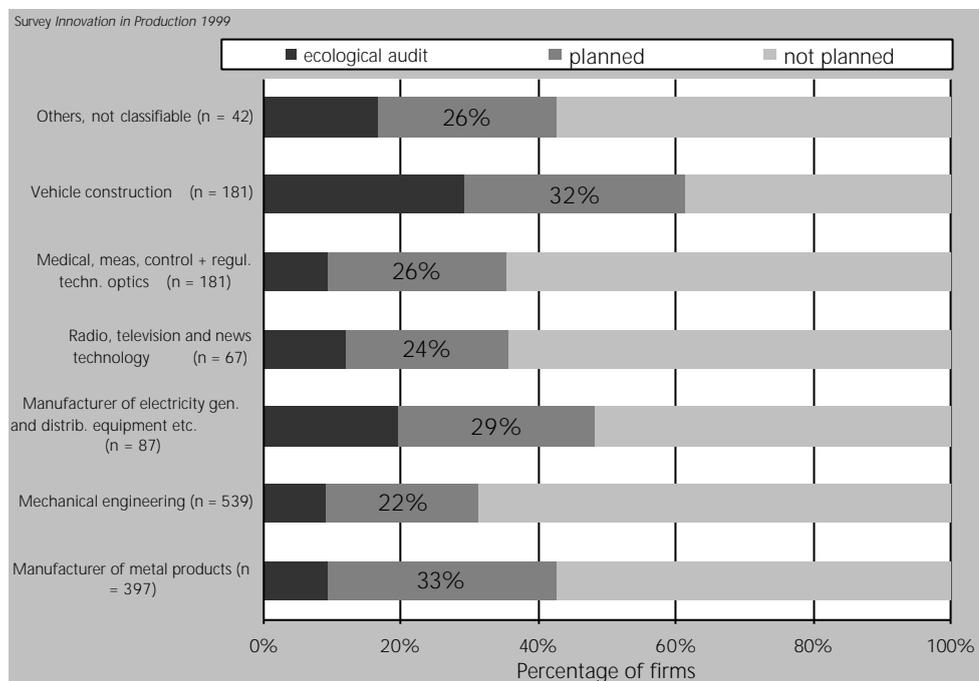
Ecological audits are predominantly carried out in large firms (35 % of all firms with more than 500 employees). In medium-sized firms with 100 to 500 employees (13 %) and small firms (6 %) this proportion is lower. The goals targeted for the next two years show that in future, medium-sized firms in particular wish to undergo ecological auditing. Development among smaller firms over the next few years is still uncertain, since these firms, more frequently than the other size categories, see no use for audits in their firm (35 % of small firms, 20 % of medium-sized firms, 11 % of large firms). Ecological

Small firms still hold back from ecological audits

audits in their present form do not appear suitable for small firms and therefore need to be appropriately adapted.

There are differences between individual branches in the diffusion of ecological auditing. The automobile industry, with an audit participation rate of nearly 30 per cent, occupies a leading position. Manufacturers of electricity generating equipment are also well above average, with a rate of nearly 20 per cent. So far only 9 per cent of manufacturers of metal products have undergone ecological auditing, but the proportion of firms planning an audit (33 per cent) is highest in this branch. Similar dynamics cannot be observed among mechanical engineering firms; they will probably continue to have the lowest participation rate in the next few years. The results show that general acceptance or expectations within a branch have a great deal of influence on diffusion.

Automobile firms take the lead, mechanical engineering brings up the rear in the use of ecological audits



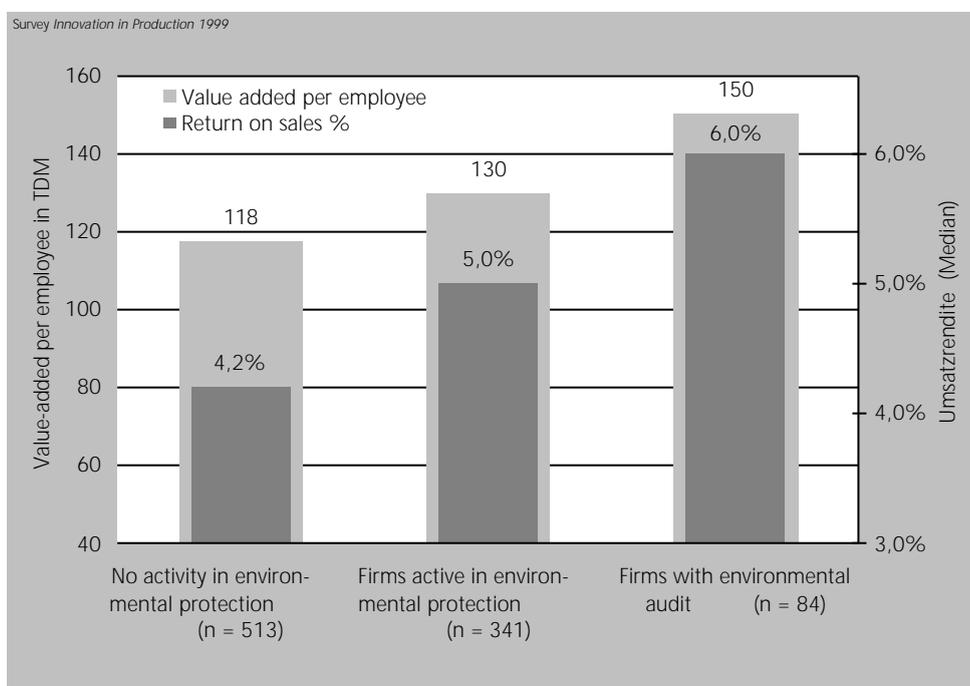
Life cycle costing is only used by 5 % of firms

'Life cycle costing' of the product produced enables an objective economic analysis of different strategies for prolonging product lives and recycling and re-use of products. Thus life cycle costing is an important prerequisite for realising strategies of this kind within firms. Until now, only 5 per cent of firms have introduced life cycle costing. Large firms (17 per cent) use this instrument much more often than medium-sized (6 %) and small firms (2 %). In the next few years these percentages can be expected to increase, as 11 per cent of firms in the survey were planning to introduce life cycle costing. 10 per cent of small firms and 12 per cent of medium-sized firms want to introduce life-

cycle- oriented cost management within the next two years. Apparently the positive judgement of its potentials is largely independent of firm size.

Environmental protection and profitability

In view of the numerous possibilities for becoming active in environmental protection, and the large amounts of resources absorbed by ecological investments and process design, the question arises of the business situation of firms actively engaged in environmental protection. To examine this aspect, the value-added per employee and the profit-turnover ratio were considered, and environmentally active firms were compared with non-active firms. All firms were regarded as active if they had invested in environmental protection, offered their customers a product return facility, undergone an ecological audit, or were using life cycle costing.



Better performance of environmentally active firms

It emerged that firms engaging in environmental protection activities have higher productivity and a higher profit-turnover ratio than firms which are not actively engaged in environmental protection. The indicators show better values for firms that have had ecological audits, independent of firm size. They have a value-added of 150 000 DM per employee and profit-turnover ratio of 6.0 per cent.

Even if it is not possible to distinguish whether a better economic situation is the prerequisite for, or the result of, a firm's environmental protection measures, it can at least be established that engaging in these activities does not lead to disadvantages for these firms in the short term. Rather, it appears that where firms critically examine their own processes and products, including ecological viewpoints, additional economic potentials are obviously discovered and realised.

Conclusions

A predominantly positive attitude towards the introduction of closed cycle concepts prevails among managers, contrasting with a rather hesitant realisation of sustainable management strategies on the part of enterprises.

- The importance of closed cycle management is positively assessed by managers. More than half of all those questioned regard these types of approach as essential, or at least feel "mainly positive" towards them. This proportion is distributed equally among all categories of firms, so that there seem to be no reservations dependent on firm size.
- Somewhat more than half of the firms in the survey have invested in environmental protection in the last few years, with firms from the automotive industry playing a leading role. Investments continued to concentrate on traditional 'end-of-pipe' technologies. The rationalisation potential of production-integrated environmental protection remains partly unexploited. The majority of investments were made on the firm's own initiative and were not exclusively triggered by legal requirements.
- Approximately 15 per cent of producers take products back. The volume of returned products when related to all firms participating in the survey is only about 5 per cent of the total production volume.
- It is the firms with competitive strategies aimed offensively at the market, such as technology leader and service-oriented strategies, which are offering to take products back.
- Only 12 per cent of firms have so far undergone an ecological audit, and life cycle costing is only found to a negligible extent in firms in the capital equipment producing industry. However, substantial increases are to be expected in the next few years, both in the use of ecological audits and life cycle costing.

- An examination of profit-turnover ratios and value-added per employee reveals that as a group, firms actively engaged in environmental protection are among the more profitable enterprises.

Activities for reducing production-related pollution of the environment (equipment for the conservation of air, water and ground purity) are now, according to the representations of the firms, mainly triggered by entrepreneurial initiatives. However, a more fundamental new orientation on the part of firms, extending to sustainable product and production strategies, cannot be observed. Despite the increase which is to be expected in the use of ecological audits, further impulses would appear to be necessary. The positive basic attitude and receptiveness of top management could be put to use, for instance, in developing new solutions or in adapting existing solutions for use by specific target groups. It was not possible within the bounds of this analysis to examine how far it makes sense to use regulative challenges and incentives to foster this development. The possible macroeconomic chances in creating pioneer markets have to be weighed against the necessity for preserving firms' freedom of action to develop their own individual sustainable competitive strategies, to try them out and to position them on the market.

Survey on Innovations in Production 1999

Since 1993, the Fraunhofer Institute for Systems and Innovation Research has conducted a two-yearly survey on *Innovations in Production*. The survey addresses firms in Germany's capital equipment producing industry, investigating the production strategies they pursue, their use of innovative organisational and technology concepts in production, and questions of personnel deployment and qualification. In addition, for the first time the 1999 survey covers the co-operation behaviour of firms. Data are also gathered on performance indicators such as productivity, flexibility, quality attainment and, not least, return on sales. With this information the survey enables statements to be made on the modernity and performance of production structures in one of the most important sectors of Germany's industry.

This PI Communication No.18 is based on data gathered in the 1999 survey. 1 442 firms returned analysable questionnaires (response rate: 14.7 per cent). The participating firms constitute a representative sample of the German capital equipment producing industry.

If you are interested in receiving PI Communications, or in special analyses of the new data base, please contact:

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