The Product Clinic - a germ cell for learning processes

Wherever products have to be renewed in short cycles, and wherever consequent customer orientation is necessary, innovation managers of a company are challenged. Customer-specific product programs make it necessary to vigorously shorten development time, throughput time and delivery time, and to manage variants effectively. But, by the usual concepts, also implemented by competitors, advantages can hardly be achieved. Successful companies are able to learn faster than others and can realize innovations in all fields - on both product and process level. Here, the product clinic may serve as germ cell for organisational and corporate learning processes. Based on market, competitive and customer data the own products are compared on a physical level to those of the competitors. As a differentiation by technical specifications has become more and more difficult, the product related activities in marketing, sales and distribution become more and more important to customers comparing products of different suppliers. The product clinic may become a strategic institution, where experience can be combined with external information and successfully be exploited. The speed of learning shows an organisation‘s competitive differentiation potential. By now, industrial companies find it increasingly difficult to distinguish themselves from their competitors only by technical product features, especially as the usual means of shortening development times also lead to faster imitation of products and technical solutions. So, the winning motto for success can only be to learn as fast as possible.

To set organisational learning processes in motion it is necessary to implement a germ cell, in which all corporate functions are brought together and where all necessary conditions are created to keep this process in motion. To achieve this, the implementation of a product clinic is suggested. Case studies will be used to demonstrate its methodic principles.

The concept of the product clinic is founded on a physical comparison of products, based on market, competitive and customer data (see fig. 1). By systematic analysis of functions and specifications, insufficincies of the own product and their respective functional units can be indentified. Solution principles are compared to best solutions of the competitors, trying to adapt the own product to these concepts.

Based on expert knowledge this proceeding shows up a new way to develop new products, processes and structures, and to find new suppliers for purchased parts. To all persons involved, the product clinic offers opportunities to participate in learning activities that lead to company-wide learning processes after methodical work-up.

The product clinic as an institution for learning

Many companies analyze products and business processes of their competitiors, but mostly scattered over different functional areas. Like this, sales and distribution often directly experience perfomances of the competitors, purchasing receives information through suppliers who are doing business with competitors as well, all this mostly filtered and only related to specific subjects. This information mostly is biased, not explicitly quanitified and will not be passed on or processed but sometimes misused for blaming others. These negative aspects must be avoided, but also it has to be made possible that external knowledge can sucessfully be used in internal learning processes. For this, an exact definition of the content and scope of the analysis have to be agreed upon, as well as a proceeding and an evaluation of the results that are accepted by all persons involved. The product clinic helps to institutionalize this learning concept.

Product functions and business processes

In an overall view of the product programs of concurrent suppliers products mostly are very similar in performance, specifications, design and price. Only an exact analysis on assembly group and functions level shows up differences in technical principles and thus in cost structures. But here, most advantages are compensated by deficiencies in other areas. Real product improvement can only be achieved when best practice solutions in product and process level can be combined. It can be shown that high learning efficiency can be obtained in analyzing and understanding principles to solve a specific problem used by other companies.

The analysis of competitors' products is a well-known tool to identify differences in performance, function and specifications compared to the own product. To improve the informational foundation of such a comparison, the analysis can be enhanced in two ways:

1) Estimation of production numbers, the development of prices and corporate profit, in order to determine the competitor's cost degression ratio. In this way, learning speed and prospective production costs of the competitor can be determined, depending on the production figures. This procedure, based e.g. on new product launches or estimated contribution margins, is very useful for strategic decisions. Though, certain restrictions have to be taken into account when using the experience curve analysis, especially concerning increasing costs of product variants.
2) Not only the cost situtation of the competitors is to be determined, but also the influence of site-related cost factors. Like this, the competitor's costs for a certain product range can be found out by determining the necessary input factors and calculating expected manufacturing costs of the own production sites as well as supply costs. Site-related advantages and disadvantages have to be taken into account to compare estimated costs with the competitor's costs. This comparison may also provide target costs and possible fields for rationalisation measures.

Apart from the product analysis all value adding processes, especially distribution, service and recycling, can be integrated into the activities of the product clinic. Of great use may also be a parallel examination of product specifications and those process parameters that are not limited to the physical manufacturing process itself. Futhermore, customer interviews help to define new products and processes. Also Quality Function Deployment (QFD) and Target Costing have proven to be useful as well.

Exceeding simple comparisons of products and process analysis, a search for a possible increase in productivity is profitable - based on detailed information on the own and the competitors' production program as well as cost structures in the corresponding sites. The information gained here can be used for factory planning, best practice solutions can be integrated to an overall optimum and be tested in simulation.

Institutional incorporation of the concept

The place where concurrent product and process analysis will be conducted and product presentations will be held is of great importance: not only must communication be facilitated, but also the search for new ideas and decision making be animated. An exposition of concurrent products and the presentation of differences in quality and costs, accessible to all employees, are to increase the employees' awareness and to support pretentious goals of optimization. This will not take place when concurrent products will be analyzed by a small group of value analysis specialists in remote or non accessible laboratories. Positive motivational effects are also caused by an early presentation of new products within the company. Here, too, a presentation in represenative locations far away from production and development will not help to sharpen and improve the employees' awareness for new challenges. If a product clinic is supposed to be a place of learning for the entire organisation, it must be placed in a central location within the production areas, to animate various communication processes. Suggestions for product improvement can be demonstrated on the product immediately, process improvements in product related characteristics like costs or quality can be pointed out on display charts. The direct link between development, production and value analysis ensures an immediate learning transfer and facilitates efforts of convincing others, e.g. of alternative solutions or the need of quality improvements.

Three different case studies will demonstrate the product clinic's capabilities:

Case study 1: Optimization of product functions and business processes in a mechanical engineering company

A German mechanical engineering company, well known for providing high-quality products, systematically followed the goal of identifying differences in product performance and functions and to learn from the competitors' solutions. Increasing competition forced this company to search for new ways to close the gap in costs and product performance. The product clinic was chosen to solve this problem. The recognition that customers choose products not only by technical and ecconomical features led to an examination under three aspects: product performance, technical and economical concepts and distribution processes.

Each of the three dimensions (see fig. 2) requires a specific use of methods. To analyze product performance, a product benchmarking was conducted to compare the own product to the competitors' products. The comparison was performed on basic data like equipment, measurements, weight and follow-up data as well as additional data on consumption, environment and service related data and performances. Already this initial comparison showed up how much the own product differed in technical conception from the strongest competitor's product. The own product was larger and more appealing in design, whereas the competitor's product provided larger usage space in spite of smaller outer measurements. Consumption and environmental data were compared by determination of energy consumption, noise and vibration in different operation modes. Furthermore, expenditures for putting into operation and ergonomics were evaluated qualitatively, and the domestic product was found to be superior. The analyzed service data included repair, preparation and customer service activities. The time necessary for preparation and the exchange of typical wearing parts were measured as well as other expenditures (e.g. the need for special equipment). To compare performance data like machine and working speed, repetition accuracy and quality, several tasks were defined that had to be completed. The differences found were only marginal and not obvious to the customer during normal operation.

As a result of this product related benchmark none of the two products had any significant advantage. The higher price of one of the products could not be justified by a higher performance. The advantage of longer durability of the domestic product still had to be proven in the progress of the project.

After these comprehensive tests the machnines of several competitors were disassembled to compare functional concepts and to perform a value analysis (see fig. 3). For a calculation of the foreign products the own costs were used (Reverse Engineering) to determine how much the other products would cost in the own company.

In the end it was clear that the main competitor's product was far lower in costs because of simpler technical solutions. Compared to other products only small differences were found. In total, cost differences were low, as advantages were compensated by disadvantages in other functions.

Two measures were defined from these results. First, a value analysis of the domestic product was performed to decrease costs on a short term. For the development of the next product a target conflict resulted: On the one hand, the company did not want to step back from the image of producing high quality products, but on the other hand customers were no longer willing to pay the higher price. To solve this conflict the cost planning of the next generation was based on target costing. To reduce costs, the competitors' solutions that were found best in the product clinic were used. As cost reductions still were insufficient, assembly groups and parts had to be indentified that increased costs but did not improve customer value. A project in Quality Function Deployment was launched. As a result, among others electrical connector plugs were found too complex and expensive. The more simple plugs of concurrent products still met the requirements. By changing to the new connector concept, customers did not perceive a quality reduction, but costs were reduced significantly.

Parallel to the disassembly the company also analyzed sales and distribution processes - especially financing, service and recycling. This showed up the main competitor‘s advantage in financing and service. Even though customers rated the domestic product higher and were willing to pay a higher price, they chose the competitor's product because of better financing options. This knowledge, gained by the use of the product clinic, led to a review of the own marketing, financing and service processes.

The integrated examination of products and processes and the interdisciplinary cooperation in the product clinic led to a distinct and measureable learning process. Product benchmarking and disassembly resulted in clearly quantifiable data that formed a base accepted by all those involved. The product clinic had positive effects on all functional areas of the company. The sales department received help for argumentation with customers when pointing out the advantages of the own product over the competitors. As all statements about product specifications could be quantified exactly, a higher customer acceptance was created compared to earlier global depreciations of concurrent products. New arguments for the own product, defined in the product clinic, were among others the low energy consumption and an additional aggregate for better protection against damage in case of power failures. When the products were disassembled, the competitors' suppliers could be identified. Queries at these suppliers led to lower purchasing costs, either by changing to these suppliers, or by renegotiating prices with current suppliers.

The most crucial changes took place in development. Here, the results of the product clinic led to a completely new profile of requirements for the next product generations. Even though the own technical solutions were higher in quality, they did not result in higher performance, but sometimes were turned into the opposite. Oversized moving parts and a cautious control of acceleration and braking resulted in low working speed and poor productivity. As productivity is an important purchasing criterion, the next product generation had to be designed in order to avoid this disadvantage. Additionally, some extras were not required by certain customer groups. For example, the standard emergency power source is hardly used because of only rare power failures in Europe. Many customers protect themselves with centralised systems against these failures, and so this equipment, which increased the price, had to be reviewed.

Case study 2: Worldwide competitive benchmarking in a supplier company

External factor costs that can hardly be influenced by a company, and internal conditions (like product complexity, corporate organisation, productivity and vertical range of manufacturing) have an influence on calculating costs for products and processes. In the past a company could ask for a price that resulted from the sum of the costs and an additional profit margin. But now the change towards a buyer market forces companies to achieve target costs that are derived from market prices. The influence on cost structures varies according to the geographic distribution of suppliers. In order to quantify the competitors' advantage in costs, supplier of the automotive industry sucessfully used the product clinic.

To focus on both aspects, product concept and factor costs, two projects were launched. In the first project a team disassembled about 30 concurrent products, performed a value analysis and calculated the technical solutions with the own cost rates. Here, too, in total the costs of the products were not significantly different, and so no obvious best product could be identified. Best solutions for assembly groups and parts were distributed over all manufacturers. By "cherry picking", the new product was realized by combining the best solutions of the own and foreign products. Overdimensioned parts were indentified and replaced by more simple solutions.

An extreme insight, after all not adopted, concerned a bearing in the main driving element. Whereas the own product had a needle bearing, the solution of one competitor provided simple lubrication without any bearing. A breakdown of this system of the competitor's product was not known, but driving habits in middle Europe made a needle bearing necessary, as the customer's country has lower speed limits. So the present market of the supplier showed no use for this new knowledge, but in the future single aggregates delivered to this specific region might show this feature.

The second project team examinated the specific external influences on the competitors' costs. An extensive collection of data that could only be gathered or estimated by direct contact to or visits at each company. So several team members examined, as far as possible, production sites of concurent companies. The willingness to present and exchange corporate data varied between companies and countries, and so a lot of information had to be collected indirectly. After this benchmark traveling a pool of about 100 indicators was available. They were evaluated in a rough top-down-approach and also in a bottom-up-approach that described each figure specifically.

In the top-down-approach, the sum of the own costs was put in relation to the sum of costs of the competitors. The own costs were estimated under the assumption that products were manufactured with the own cost rates but in the competitor's quantities. The relative result showed up corporate differences independent from the different output levels.

In the bottom-up-approach, specific reasons for the cost gap were indentified. This approach is based on the idea of transferring the own company with its product range and manufacturing quantities into the competitor's country or to its production site. In this case, different factor costs, factor quantities and sometimes other criteria for the product design would influence the cost blocks representing staff, capital and material (see fig. 4).

Personnel costs are used to describe this evaluation process. Based on personnel costs, calculated from the number of employees, cost per employee and time expenditures for manufacturing, these figures were transformed into multipliers. The information required was cost per employee, per year and per time available for manufacturing, as well as the number of employees required for the specific production range. Costs per employee, especially social contributions, are strongly depending on national regulations and other factors like education, vacation time, working hours, absentism and productivity. Furthermore, the total number of employees had to be classified in three groups: unproductive, directly productive and indirectly productive. With this evaluation, the information gained in the top-down-approach was broken down to individual figures. In this way, advantages and disadvantages of each competitor were identified.

Apart from costs, also certain processes, especially in manufacturing, were examined and analyzed. This provided information for technology portfolios, which indicated each competitor's core competences and bottleneck factors.

Based on results of both teams, the next product generation was developed and sucessfully introduced to the market, at costs of 40% less than those of the predecessor. The competitors' costs were used as "allowable costs" in a target costing process and were realized by implementing and improving the competitors' best solutions, identified in the product clinic.

This example illustrates that even Germany can be a competitive location for manufacturing, if the high level of education can be used and the employee's creativity be improved by new ideas. The necessary location for organisational learning was provided by the product clinic, where knowledge was evaluated and brought into new products and processes by an integrated use of different methods.

Case study 3: Site changes and location planning of a manufacturer of household appliances

The replanning of production sites and a shift in manufacturing range from one site to another offers the chance to question established structures and processes by means of reengineering the entire value chain. Especially those parts of value adding processes with a likely chance of productivity improvement can be transferred, when they cannot be performed on the current site in a competitive manner. The product clinic was used to show up existing possibilites and alternatives. Here, too, detailed information on product ranges and cost structures in concurrent sites were gathered. The target costs derived from these data were so low that a continued production in Germany was not considered possible even after product and process optimization. The problem was to ensure constant levels of quality, costs and delivery reliabilty, should a shift to a low wage country take place. The manufacturer of household appliances used the learning concept of the product clinic to solve this problem. The goal was to move production of an entire product variant from a German site with functional organisation to a plant in the Czech Republic with modular organisation.

A simultaneous change in organisation and processes with a parallel change from experienced workers to untrained foreign workers was not possible because of the high risk of quality and delivery problems. A decision for a two step procedure was made. In the first step, all necessary functions to complete the process chain were separated from the plant structure and rearranged in a different factory with new modular structures. In this new organisation the employees continued to manufacture the product, which led to a first increase in productivity. Parallel to a value analysis of the products the employees took part in an optimization of partial processes towards zero-defect-manufacturing.

The potentials indentified here immediately were implemented in the production process. The development of error prevention strategies led to robust processes, which was a necessary precondition for the intended move to the new site. For these processes, training of new employees took place in this new factory.

Personnel from the new site was integrated into the German staff, and trained until they were able to perform the partial processes without any further assistance.

Only after this, machinery, German excutives and the newly qualified personnel could be transferred to the Czech Republic, each partial process at a time. This step by step procedure continued until all necessary modules and functions were implemented in the new site. If overall transfer time is measured by the time between relocating the first machine and reattaining process stabiltiy, substantial improvements in time necessary and quality were realized, despite the implementation of the temporary plant - overall transfer time was 30% lower compared to the usual approaches to this problem. Furthermore, a zero-defect-production was possible from the beginning due to the training of the new staff before the start of production. The ability to redesign the entire production system was based on the knowledge that structures implying behavioral changes need to be modified first. Changes in behavior and structure led to an increase in productivity.

Inevitably, new suppliers had to be found as well. The quality of these suppliers was verified in the temporary plant, and supply chains were shifted together with manufacturing processes.

The employees‘ creativity was used within new solution concepts and for the qualification of new staff members. Internal and external knowledge was evaluated methodically and integrated synthetically into new factory and staff structures.

Suggestions

Even though the case studies presented above are different in content, the concept of the product clinic as an institution for learning is cleary visible in all three. A constitutional feature is mutual learning based on a physical object.

This opens up the possibility to discuss solutions on a low level of abstraction and to clear up misunderstandings between the persons involved due to different experience, all this because of the measurement of physical figures and the assessment of costs. The acceptance of these results is the base for the elaboration of new solution approaches that can be evaluated by predefined figures. An intense interdisciplinary exchange and transfer of knowledge takes place between the team members and functions integrated in the product clinic. The examination of specific figures is useful for each functional area, and helps to set adequate priorities.

This is why the team should consist of representatives of all activities in the process chain, from product development to service and recycling. To increase customer value, customers should be integrated temporarily to discuss details.

When discussing specific problems, a team needs the cooperation and assistance of specialists. Specialists often are worried that their work might be controlled or their knowledge be spread and distributed. To avoid this, and to broaden the range of functions involved, a part of the team members should rotate. Like this, each member can use his specific knowledge in the process and may benefit from the product clinic as an institution for learning. The methodic procedure of setting goals and evaluating results should be accompanied in the beginning by a moderator. To benefit from the product clinic on a long term basis, this concept must not only be used for one product and one competitor. Instead, a continuous process of comparing and learning must be implemented for each product generation. Even apparently worse competitors should be examined, as here, too, best partial solutions may be identified.

The implementation of a permanent product clinic creates an institution for learning, integrated into the company's organisation. Responsibilities for the product clinic may be defined depending on the subject, be it process or product analysis. The product clinic may be part of the sales departement, production or development. The results achieved in the product clinic are essentially influenced by the definition of the extent of the examination. The cost and time required for achieving and implementing results also have to be taken into account. Generally, complex product and process structures require higher efforts during analysis, but the possibilities of comparison to competetive products decrease. A learning process takes place, but the results can only be implemented on a long term base.

Similarily, a long time required for the generation of results compared to the length of product life may have the consequence that competitiors will launch the next product generation before the results of the product clinic are implemented.

In both cases a limitation of the examination subject to partial functions or processes is useful and profitable already on a short term base, e. g. by concentrating on core competences or side aspects of the product or the processes. Conducting learning processes on the field of the own core competences usually lead to low gains of knowledge, as already a high potential of know-how is available. If side aspects are examined, the gain of insight is higher and the imitation of competitors' solutions lead to a higher increase in knowledge, which also means higher advantages in cost improvements.

The step by step approach in the analysis must also be applied when implementing results. Those best solutions that require fundamentally different solution algorithms are to be used in the next product generation or in other processes. Other results may immediately be implemented in a continuous improvement process. Those are, among others, a change of suppliers, software adaptions or the dispense of extras that do not create any additional customer value. Product specifications and manuals must be updated accordingly.

The interdisciplinary composition of the product clinic implies changes in all functional sectors of the company. The quantum leaps now possible in research and development are consequences of the identification of the competitors' technical solutions in the product clinic. Implementing best solution principles in the own product either leads to cost reduction or an enlarged functionality.

The key to acceptance by the employees is the quantification of advantages by physically measurable figures. To do this, functional parameters determined in tests have to be brought into relation to their according functional element, and the solutions found need to be analyzed for customer value. The product clinic has an influence on the production sector mainly by the technical product concept defined by R & D. Also the competitors' manufacturing processes may have effects on the own production.

To draw conclusions on processes from products certainly is difficult. But especially the benchmarks used for analysing the competitors' processes are of great use for the production sector. Apart from this, an analysis of product related distribution and service processes and an estimation for service and repair help to determine after sales tasks. This influences expenditures the price of repair parts, the design of service packages and replacement times.

The better understanding for product concepts as well as and advantages and disadvantages of concurrent products gained in the product clinic helps finding arguments in the differentiation to competitors and forms the base for a specifically designed marketing strategy. Disadvantages of the competitors and advantages of the own product can be pointed out clearly. In the same way, sales personnel may enter negotiations and justify higher prices. Additional service and maintenance concepts may also be acquired during those negotiations.

Effects analysis

An institutionalized product clinic can help to increase effectivity and efficiency and modify the entire value chain. In case of severe productivity deficiencies, it helps to manage production site changes. Constitutional success factors of the product clinic are

- ❐ learning on a physical object
- ❐ work in interdisciplinary teams
- ❐ presentation of the project
- ❐ integration of external influences
- ❐ methodic evaluation of information
- ❐ quantification of competitive differences
- ❐ constructive apprehension of competitors solutions and
- ❐ immediate implementation of results.

The product clinic becomes a learning institution by integrating classical forms of knowledge transfer into a germ cell for new products, processes and structures. Additionally the case studies shown above demonstrate the effect of the product clinic to increase learning speed.

In result the combination of internal and external know-how is more than just an addition of knowledge. The knowledge carriers are inspired by other solutions to think in new dimensions. Best solutions will not only be imitated, but instead own ideas will be integrated to create know-how on higher levels.

Apart from learning in their own disciplines, the employees involved are animated to participate in an interdisciplinary learning process. From this a computer-based product data model can be derived and may be used as an information source by all employees. This makes possible a comprehensive personnel qualification. The positive attitude to understand competitors' solutions is equal to the feedback between action and environment necessary for organisational learning. Feedback paths are shortened significantly, and permanent learning is institutionalised. The fast evolution of knowledge now made possible has the consequence that present knowledge is available to all organisation members, and new knowledge combinations lead to innovation.