New methods of optimising production in the plastics industry

H. Wildemann*

Despite yearly growth rates rising personnel and material costs put the plastics industry under significant pressure. Besides a progressing wave of concentration the optimisation and advancement of production and logistics processes has to be focussed and processes have to be aligned with the requirements of global value chains. New production systems are able to realise the combination of cost and performance leadership. They not only integrate the well-known methods of lean production, but also elements like relocation planning, global ramp up management, global sourcing as well as controlling instruments.

1. Which trends are challenging the plastics industry?

Production as the core of value creation in the plastics industry is facing new challenges. On the one hand, the existing structures of production are getting under pressure in the environment of a global plastics industry. On the other hand, certain mechanisms of the market can be observed that necessitate a change of the actual state.

Indeed the industry of plastics goods in Germany has had a year growth ratio of 4 % in the year 2005. But this increase has been accompanied by a continual process of concentration on the supply side. Especially the rising material costs contribute to this. There has been an increase of 2.2 % in 2005 and in 2006 it was presumably 1.5 %. The development of costs can only be absorbed by incessant gains in efficiency which have led to a reduction of employment of 1 % p.a. in recent years. If the increase in production that can be achieved in Germany does not suffice, outsourcing and shifting are going to be the consequences. In the German industry, vertical range has been receding from 70 % in 1980 to 43 % today. From the German point of view, the Eastern European states profit the most from this as they combine low factor costs with a good logistic position **(fig. 1)**.

In the market we are experiencing a rapidly increasing complexity of products that manifests itself in complex forms, new materials as well as the combination of materials and a buoyancy of individualisation. Of course many opportunities for the highly engineered German plastics fabricators are to be found here.

The challenge therefore consists of two parts: first, to cope with the constant pressure to increase productivity, and second, to be capable of skimming peaks of demand and of producing a large variety of products at low costs by means of flexible and intelligent production concepts. This requires a paradigm shift that leads from the old paradigms of stability and availability to the new paradigms of agility and flexibility.

2. Which strategies open up new growth potential?

The profitability of a company is determined by the effective regulation of the entire portfolio as well as by the profitability and sustainability of the respective business segments. New sources of profit result from the combination of several levers that lead eventually to an increase of the company value. In this process it is essential to aim at a combination of both cost and performance leadership. Cost leadership in particular will use a consistent target costs management, new financing forms and modular organisation concepts in the future. Performance leadership is the consequence of innovations, an increase of the core business towards comprehensive service packages and a flexible configuration of added value. It is imperative to control these levers and to use them in the context of a holistic production concept **(fig. 2)**.

3. What are the achievements of production systems?

The effectiveness of production systems is first of all based on the holistic connection of methods, people and technologies throughout the complete chain of innovation and added value. Methods for implementing production systems are the precondition for a trusting and long-lasting cooperation with suppliers and customers in the context of partnerships for adding value, just-in-time in production, development and supply as well as for the concept of total quality assurance.

But new production systems exceed the optimisation of operational value adding and innovation processes and extend the value of JIT by adding the dimensions of organisation, management and employee know-how. Furthermore a consistent customer orientation within and between the departments is inspired by the introduction of production systems. Thereby the main emphasis is put on the cognition that there cannot be a rival relationship between productivity, quality and time as a factor for success, but a complementary one.

However, the path to these new production systems was characterised by several erroneous trends. At first the automobile industry reacted to the high productivity of production systems in Japan, for example at Toyota, by intensifying automation. The Saturn plant of General Motors in the USA represents a climax of this erroneous development. It was supposed that the problem of increasing personnel costs could be got

* Univ.-Prof. Dr. Dr. h. c. mult. Horst Wildemann
mail@tcw.de
Managing Director TCW GmbH Business Consultants, Munich, Germany
Chair of Corporate Management, Production, and Logistics, TU Munich, Germany

under control by extending capital spending. As the implemented investments were often evaluated strategically without being capable of generating the necessary ROI, the total value of the company was reduced, the more so as the products were not sufficiently standardised, which in turn meant that the running time of the highly automated plants was unsatisfactory.

Moreover, attention was focused on the productivity of the employees and it was believed that this could be improved by amplifying the work load of every employee and by teamworking. This has been an error in the Volvo assembly plant, for example. Neither productivity nor quality could be brought under control by this means. Instead, the time spent by employees in non value adding team meetings exploded. Later the employees potential for generating new ideas was discovered. They ceased to be mere „costs on two feet". With the help of methods of continuous improvement big initial successes were achieved by skimming ideas. But, in a later phase, this development came to a halt with no further ideas being identified. The cognition became accepted that the continuous process of improvement in Japan was not organised in a way typical of grassroots democracy, but rather follows the principle of mountaineering: The more skilled person stands at the top and belays the weaker person. Only expert and management oriented CIP processes permit continuous improvements.

From this production a system results, that aims at both a strategic orientation and an operative improvement, combining both aspects in a holistic organisation design. They consist of strategic guidelines, fields of design or subsystems as well as a multitude of methods that can be implemented in the process of adding value. The main strategies thereby are continuous efficiency improvement, total quality in all divisions, asset light for optimising capital expenditure, material flow designed in terms of a just-in-time approach and a continuous increase in flexibility **(fig. 3).**

The benefit of this concept is, above all, due to the linkage of seemingly competing aims which makes it possible to reach an over-all optimum. In practice, this can be gathered from a simultaneous improvement of the dimensions of quality, costs and time. The effect is a holistic view of the value-added chain. Furthermore production systems help to acquire synergies over all locations, which marks a fundamental task of the management considering the increasingly networked structures of production.

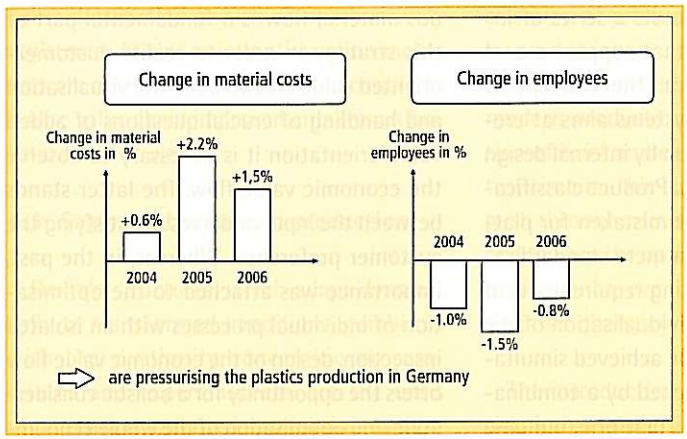


Fig. 1:
Material costs and employment in the German plastics industry

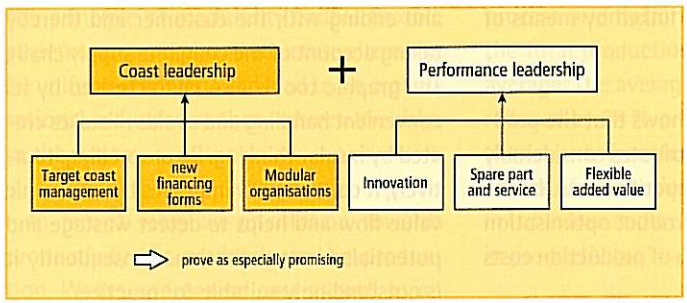
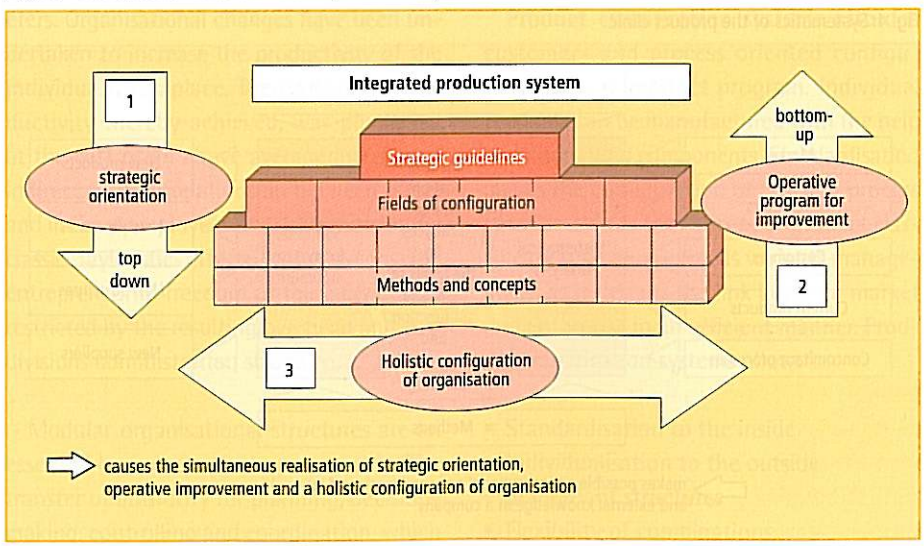


Fig. 2:
Strategies for opening up new commercial stocks

Fig. 3: Structure and elements of new production systems



4. Which methods support implementation?

New methods support the realisation of new production concepts. In order to help the plastics producers to reach long-term success, these should not focus only on production in a narrow sense but should consider the whole value-added chain, starting with the customer.

4.1 Product clinic

"Find wants and fill them" is a rule of marketing. But products are frequently technol-

ogy-driven and in danger of over-fulfilling or fulfilling inappropriately the customer's wishes. This is why there are still large potentials for optimisation within the comparison of customer requirements with the design of products and processes. The knowledge of customer preferences has proven particularly important for success **(fig. 4).**

As static and clearly defined market segments dissolve in many markets, companies cannot act on the assumption of a small number of typical customer groups anymore but instead have to be geared to the requirements of individual customers in a very exact and updating way. The aim of this is to reach a ratio of costs and functionality that is ideal from the customer's point of view. This balanced ratio is also called target costs zone. Excessive costs as well as excess supply of functionality should be avoided.

Another problem of cost-oriented product design arises from the increasing complexity of product programmes and the costs resulting from them. For example, at an internationally operating producer of commercial vehicles the quantity of part numbers multiplied in the course of the life cycle of a production line, reaching finally 120,000 components. Thus with 2000 EUR as the estimated cost of a part number per year 100 m EUR of additional costs were the result. For this reason the handling of complexity becomes a discipline of management. There is necessity for controlling and reducing complexity.

The way to a product design that is appropriate for both costs and customers can be described as consisting of three phases:

The phase of finding target costs is characterised by interpreting accurately the customer's requirements and converting them into technical performance parameters. Simultaneously the costs in terms of reverse engineering also have to be identified. Coming from a realistic market price the target costs for product design should be determined by means of a target margin. During this phase the cooperative analysis, apart from various costing methods, is of great importance. It facilitates a very accurate identification of customer requirements including a corresponding back up with possible prices.

The division of target costs aims at identifying realistic single target costs for the individual assembly groups or components and thus dividing into packages the overall block of target costs derived from the customer. Important information can thereby be deduced from comparison with competitive products by means of benchmarking and disassembling. Although the systematic elemental breakdown and evaluation of competitive products is very well known from Japanese companies, it is still not widespread enough in other countries.

For obtaining target costs a series of instruments is available that support a cost oriented product design. The concept of product classification systems aims at creating a long lasting system by internal design of the product assembly. Product classification systems may not be mistaken for platforms that aim only at a mere standardisation. In fact the conflicting requirements of standardisation and individualisation of the product program must be achieved simultaneously. This can be reached by a combination of strategies such as platform, building set, non-variable parts and module and system strategy, which are linked by means of formational laws.

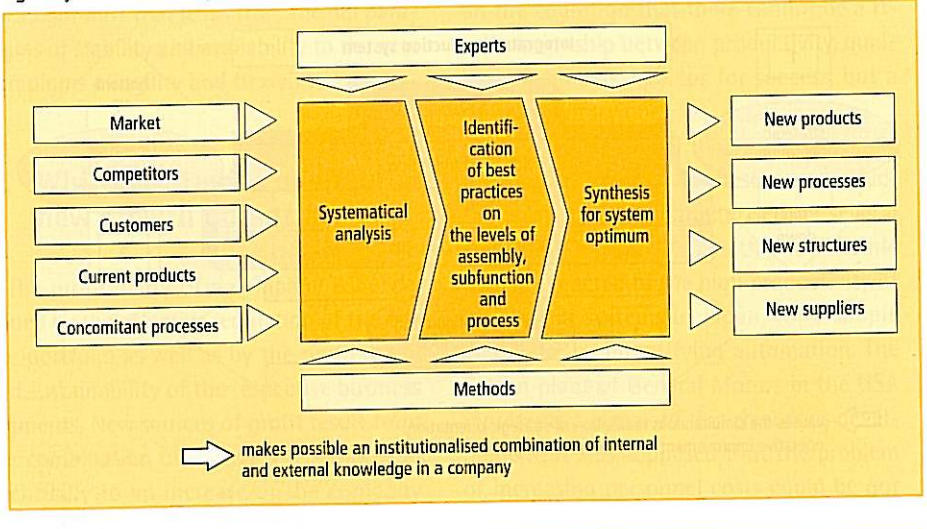
Practical experience shows that the product design potential contributes considerably to improvement of competitiveness. In the frame of a systematic product optimisation frequently 15 up to 30 % of production costs can be economised.

4.2 Supply footprint design

Effective production processes are geared to the customer's benefit and the process design requirements are derived from them. Efficient processes are based on the principle of continuous material flow. Both aims are linked in the design of the flow of economic values and lead to robust and risk resistant processes.

The design of the flow of economic values offers excellent opportunities for optimising networked structures. Reaching a continuous material flow is a fundamental part of this strategy in order to realise customer-oriented value creation. For the visualisation and handling of crucial questions of added value orientation it is necessary to observe the economic value flow. The latter stands between the input and a result satisfying the customer preference. Whereas, in the past, importance was attached to the optimisation of individual processes with an isolated inspection, design of the economic value flow offers the opportunity for a holistic consideration and optimisation of the whole economic value flow, starting with the raw material and ending with the customer and thereby taking account of the complete supply chain. The graphic tool is also characterised by its convenient handling and avoids mistakes created by insular thinking. By proceeding iteratively, it continuously improves the economic value flow and helps to detect wastage and potentials for optimisation. Consequently it is outstandingly suitable for practice.

Fig. 4: Systematics of the product clinic



Value stream mapping can be applied on different levels, ranging from production networks to the individual machine. When focusing on individual product spectra the actual state of the economic value flow can be analysed with the aid of a well-balanced portfolio of key figures. Thus sources and drains of value addition and destruction within a value adding network can be identified. The interdependences between logistic measures by means of logistic principles of a value adding partner and the effects of these measures in relation to all others involved are of special interest. This way growth and value destruction can be comprehensively registered. At this point optimisation measures are established that make it possible to realise value chain improvements from a holistic point of view.

4.3 Segmentation within production

Flexible structures, which adapt dynamically to transformed conditions, combined with the continuity concerning process-related and expert aspects, are the basis of a venture oriented production system design. Organisational structures based on the principle of modularity enable flexible structure expansion und structure alteration by uniform standards and lead to an organisational redundancy that reduces the risks, in the system.

In recent years an orientation towards productivity has predominated in production. Wages and capital cost as well as an efficient division of work aiming at automation of repetitive tasks were action parameters. Organisational changes have been undertaken to increase the productivity of the individual work place. The progress in productivity thereby achieved, was purchased at the cost of an above average increase of indirect tasks. A relationship between direct and indirect employees of 1:1.25 exists in the classic "tayloristic" affected organisations. The entrepreneurial freedom of the individual is restricted by the resulting overhead and cost divisions administration structure.

Modular organisational structures are an essential basis for co-entrepreneurship. The transfer of authority for planning, decision-making, controlling and coordination, which is necessary for entrepreneurial thinking and action, occurs within the scope of teamwork. Indirect functions such as work preparation and work regulation, set-up, quality checking and preventive maintenance lead to a qualitative enrichment of the scope of duties, specific to the production.

Through co-entrepreneurship at the employee level, the elimination of waste and idle power in processes and the adjustment to dynamically changing general production system conditions are possible. Both aims have to be assured by an appropriate selection of production concepts as well as by an appropriate methodological support based on guidelines. A central guideline of modern production is a systematic definition of brief and employee-orientated control circuits. This is necessary to be able to push through relevant developments quickly and to keep the optimal position of costs and performance, even when peripheral conditions are changing.

The introduction of a modular organisation impacts the time, inventory, productivity and quality goals. With a consistent process orientation, it is possible to lower the total production inventory by 25 % on average. The average area demand could be reduced by 24 % on average by redesigning the layout. Transferring responsibility and modes of interaction brings about a change in behaviour and a consequent improvement in productivity.

4.4 Product classification systems

Product classification systems afford a customer- and process oriented configuration of the product program. Individual products can be manufactured with the help of standardised components. Standardisation allows the configuration of efficient process structures. Thus the concept of product classification systems exceeds variants management, as it designs the link between market and enterprise in an efficient manner. Product classification systems allow:

- Standardisation to the inside
- Individualisation to the outside
- Stability of structures
- Flexibility of combinations.

Distinct modules can be used for the implementation of product classification systems such as systems, non variable parts, platforms and construction kits. The architecture and the design of interfaces form the framework. Due to the consideration of creating laws the field of usage is limited and the right combination of creation laws is assured.

Modular and systems design are splitting strategies, where the product is disassembled into different elements in a top-down process. Next to module design also systems design aims at reaching a reduction in complexity through the separation of completed task packages. The components of modules and systems are not necessarily standardised, yet they contain the same functional ranges in different products. The law that is behind the generation of modules and systems is the aspiration of high autonomy in elements and products. Thus the processes and organisational units that are linked with the product can work independently. At MCC Smart for example the design of the chassis was intended, to define the single assemblies in a way (outright tyres from Continental, axle production from Mercedes-Benz, axle development from Porsche Engineering, engine suspension from Allied Signal, brake system and wheel suspension from Bosch), that only little voting and coordination effort is necessary. To do so the interfaces have to feature little complexity and have to be defined in an early stage. The first modular computer system was developed by IBM and aimed at creating clear classifications and stable interfaces in the product, to parallelize the development processes that are based on it and to shorten the total development time through it. In the middle-term modularisation led to the development of so called modular clusters; groups of enterprises that have specialised on only one module in the overall system. This led to a rise in innovation and acceleration in development.

Non-variable parts and platforms are bundling strategies. They start with the bottom-up consideration of single parts and try to use those over different products and product generations. Non-variable parts attend single components of products while the platform is a combination of dif-

ferent components. A creation law behind the bundling strategies is the realisation of high standardisation grades. Next to the opportunity of an increase in sales and the achievement of economies of scale, the units per element of the product classification system can be enhanced due to standardisation of elements. Due to the lower number of parts actions are saved.

4.5 Operating models

In making investments several funding alternatives are available to a company. These have different effects on the balance sheet or liquidity. In general companies try to arrange the funding of their investments especially when they are capital intensive in a way that ties up as little capital as possible. This is to conserve liquidity and to avoid damaging the margins in the core business. One way is for companies to share their funding risks with cooperation partners or even to shift them completely. Such "capital poor growth" can enable a company to avoid growth barriers. Furthermore long life supporting assets such as buildings or energy plants are amortised over 15 to 35 years. These are often postponed for the benefit of investment projects with shorter amortisation periods even though they are sensible investments. To conquer this "innovation dilemma" it is in the interest of clients to uncouple the current investment from the current funding actions for such investment projects **(fig. 5)**.

Particularly in the case of investments with a long lifetime, asset flexibility is playing a steadily growing role. Systems that are once realised or purchased be adaptable for changed requirements, to be sold or liquidated with little financial distribution.

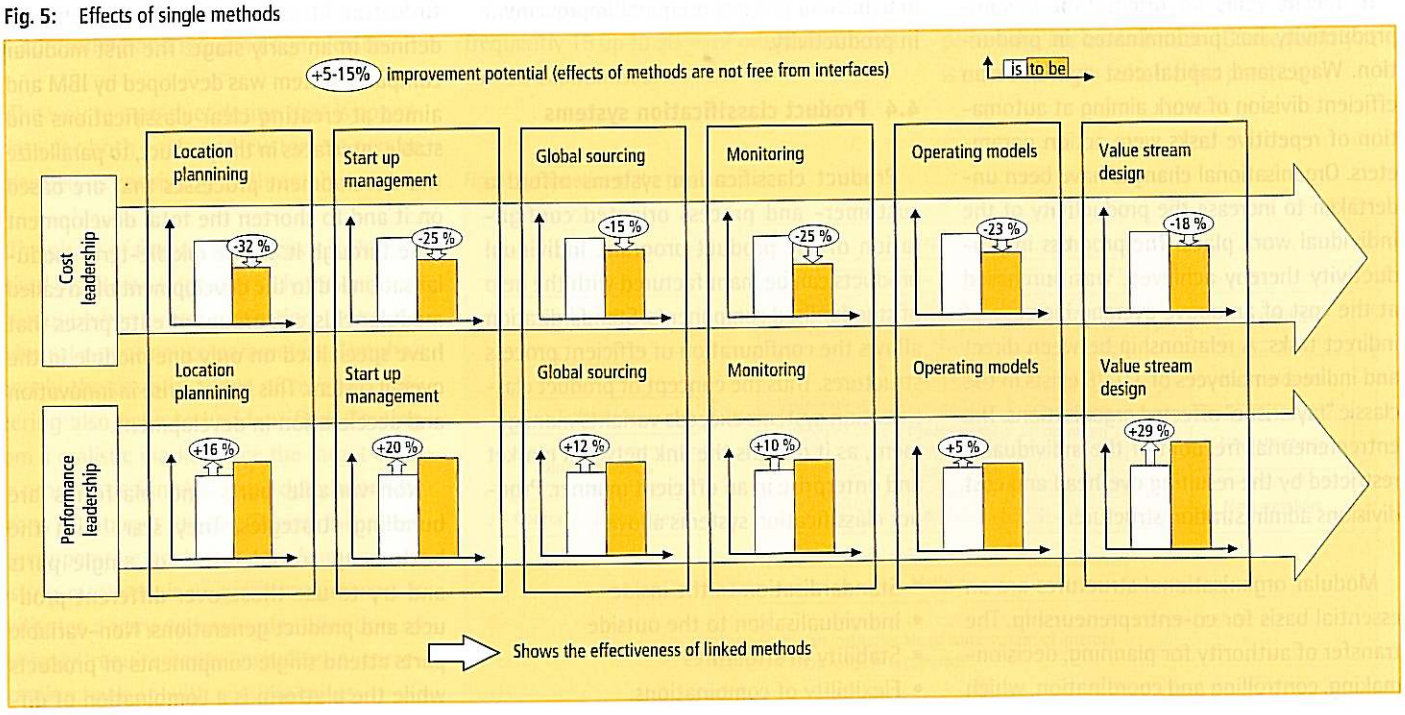
How can investments be funded through operating models? Since operating models come onto the balance sheet as a category designed for this purpose, the funding of operating models matches the start-up funding of an economically independent business unit, the operating association. Depending on the perspective this has advantages and disadvantages. There are balance sheet advantages because the investments do not burden the balance of the underwriting partners (asset manufacturers, service providers) with more than the equity used for launching the operating association. Furthermore the asset manufacturer can gain sales revenue by transferring and accounting the assets to the operating association. But since refunding of assets is carried out in the operating phase, banks and financial service providers have to be found for prefinancing the investment goods. Here the disadvantage of funding operating models appears. Banks and financial service providers expect a satisfying collateralisation of capital for credits provided. But since the operating association possesses no securities other than the launch capital, this is not possible for operating models. Financial service providers have to evaluate credit payment risk and creditworthiness solely on the basis of forecast cash flows.

4.6 Monitoring

In the company decision makers need a suitable instrument to manage and control operational processes. With their help risks can be detected in all of the four risk areas and the results of actions taken can be controlled. Functional management ratio systems have the disadvantage that without adaptation to the corporate strategy and adjustment to the aim of corporate value creation there is little possibility of recognising viations and to control the costs involved.

These problems can be avoided by a strategy driven management ratio system that displays an instrument for steering the company in the sense of a monitoring system. This management ratio system is an integrated approach that connects the two worlds of strategic management and operative strat-

Fig. 5: Effects of single methods



egy implementation. It is based on the three operational pillars organisation structure, target system and planning system. In addition to financial ratios, non financial and future oriented management ratios also give a well balanced picture of strategy and target deployment. Within the broad management ratio system, the core competencies and the monetary aims, which are derived from strategy, and the approach of corporate value creation, key value oriented figures obtained from cause effect chains are linked with figures from the areas of finance, processes, clients and learning growth. Hence a targeted coordination is possible, which means that it is aimed at the corporate strategy. This management ratio system displays a further development of present management ratio concepts in the form of a combination of a balanced scorecard and value driver concept. For monitoring performance risks, the causalities between events in production and financial ratios are vital. This deficit takes into account the risk-enhanced balanced scorecard by supplementing the balanced scorecard with a further cause effect chain of risks and ratios. The system has proved to be suitable as an integral steering instrument for this purpose.

5. Conclusion

New concepts for product design contain all methods and instruments for optimal definition of production structures, processes and control principles as well as strategies for maintenance and quality in production. To assure optimal cost and performance positions slim and agile plant concepts have been established on the basis of short reaction loops. Production segments, Kanban-steering and measurement concepts as demanded by the continuous improvement process are the main elements of modern production management. In this process three success patterns seem essential: The production should be considered as a tool for future value creation. Hence it is necessary to break with usual fixed thinking patterns and to exchange information within the supply chain. Finally the creativity in value creation is to be complemented and implemented through methodical procedure.

6. Literature

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