

# **GUIDELINES FOR FUTURE MANUFACTURING - NECESSITY OF A CHANGE OF ORGANIZATIONAL STRUCTURES IN INDUSTRY AND WAYS TO THE "FRACTAL COMPANY"**

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The world economy is in a state of flux. Changes caused by the European domestic market, by the opening to the East and by technological developments have strong effects on the manufacturing companies. Only those who survive are able to adapt quickly. This situation bears danger but also chances. It will be the challenge of the years to come to take these chances in an active and consequent way.

## **1. The Shift of Goals**

There has been a clear shift concerning the objectives of industrial production. Goals of production which have been held up for decades give way in favour of speed objectives. This is mainly due to a shift from purchaser markets to seller markets. The cause for this shift is the saturation or even the oversaturation of the markets. According to surveys, the losses of profit during commercialization of a product are the highest if the product is put on the market with delay. Other factors like excessive development costs or higher costs for materials are by far less important.

There are less and less products and the production of which is complicated in the conventional sense. On the one hand, fully matured components whose combination results in final products contribute to this fact. On the other hand, the manufacturing technologies, becoming more and more reliable, ensure constant quality as well as the production of even complicated parts by staff which is trained on an average. This means that there will be more and more suppliers serving the market with similar products. The result is an increasing oversaturation of the market with all features of a purchaser market.

## **2. Historical Change**

Taking a look at the historical development of the availability of production factors, it has to be stated that the number of used factors has always been increasing, and that the availability of these factors has been rising strongly in the course of time. This fact is remarkable especially concerning the availability of mechanical energy and of information which are crucial for industrial production because they allow the effective and timed use of resources.

Effective use of resources in this sense results in a reduction of the stock of resources. For this reason it is not possible always to have a stable situation or, in other words, always to run the production according to events calculated in advance.

Rather the dynamics of the events will increase. One will have to prepare for letting go certain processing stages without having them planned ahead and to leave them, so to speak, to their own devices, which means entrusting them to higher control circuits. As a consequence, it is of most importance to incorporate greatest closeness to customers and extreme ability to react into the company and manufacturing strategies. This includes especially the speed objective which must be pursued vigorously and even with regard to the development of operating technologies.

### **3. The Production Factor Information**

The decline in prices for electronic components, improvements in efficiency of data processing units and progress concerning communication technologies make and desired quantity of information available at any place at any time. Despite this fact, the processes in our industrial companies are still organized according to the old model, by which the division of labour has also been used for minimizing the effort for drawing up information.

Although each worker could be included in the fetch-principle, as far as the required informations are concerned, our organizational structures work according to the bring-principle for information by staff functions and through hierarchy levels. The overcoming of this discrepancy is the task of the years to come for each industrial company. The above mentioned developments could enable the organizational structures to get flatter and will result in more scope for decisions and more responsibility for each and everybody in the organization (Fig.1).

While in the past one believed that the secret of an effective performance specification consisted in Taylorism, which means the division of a task into many little tasks while applying appropriate coordination, now the conditions have radically changed. The summing up of contents of labour is demanded. Tasks must be interlinked and turned into processes, and also the design of flows are the orders of the day. The organizational structures will increasingly turn into project organizations.

Assumed that the competitive basis of an industrial company is composed of technological standard and process quality, during the last years there was an increasing shift of the minimum competitive basis towards the process structure. There are only few cases where technology alone is enough to hold the competitive position. Merely a clearly visible leadership in technology can be realized by the customer only in regard to a few products, the minimum strategic basis moves towards a higher process quality and therefore towards speed objectives and time competition.

### **4. Limitations of Current System Considerations**

The constantly faster-moving markets, technologies and informations which are available everywhere, mobility of productive factors and, last but not least, know-how which can be

accumulated more and more faster, sum up to an unknown global challenge for manufacturing companies. The aspects mentioned have their origin in changes which partly took place as very slow and therefore unnoticed developments (e.g., the worldwide availability of technological know-how or the mobility of resources).

Other changes have rapidly changed the world because of rushing technological developments (e.g., the information technology by making enormous amounts of information accessible at any point on the globe). This leads to a higher pressure on the companies.

More than ever before there is a demand for innovative power as well as speed concerning processes and adaptation. As a reaction to the environmental dynamics and the ability to develop (evolution) are required.

Our current view of a manufacturing company however is static-oriented. We assume that there are definite, clearly differentiated areas of tasks and fields of action, and that there is a need for responsibilities and authorities who issue instructions on the scale of a hardly changeable organizational structure. According to these models of ideas, a company develops continually linear, and the economic arithmetic models are static.

This way of thinking also applies to all instruments which have developed in order to improve the efficiency of drawing up performance. Because of this, certain information technology aided functions for example are only an updating of sharply differentiated contents of labour (taylorization) and are therefore subject to the same mechanisms.

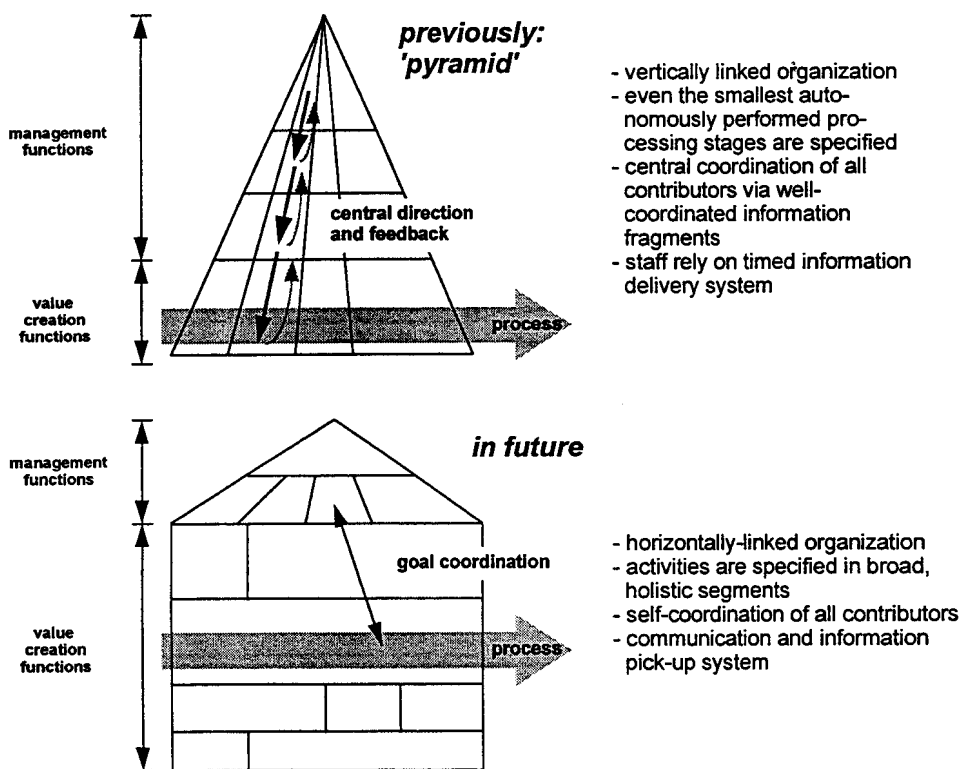


Fig. 1. Interplay of organization, information and value creation

## 5. Characteristics of Dynamic Change

If there are changes as described above which concern parameters that are important for a manufacturing company, companies which are structured according to conventional principles

are no longer able to fulfill the required self-dynamics and the necessary speed of evolution. The results of this immobility and inflexibility become increasingly perceptible for each and everybody in the company. To mention are phenomena like

- fast-rising pressure concerning costs and a profit situation which is worsening rapidly
- increasing hectic rush concerning the sequence of events in the company
- waning ability to adapt to the market situation
- increasing difficulties concerning the contact with customers and suppliers
- obvious weakpoints in management as well as discipline problems
- lacking motivation
- continually decreasing ability to react to situations in a calm and carefully considered way and to make strategic decisions
- poor satisfaction with the work to be done
- decreasing quality of products
- bad condition of manufacturing equipment and losses of productivity.

In such cases, additional feats, working overtime and reorganization can not put things right. They represent a specific consideration of single phenomena like throughput times, wages or productivity, which can only have a limited and temporary effect. A paradigm change is required - a new conceptional establishment of the way of thinking which is the basis of the manufacturing company. The new basis must take into consideration that nowadays these changes take place with enormous dynamics. If a company wants to stay alive, it must learn how to secure market shares and rentability in such a turbulent environment by developing adaptability.

All managers are faced with the necessity to watch the economic environment and to create structures which are able to adapt fast and efficiently. For this reason, product strategies, companies and technologies must be changed in a purposeful manner. This must be embedded in the context of long-term strategies and concepts, connected with fundamental development trends and relevant informations.

A company in such an environment does not develop in a linear way but with leaps in development and with transformations which come into existence according to the laws of probability and which, although they can be controlled, can not be predetermined exactly. It is therefore a matter of dynamic systems, the development of which can become very complicated with the progress of time. The dynamics a company has to develop under these conditions is one called "evolution". Only a continual development secures an appropriate adaption to the changing environment. There is a key sentence which can be derived from these explanations. It says that a company is an open complex dynamic system whose logic, based on the chaotic system thinking, is the one of fractals and whose dynamics are shaped according to laws of evolution.

## **6. Design of the Industrial Drawing up of Performance**

In order to be able to master the future, ways of thinking and points of view must be changed radically. The considerations must move away from static systems towards dynamic systems, away from mechanistic and towards dynamic organic models of explanation, away from monocausal towards multidimensional explanations. We must learn to understand a manufacturing company as an integrated system with its own processes and structures, a system which does not develop in a linear way, which is not exactly predictable and whose interior and exterior limitations are fuzzy and permeable. For this the model of the "fractal company" is suggested (Fig.2).

| Traditional View  | Fractal View   |
|---|--|
| <ul style="list-style-type: none"> <li>- The company is the sum of its activities and strategic fields of business.</li> <li>- The company develops in a linear, stable and predictable as well as manageable and controllable way.</li> <br/> <li>- The organizational structure is a matrix hierarchy.</li> <br/> <li>- Business dealings with suppliers, commercialization and competitors are of the kind of the zero-sum-game (what I win, you will lose).</li> <li>- There are clearly defined limits within the fields of the company and between company and environment.</li> <li>- Information is handled according to its priority and momentary necessity, and this is based on the division of labour (bring-principle).</li> <li>- Certain departures from the plan are periodically corrected by new plans and compensated by holding resources in stock.</li> </ul> | <ul style="list-style-type: none"> <li>- The company is an integrated system with all its processes and structures.</li> <li>- The company develops non-linear but with leaps in development and transformations according to laws of probability. This development can be controlled, however it can not be predicted.</li> <li>- The organizational structure is superordinate and interlinked, it is the basis for the company fractals.</li> <li>- All business dealings aim in fact or potentially at making a joint profit (together we will win).</li> <br/> <li>- Limits are fuzzy as well as permeable to information and they are characterized by process-functional links.</li> <li>- Information is available for everybody and is evaluated individual to profit-points of view (fetch-principle).</li> <br/> <li>- Goals/fulfillments of objectives are not planned in detail. Self organizing, self acting units secure the intermediate results.</li> </ul> |

Fig. 2. Traditional view and Fractal view of the company

The “fractal company” is an open system which consists of independently acting self similar units- the fractals- and which is a vital organism because of dynamic organizational structures. This approach does not describe the world anew but it emphasizes the dynamic and multicausal relations of the real world.

Now the question must be put on how you get units in the factory which are, in regard to their objectives, self similar, self organizing, and acting independently. This is a structuring task of an integrated kind. Structures must be created which support and develop the mentioned abilities.

## 7. The Basis for the Formation of Fractals

While deciding what kind of fractal formation has to come into existence, criteria must be considered like

- product volume as product groups
- complexity of variants within the product groups
- technical structure of individual product groups
- technical and economical demands concerning the production factors.

In order to find a way to transform a company into a “fractal company“ the methodology must meet the following conditions:

- According to the dynamics and non-linear developments there must be a steadily in steps. The “fractal company“ is therefore not the result of a final sequence of steps but of a continual development process
- Complexity and permanent character of a task must be defused by cyclical sequences of individual steps. A transparent, simple and clear bundle of instruments must be put at disposal
- Individual complexes which must get an isolated treatment can not come into existence by a vertical company structure, as it is the case for current function-oriented differentiations. A structuring of the company must be chosen which reduces the partitions of systems – flows and complete processes – to one single aspect.

The general methodology must on the one hand contain a sequence of steps, on the other hand, it must enable integrated views, and a continual development process must be the result. In order to reduce the complexity of the company, and aiming at the creation of a “fractal company“, only horizontal divisions into levels are imaginable. All project cases which are currently dealt with show, with the help of the intermediate results, that the basic pattern consists in the division into six levels which can be seen and handled as a whole but which are separated from each other (Fig.3).

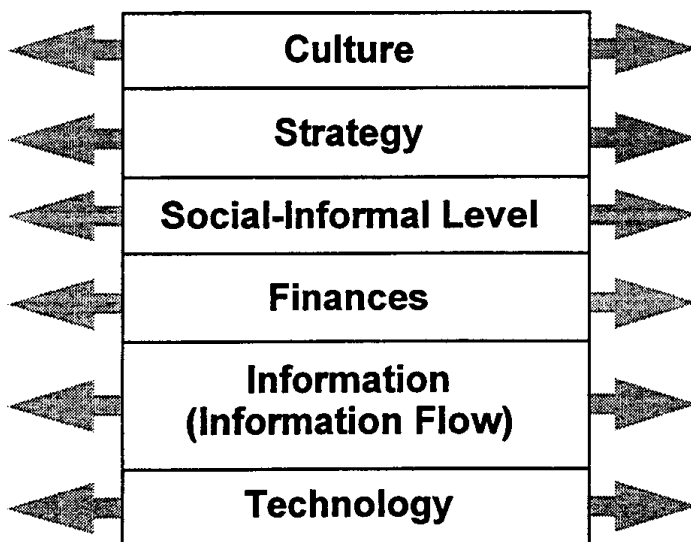


Fig. 3. The level concept of the Fractal company

## 8. The Level Concept

In the following, the levels resulting from the experiences of numerous industrial projects will be explained shortly.

## **8.1 Cultural level**

Culture is a collective programming of human thinking which has been acquired in the course of a lifetime and which differentiates the members of a group of people from each other and from the people of another group. A group of people sharing objectives at least rudimentary, and having to some extent an internal cohesion, is usually called 'organization'. Because of that each organization has a more or less highly developed culture. Therefore organization culture is the generic term which includes the company culture. Values are an essential part of organization cultures. They express what is desired and contain in this way the whole field of human preferences. Behaviour is value-oriented. If the values prove themselves and lead to success, these values are shifted from consciousness into deeper-lying levels of thinking. Not later than that it becomes clear that a goal-oriented acting company cannot get along without values or cultural elements. This has been recognized by many companies. Ideals are developed as well as common views of values and principles concerning the getting along with each other and with the outside world. Furthermore, the company-own organization is allocated a place and its purpose is pre-determined.

## **8.2 Strategic level**

Strategy is the way in which resources which exist in the company are used in order to reach a pre-set goal. Balances must be struck as far as the actual own resources and their values are concerned. Furthermore, clear goals have to be pre-set for being able to follow the path to them consequently by using existing possibilities in a specific way or, if necessary, by creating the necessary possibilities. Important strategies of innovation, me-too strategies, specialization and diversification strategies, etc. First, however, the system of objectives must be defined.

A goal-oriented way of action is the basis for a successful structuring that requires a minimum of time and costs. For this, it is necessary to generate a system of objectives which is based on the company philosophy, the strategic orientation and the culture of the company. It is fixed in the system of objectives how a company must react on influences of the company environment in order to be able to meet the increasing competitive pressure, the increasing economic insecurity and the political and technological changes.

The responsible people of a company work out a goal structure for the company objectives. Company objectives are compared and evaluated with the help of the comparison in pairs. According to the goal structures which are evaluated in this way, concrete planning goals can be expressed in order to be able to compare the alternative principle solutions which have been worked out.

This system of objectives must be fixed at big tables and together with the management, and it must be provided that the already existing parts of the company, or those who have to be formed, are oriented towards these goals. This concerns the mental attitude as well as the wage and stimulation system, the management behaviour and the company culture. Depending on the system of objectives fractals must be differentiated.

As an initial situation a fractal structure can be generated which has fractals along the logistic chain and fractals which divide the logistic chain for example into manufacturing and assembly.

### **8.3 Social-informal level**

The social-informal level of the fractal company stands in close interaction with the cultural level of the model. The latter provides the context within which the distinctive features must move.

The social-informal level includes all kinds of psychic, social and informal factors which determine and influence the structure of relations of the whole staff. During the design of the features like on any other level, one can fall back on already existing approaches.

Organizational structure, communication and ability for team-work can be identified as central variables on this level. The corresponding methods which must be adapted to the context of the fractal company would be

- development of organization
- formation of teams and working groups
- guiding of the teams
- information and communication management
- coaching.

The terms information and communication are central, the design of the corresponding structures becomes a “conditio sine qua non“ of the fractal company. If the inclusion of the whole staff into the dynamic process of change does not succeed, this process will inevitably fail.

### **8.4 Financial level**

The financial level of the fractal company deals with the method concerning the settlement of performance. Business management data must be judged here in regard to their economic and efficiency related viability. This means that sales-cost-consideration must be connected with the design of processes. In this case, the suitable instrument would be the simulation of processes in a way which secures this connection. Furthermore, on the financial level for example, the kind of resources and the way of taking into account the use of resources, the way of calculation and the balancing system concerning “profit“ and “loss“ must be adapted to the specific conditions of the fractal company.

### **8.5 Informational level**

The informational level primarily deals with the design of the technical information flow, the central term is therefore the process organization. The main problem consists in keeping up the continuity and the integration of information systems without hindering the dynamics of the structures. This task is connected with the following demands:

- registration of information
- drawing up of information
- exchange of information



- use of information
- information channels

There are many possibilities for a realization apart from computer-aided manufacturing. The use of information must be adapted to the processes and not vice versa. Numerous industrial projects which have been finished successfully show that this is not only desirable but also achievable.

## **8.6 Technological level**

The technological level of the fractal company is responsible for the technical design of the material flow equipment. The whole complex of logistics and material economy including all kinds of parts of components belongs to this. Aimed variables, like the increase of productivity, the increase of flexibility and the keeping of the schedule, which concern the whole handling of orders as well as the shortening of throughput time, are getting more and more important and become the focus of attention. First pilot projects already brought the desired results as for example:

- transparent manufacturing processes
- reduction of throughput time
- reduction of the stock value and tripling the output at the same time.

On the technical level, arrangements and flow relations within the company are designed in regard to the system of objectives, the stock is defined and the use of transport equipment is optimized.

## **9. Level Model and Vitality**

The vitality was defined as a superordinate term for the measuring of viability and efficiency of fractal. This definition was created because it was realized that productivity, rentability and profit are punctual or retrograde variables which allow only very limited statements on the further development. Today's rentability does not secure tomorrow's rentability, and a bad profit situation in the past does not need to have a bad meaning for the future.

In the level model, this can be considered by dealing with these factors on the level of financial statements and interactions.

The vitality however has not only effects on this level but also on each of the other levels of the model.

The variables which must be taken into account are considered to be able to develop a dynamic system behaviour. Therefore, vitality must record and evaluate mainly variables which are included in the individual characteristics and which can be used as a measure for the change or changeability of the individual characteristics of the levels.

## **10. Summary**

The fierce international competition forces the industrial companies to restructuring. This perception has found acceptance on a wide scale. However, the question is, in which direction the organizational structure of a company can be developed in order to meet the requirements of markets and of competition and in order to keep strategic possibilities.