

INTEGRATED DEVELOPMENT OF A MACHINE TOOL

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1. Introduction

Every manufacturing company tries to be a good manager, i. e. to dispose of its own means in such a way, that it can reach some benefit and its activities are economical and profitable. In short, this can be characterized with these words – to obtain the maximum profit applying the minimum costs. The market mechanism is based on coordination of activities performed by economic subjects on the base of free creation of prices, e. g. product prices. Products are offered in such a way that customers' wishes can be fulfilled and due to this, customers' needs are satisfied. Regarding to the product, this can be a physical product, a service, some information, etc. If the product is understood as an object of a barter, it is characterized especially by the following features [1]:

- it satisfies needs;
- there is a market available for it;
- there is a demand for it.

Physical products and services are understood as various product types. Kotler mentions that material goods can be delivered together with services [1]. A machine tool – as material goods - can be also delivered with a service (with technology). A machine delivered in this way is adjusted to customer's technology. Then, the machine tool is serviced by the manufacturing company.

2. Aspects influencing the quality and costs and a role of systematic designing

If a machine tool is created, it is necessary to select the approaches influencing the quality and costs. If all aspects are summarized in Fig. 1, then three internal factors are shown there which influence the origination of a product (of a machine tool):

- quality;
- price;
- time.

Moreover, three external factors are shown there which influence the product origination:

- competition;
- market;

➤ frame conditions (ecology, standards, technology).

The company is able to influence especially internal factors (quality, price and time) very effectively, most of all by means of:

- system approach (i. e. strategy);
- applying creative work methods (i. e. a tool to realize strategy);
- undertaking the responsibility for quality, price and time in particular creation phases of a product (of a machine tool) – applying the integrated development (this is a target which all efforts shall be aimed at).

Fig. 2 shows an example of the product creation (of the machine-tool creation), and moreover, the internal structure can be seen very well there. Essentially, this is a rather complicated action and process, which is shared by a great number of activities and operations performed by particular concerned sections within the company. The priority target of these activities must be elimination of "bottle-neck" places in the product creation process. Today, designing and development are concerned in this target in the biggest possible way within the company's sphere. So much the more, it is necessary to pay attention to this factor, especially also therefore, if we have in mind that design has influence of 67 % during the order.

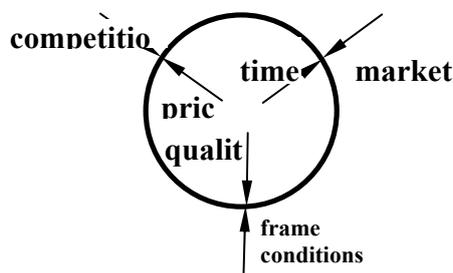


Fig. 1. External and internal factors influencing the product



Fig. 2. Creation of a product – of a machine tool

3. Company's visions and philosophy

At the current time, some companies would like only to maximize their profit. Short-term earning of money is not essential, but philosophy developed together is very important [2]. The company's philosophy developed correctly is the other target of the manufacturing company and it can be based on the following "building stones" (Fig. 3):

- people, knowledge (L);
- technical means and technology (T);
- outside business surroundings (P);
- financial sources (Z);
- specialized information (I);
- management (M).

These basic factors of the up-to-date company's business philosophy should be uniformly used in the global age (Fig. 3a). In the case, that these factors are not used uniformly, some imbalance will occur and some of the "building stones" will not be in the sufficient quantity, but the other ones will be in an excessive number.

For example, human resources and their knowledge will be available, technologic now-how will be available too, but no financial sources will be available. Then, the way to the successful business will be very complicated (Fig. 3b) and it is not possible to speak

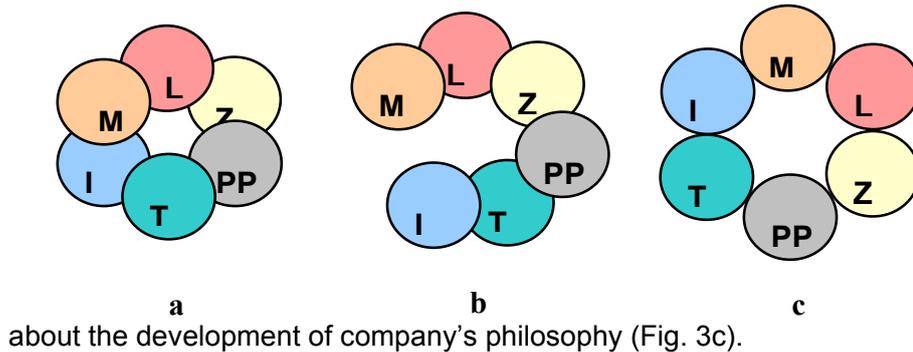


Fig. 3. Building stones of company's philosophy

In addition to the company's philosophy, every manufacturing company should also have its own vision which is a part of this philosophy.

Company's philosophy defines:

- relations to the customer;
- relations to the owners;
- relations to the suppliers;
- relations to the associated companies;
- attitude towards the competitors;
- attitude towards the employees;
- attitude towards the top management.

4. Designing process

For example, the designer shall think out something and he has been already thinking about this matter for long time – therefore, it is an abstract object and it is necessary to materialize this abstract object in assembly and manufacture drawings. This all shall be done with participation of the following factors:

- customers' needs;
- limitation and restriction by various standards, regulations, by the conformity declaration and by safety rules;
- company's technologic possibilities;
- company's assembly possibilities;
- manufacture and assembly feasibility;
- technical parameters should be obtainable at the final work and these parameters should be better ones than competitors' parameters;
- economic efficiency of future production.

In general, it can be said that any idea which the designer has in his head is limited and restricted by the above-mentioned presumptions. So, it can happen in many cases, that nothing remains from the original idea, after it is filtered by these presumptions. The complete designing process and its course must be divided in partial steps, which follow each other in the logical sequence and which are synoptical (or, e. g. these can be elaborated by a computer).

Solution methods must be prepared then for these steps. The designer's work can be divided in three different phases of the design problem solution:

1. task determination and formulation;
2. solution searching using various variants;
3. evaluation and decision making which are connected with the determination of the optimum variant.

The particular stages can be proceeded thanks to the support and application of various methods. Doing this, it still depends on the fact, what originality the new-originating technical object has regarding to the knowledge, which the designer obtained in the previous time period, e. g. when he created some similar design. The matter is that this designer can create:

- new arrangement or layout;
- adaptation of the existing design;
- modification of the existing design.

There are four essential approaches to designing – these are the theoretically supported (scientific) approach, the procedural approach (based on methodical instructions), the intuitive approach (based on knowledge and experience obtained up to now) and the approach called "attempt – error".

5. Principle of the integrated product development

It is not only the quality of production and manufacturing processes, which are the features providing the product supply to the customers in time. The design can become a bottle neck and at the same time, the design creates 70 % of all costs necessary for the future product (for the machine tool). The design influences the fact, whether it will be possible to manufacture the product or not. Almost every real design problem can be solved. However, the question remains, what time is necessary for the problem solution and what costs are necessary to do this.

If the design plays such a great and important role, how can be eliminated the above-mentioned possible negative results ?

The key, how to eliminate successfully all unnecessary costs, the long development time and how to increase the quality, is to integrate the product creation through all sections within the manufacturing company, all the time of the product life cycle.

The following ones belong among those sections:

- marketing (M);
- designing department (K);
- technologic production and assembly preparation (TPV);
- purchase (N);

- production (V);
- assembly (Mo);
- sales, dispatching and service (O).

Reasons of the incorrect integration through the sections are:

- incorrect offer and a contract concluded incorrectly due to this incorrect offer;
- insufficient transfer of customers' requirements to the internal order in the company;
- formal errors in documentation;
- errors in sequence of groups;
- incomplete documentation;
- changes;
- non-fulfilment of terms needed for documentation delivery;
- incorrectly supplied and specified subdeliveries;
- inadequate material;
- incorrect manufacturing and assembly technology;
- manufacture and assembly of parts which are not coincident or identical;
- unprofessional dispatching and service.

It is very easy to presume and to state, that under the influence of these factors, the product realization project will not run in the same way, as it was intended – with low costs, in a short time period and with high quality (Fig. 4).

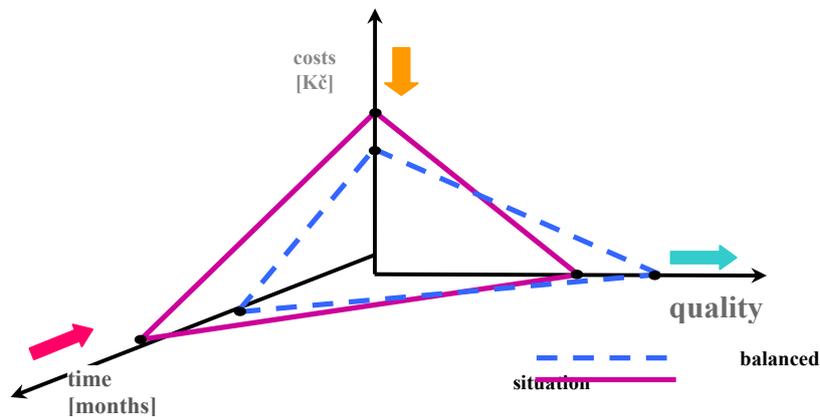


Fig. 4. Factors influencing the product realization

The reality, how the order pass through the company, with the target to optimize the factors mentioned in Fig. 4 is more complicated, as it can seem at the first sight. No phase of the product life cycle and no activities of company's sections can be seen independently, without relationship to their surroundings. The complete view of the above-mentioned problem is shown in Fig. 5. In this picture it is possible to see three possible approaches to the product realization during its development cycle. Serial Engineering seems to be the least advantageous approach; however, this approach is used in practice very often.

Here, the particular sections submit their work shares on the product realization to the other sections, after the work is completely finished. The work is performed with particular quality (Q) creating some costs (C) in a particular time period (T). The total realization time is given by the time share sum of the particular sections.

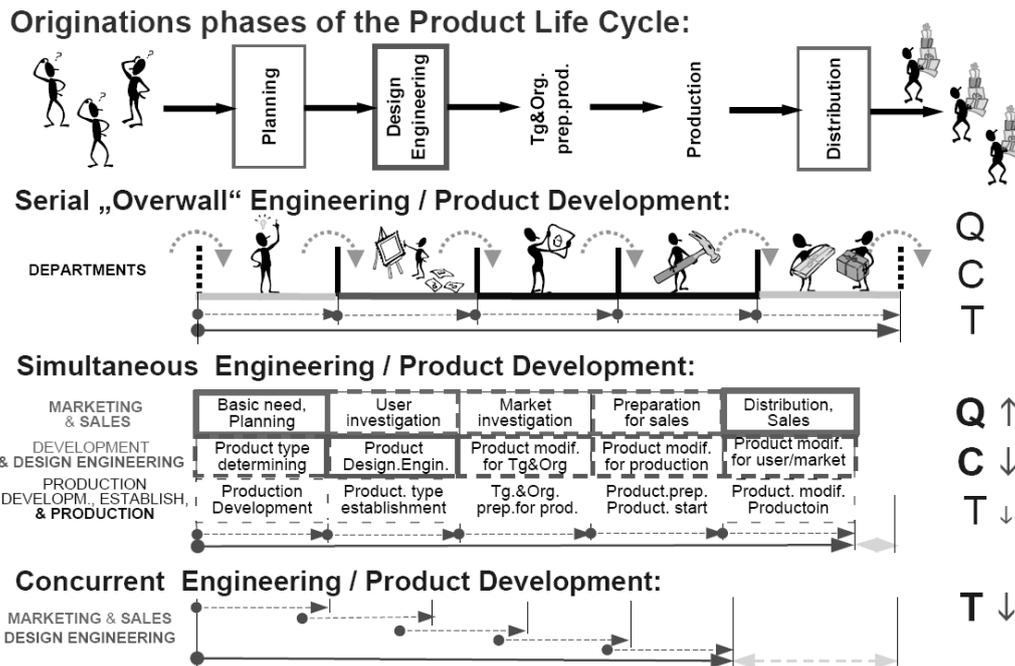


Fig. 5. Integrated product development [3]

On the contrary, if the simultaneous realization method (Simultaneous Engineering) is used, it is possible to start the project management in several sections, applying their interdisciplinary team work (planning, purchase, designing department and production), which results in bigger quality, lower costs and time saving. Parallel realization (Concurrent Engineering) saves time even in a more important way, because the realization of particular phases is started in advance, before the previous phases are fully completed. During the project phase (i. e. during the designing process), it is possible to know about 70 % of costs necessary to realize the product – the machine tool. The company should reserve these financial means to be able to purchase subdeliveries and to perform manufacture.

After the previous explanation and interpretation, the integrated product development can be understood as a process, when a product originates using the project management, with participation of the customer and of the particular sections in the manufacturing company. This product is made with the optimum quality and price during the minimum time period.

The new proposal of the integrated product development is based on the model of Simultaneous Engineering (SE) and Concurrent Engineering (CE) (see Fig. 6) completed with primary and secondary processes. These completed processes have an important part in product realization by means of the main process (Product Life Management).

The matter consists in:

- utilization and management of working teams;
- application of methods, especially of systematic methods – scientific methods (e. g. EDS);
- utilization of modern technology;
- control, organization and management;
- ambient activities outside the company;

- financial means including cash flow;
- control of risk management, when the order passes through the company.

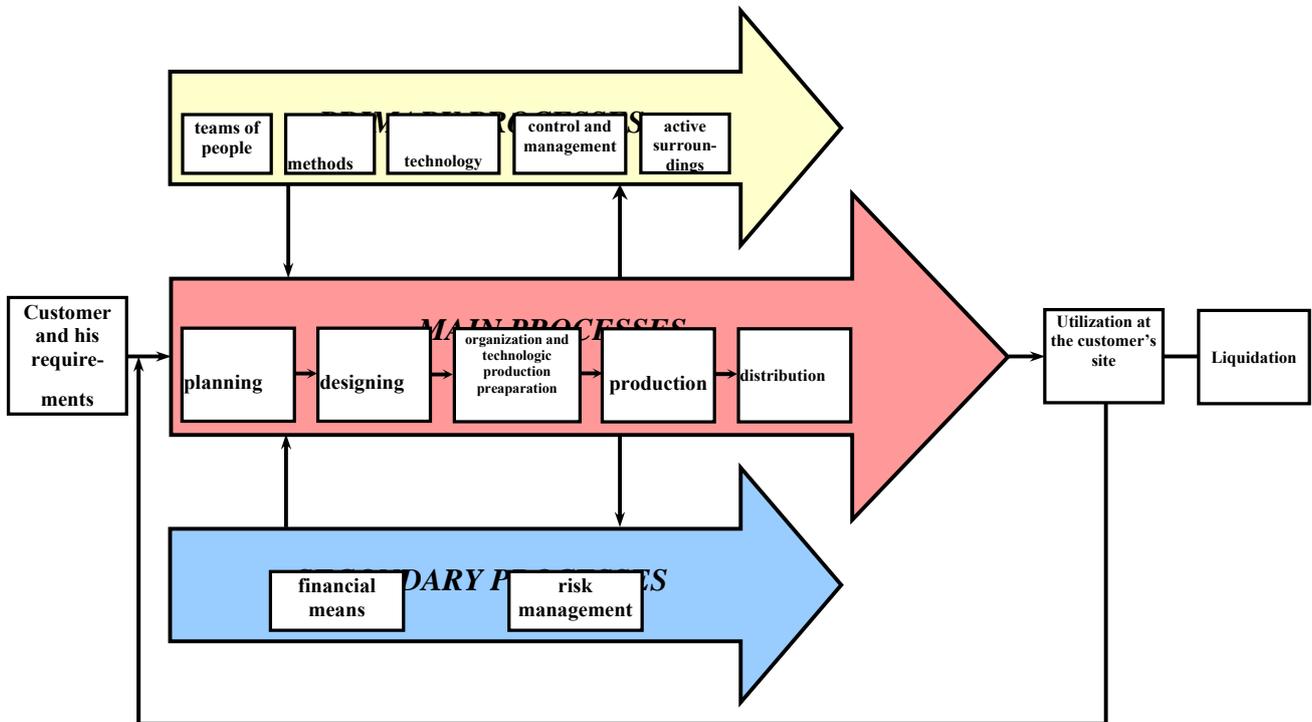


Fig. 6. Modified schema of Integrated Product Development

Acknowledgement

The machine-tool life cycle is influenced by internal and external factors. The internal factors are connected with the particular life cycle phases (project, designing, production, assembly, dispatching, machine operation and machine recycling, including possible repairs and service) and every part of the manufacturing company influences the life cycle in another way. The designing phase and applied approaches belong to the most important phases of the product life cycle. The shown modified schema in Fig. 6 is completed with primary and secondary processes. When the order passes through the company, and most of the product life cycle phases are realized, the order is influenced by risk factors. These risk factors can cause that the order comes to the situation, when it cannot be realized more and financial loss occurs. The serious risk already acts in the offer phase; therefore, it is necessary to describe this risk and to control it subsequently so that this risk can be eliminated successfully.

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