

Possibilities to Reduce Manufacturing and Management Costs of Tractors and Agricultural Equipment

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Simultaneous (or concurrent) Engineering, is a concept which should be normal nowadays. Then, without early and simultaneous involvement of all departments, specialists, special suppliers and potential external consultants, you are no longer able to develop these ever more complex agricultural machines. In that case „simultaneous“ means to be faster on the market, because all manufacturers can contribute their expertise earlier, and also have the opportunity to use the expertise of the various specialists as early as possible. Thus, the product quality and the market use is improved simultaneously. By the product accompanying calculation the economic parameters are available on time too. In former times and up to now with small machines, you could afford to have them designed and looked after by one specialist. Nowadays this is no longer feasible due to the fact that machines became too complex. For the various conditions in different markets it is important to cooperate with a very high flexibility in the field of design, production, purchasing, controlling and at least in the sales field.

General aspects

In all parts of the industry there is a big pressure on the development departments. The main points are shown in Fig. 1.

Pressure on Time	Pressure on Costs	Pressure on Quality
short product life time	increasing complexity	realization of customers request
quicker in the market	outsourcing	flexibility of development process
accelerate development process	overhead expenses	integration of special know-how
development process must be shorter than product life time	production expenses	innovative concepts for new products

Fig. 1: Pressure on the development department

Conventional procedure of development

With most enterprises, product development steps are defined by ISO or internal system processes. It is more or less a systematic description of product development activities. Task, competence and responsibility of the individual work packets are assigned to the appropriate departments. This institutional procedure is always the same and contains a large number of routine cycles. This procedure is characterized by:

- sequential working through the individual process steps
- different specialists work independently of each other
- product requests are distributed through several experts
- partial optimisation for internal department requests
- many iteration steps are necessary for product optimisation
- the number of redesign cycles affect all process steps and is directly cost- and time-intensive

General aspects for agricultural machines

To look for ideas in agricultural engineering is one of the most important tasks for the customers, especially in industrialized countries the search for innovative products is strictly necessary. „Customers or drivers" do often have excellent ideas.

Welger e.g. (in former times one of the market leaders for agricultural balers) had 25 designers in 1990; they had been able to think during a working time of 150 h/month nearly 45.000 h/year about ideas and improvements and also had to carry out their ideas. Welger has sold between 1950 and 1990 approximately 350.000 balers of which in 1990 approximately 150.000 may have been in use; if the balers were operated only 100 h/year there are approximately 15 million hours in which a driver can think about possibilities for improvement on the machines. For the design engineers it is most important to get these ideas. Therefore a close cooperation between designer and customer is important. Unfortunately only 1 - 2% of all ideas will be implemented finally. Therefore it is better to get the right and successful ideas. However, the most important solution to find new ideas for the development of agricultural machines is following:

Construction has to be done on the field and not in the office.

That means that a designer of agricultural machines has to be more time on the field than in other parts of the industry because grass and grass or grain and grain is not the same in various conditions or countries.

Agricultural machines are characterized by a very high and complex technical standard, a strong pressure on costs, a simplicity in the construction and a

permanent demand for innovations. The main problem concerning harvesting machines is the short harvesting period. The machines can only be tested during the harvesting period. For this can not be done in all interesting areas of application a special rule should be accepted. This rule implies that between two seasons the manufacturer should never increase the number of sold machines more than by factor 10. Otherwise the risk of getting financial problems is very high.

Economical aspects

For many years it is well known that the design can influence about 70 % of the final costs of a machine. A new calculation [based on VDI-Nachrichten 40/2003] indicates the same data. The main results are shown in Fig. 2. Therefore it is most effective to do the design of a machine under cost aspects and to make changes during the development phase as soon as possible. The earlier you know which problems and advantages your machine will have, the better and faster you can react.

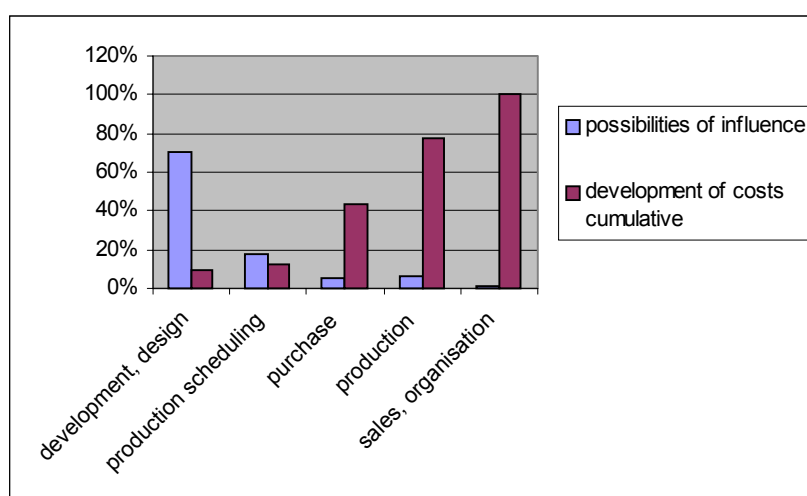


Fig. 2: Possibilities of influence and development of the costs during the lifetime of a product

If you look at the steps of a development you will see that there is big step possible, that can be covered by research projects in which the costs of the function does not play an important role. Normal development is completely different. If the research project shows a good result the development will lead into the same direction after a reasonable time. For a company it is very important to find the right steps to change. As a result of a too small steps to many design activities and parts are necessary. Consequently to earn money might become a problem. So it is very important to find the correct size of steps. This must be decided between all involved

parties in a company and will lead to a better teamwork. This teamwork will save 20 – 30 % of time. The main task in a factory will be to destroy the existing intellectual walls between the different departments.

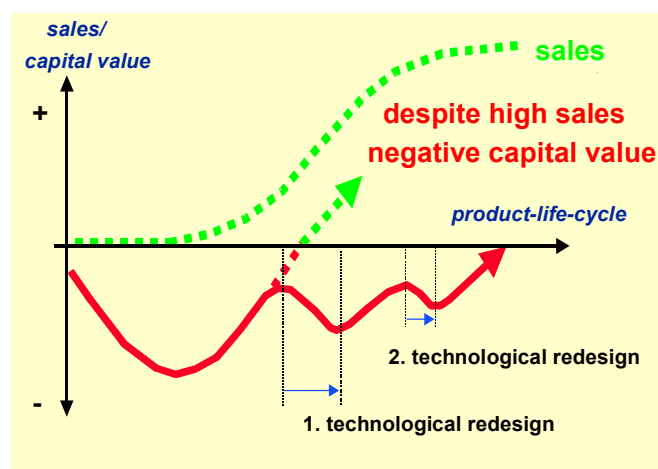


Fig. 3: Development of the capital value

The profit shrinks by shorter product-life-cycles. But the capital value remains in the minus area during the product-life-cycle despite putatively good sales. The product does not manage to amortise the invested capital (see Fig. 3). The more often a technological redesign is necessary the worse is the capital value.

There is a very big difference in various countries and regions

. Therefore an excellent knowledge of the condition and the machine as well as a good contact to the country is necessary.

The experience of the driver is very important; the larger and the more professional the machine operates the more important is fast servicing and a reliable supply of spare parts; that is why teleservice might be a solution for larger machines in the future.

Comparing e.g. Romania and the existing EU-countries, Romania has about 10 % of the farmland of the whole EU but is running this farmland with 3,6 Mio farms (average size about 2,4 ha). Most of them are operated with horses and by hand. Accordingly there is a very big market, but there is no money. High performing machines are just possible to run on very big farms and cooperatives in these countries. The simple machines for Romania could better (and cheaper) be produced in Romania. Looking into various regions of the world the value of labour in a region is very important. In India e.g. people have to work about 7 times as long for 1 kg of rice and 10 times as long for a middle class car than in people in the United States. Despite these figures India has about 100 billion € free currency available and China 320 billion €. That means that these countries are the most important markets for the future.

Fig. 4 gives an indication of the economical data of the 10 new states that will be integrated in the EU in 2004. The share of agriculture is rather different. These countries belong to the most important future markets in Europe. It can be expected that the share of employees in agriculture will decrease in the next years. Rationalization is necessary as soon as there is money available.

	Estonia	Latvia	Lithuania	Poland	Czech Rep.	Slovakia	Hungary	Slovenia	Malta	Cyprus
Population [Mio]	1,4	2,4	3,7	38,6	10,3	5,4	10,0	2,0	0,4	0,8
Farmland [Mio ha]	1,4	2,5	3,4	18,4	4,3	2,4	6,2	0,5	0,0	0,2
Share of agriculture in GDP [%]	3,1	4,7	7,0	3,9	4,5	8,8	4,2	2,9	2,6	3,8
Share of agriculture in total empl. [%]	7,0	14,4	19,2	18,7	5,2	6,9	6,5	5,6	1,8	8,3
Farm infrastructure:										
large farms with > 50 ha [-]	700	620	990	7400	4800	1400	8500			
percentage of the farm [%]	24,0		75,0	33,0	76,0	82,0	59,0			
family farms [1000]		100	67		120	21	267			50
percentage of the farm [%]	50,0		25,0			9,0	35,0			
very small farms [1000]				1100			670			
percentage of the farm [%]							6,0			

Fig. 4: Economical data of the 10 “Newcomers” [agrifuture 3/2003]

But in any case the "cheapest" solution is not the best but the cost permissible solution is acceptable for the customer.

The customer is the only person whom the manufacturer will get money from. The customers success has to be the goal of a manufacturer. In other words the main goal of a manufacturer is in any case to find a solution that has advantages for the customer. The customer expects from one year to the next that the price will decrease for the same technique or that the technique will be much better for the same price in comparison with last year. As a consequence the calculation of the customers value is necessary for any new product. An example is given in Fig 5.

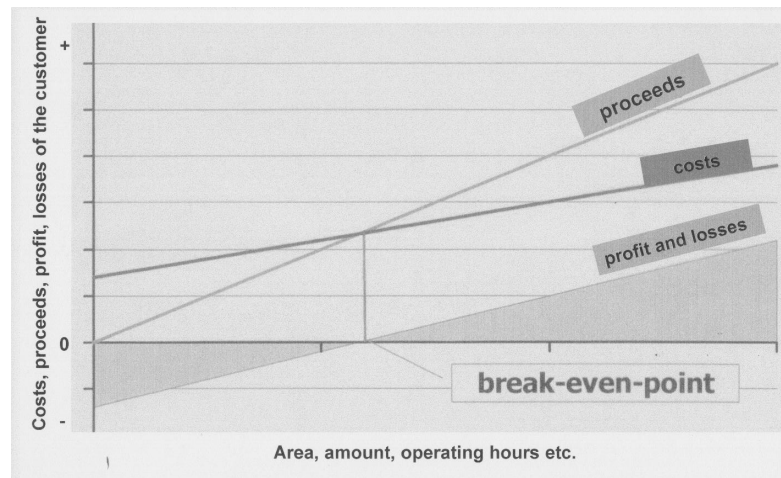


Fig. 5: Calculation of the customers value

Central ideas of SE

The simultaneous development of product and production equipment in an interdisciplinary project team with simultaneous inclusion of users and suppliers is the so-called “Simultaneous Engineering” (SE) (in English it is often called “Concurrent Engineering”). In the meantime this central idea is meant for all activities from the product idea to the market introduction.

In short the central ideas are:

- being faster on the market by shorter development time
- reduction of development time by organised working processes
- reduction of bureaucratic formalism resulting in shorter decision ways
- early recognition of complex cohesions by integral consideration
- target marketing by intensive cooperation with users
- reduction of expenses for tools and equipment by integration of specialists in the development process
- risk minimization by accompanying project controlling (time, expenses, cost and product requirements)

It is important that all involved departments work on the task early and simultaneously and not sequentially. Aside from the integral consideration, the development time will be reduced. Thus it is possible to make all substantial decisions together with the people responsible for the product. It is imperative to be immediately informed of any target deviation.

Simultaneous Engineering – practice examples

With two practical examples of SE the main advantages are obvious. Both cases involve innovative, new products from the enterprise Krone.

Example 1: The first self-propelled mower Big M (see Fig. 6)

The complete time span, from the pre-study to market introduction took 2 ½ years, in which the first prototype was already proof tested after one year. After this phase the motto was “test, test, test“. The main development took place on the field. It was the unanimous opinion of all experts that this development period was at least 1 year shorter than with the normal development methods.



Fig. 6: Self-propelled mower Big M (Krone, Spelle)

The real competence of the enterprise lays in the cutting works. Expert know-how from external specialists regarding drive, hydraulics and electronics developed simultaneously with the development of the machine was integrated. The sub-suppliers, responsible for the engine and the cabin, were involved from the beginning.

Example 2: Self-propelled forage harvester Big X (see Fig. 7)



Fig. 7: Self-propelled forage harvester Big X (Krone, Spelle)

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With regard to this machine an intensive market interview went ahead – as in the case of the mower „Big M“ – in order to hear about problems, expectations and ideas mainly from the users and to imagine the ranking of the requirements. In this example, the time span from the vision up to the delivered series product was also extremely short, because of a parallel working of processes:

1st phase (time 1½ years)

market research/interviews, concept study, product development, prototype 1, supply- & production concept

2nd phase (time 1 year)

test phase , modification from results of test phase 1, prototype 2 (pre-series 4 pcs.)

3rd phase (time 1 year)

test phase 2 & presentation in the market, production of equipment & tools, production of new assembly line, modification from results of test phase 2, 0-series (roll-out)

Not only the development time was short, but the product cost was also steadily controlled (target costing) by tight project management and the aim oriented systematic of SE.

Advantages of Simultaneous Engineering methods

Shorter Development Times by parallel sequence of operation and additionally with:

- reduction of the development cost
- faster market presence “to occupy the market“!
- improvement of capital value

Time can also be saved by using E-Business for rationalizing. According to Kowalewski [Capital 22/2003] the following trend can be expected in this case (the percentage indicates the number of positive answers):

- speeding up the process 91 %
- satisfy the customer 85 %
- more flexibility 82 %
- reduce costs 80 %
- higher sales 63 %
- new business 58 %
- better quality 35 %

More and more companies are using E-Business already in the meantime.

Target Marketing by evaluation of the market and profit relevant functions and processes and their positional value compared to those of the competitors.

Cost Optimised Solution by construction accompanying calculations and early inclusion of the production and assembly managers, in order to optimise the tool and equipment costs as well

as to avoid expensive modifications. But if you look at the cost for developing different machines you have to look at the possible number of units for that type of machine like shown in Fig. 8. In case of a high volume minimizing the costs per unit is important. This can lead to special solutions for that group of machines. But in case of a very low volume minimizing the engineering costs per unit is important. In this case already known components or existing modules should be assembled. This makes the solution much cheaper and gives the management a better feeling of the economical figures for the new product.

In any case a Target Costing Control is necessary to have always a better sense for the performance and the result of the final product.

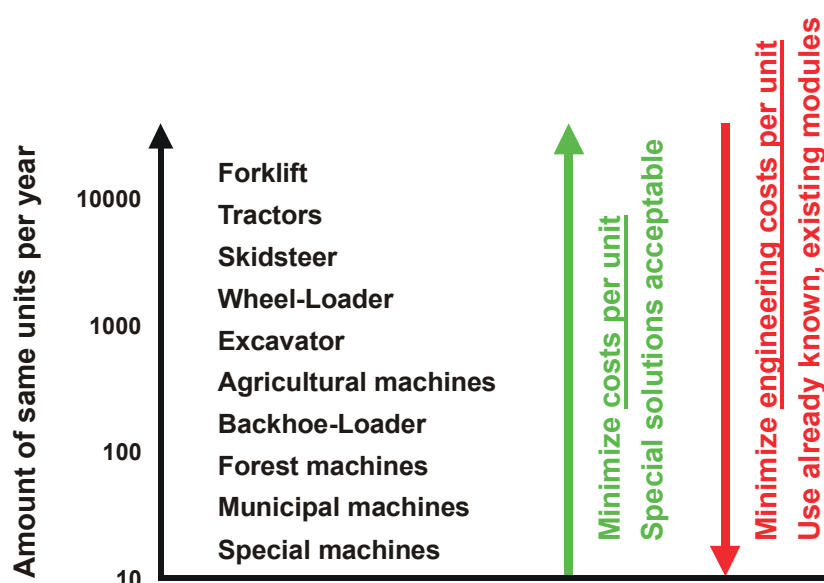


Fig. 8: Possibilities for a cost-reduction depending on the number of machines (acc. to: Benz, Bosch-Rexroth)

Summary

Knowledge in agricultural technology doubles in shorter time periods and thus reduces the product life cycle. Therefore it is necessary to develop new products in a shorter time. One method, proved in practice, is “Simultaneous (or Concurrent) Engineering“, i.e. that products and production equipment are developed simultaneously in interdisciplinary teams and sub-suppliers are involved as early as possible. The main advantages of the SE-method are a much shorter development period, lower development cost and earlier market presence. Therefore the capital value increases enormously.