Cooperative Innovation Engineering

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1. The necessity of product innovation

The meaning of a consequent product innovation activity becomes more and more important for enterprises. Reasons for this are the increasing competition caused by globalisation and individual customer-specifications that have to be considered. In contrast to this the life-cycle-time and the development time of a product become shorter [AlSc-99].

Figure 1 shows the typical process of product innovation.

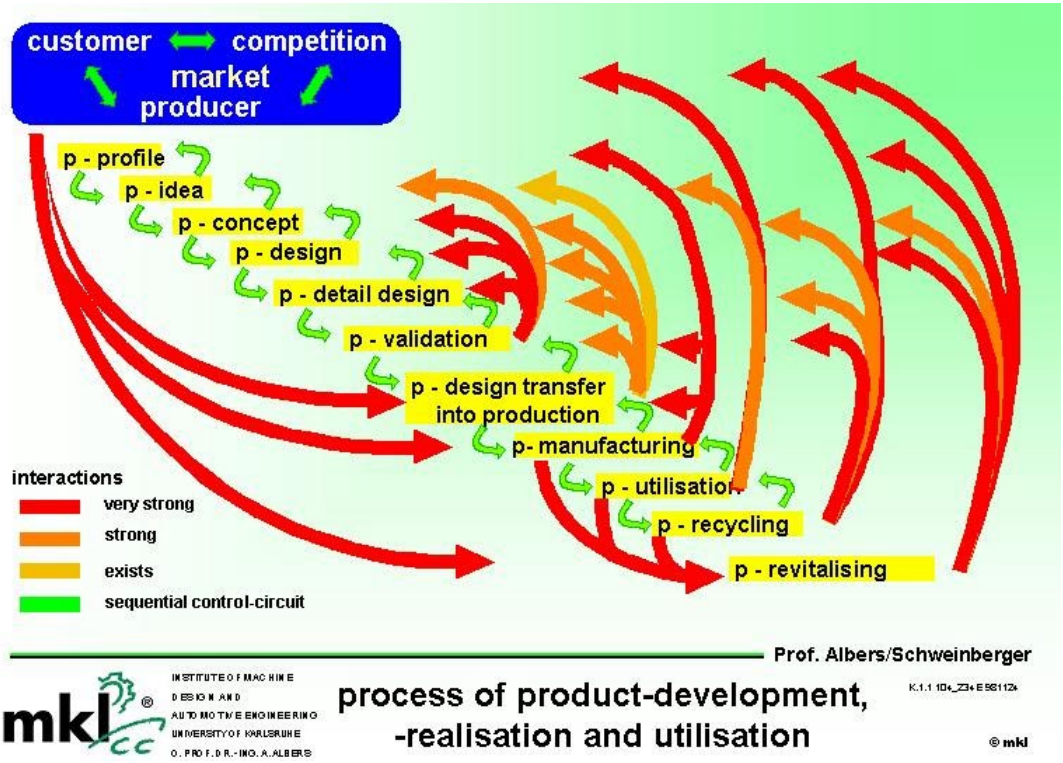

Figure 1

This process illustrates a correlation between target definition, planning, execution and controlling. It is characterized through a lot of interactions between the different steps which are connected by decisions. In this representation the steps are arranged in a logical order. Under the aspect of time a simultaneous execution of

activities is reasonable. For support of the activities in the process nowadays a lot of tool and methods are available.

2. Industrial situation

The conversion of the innovation process by one company itself is mostly ineffective and takes place exceptionally. Outsourcing of non-core-competence-areas is a meaningful decision and can be seen in nearly every enterprise. As a result the product development process becomes divided up into several parts which have to be realized by different partners in fixed time periods. This causes a complex system of partnership which can be explained by the German automotive industry exemplarily.

During the last years the „pyramid of suppliers“ with a hierarchy of different levels of supply occured (Fig. 2).

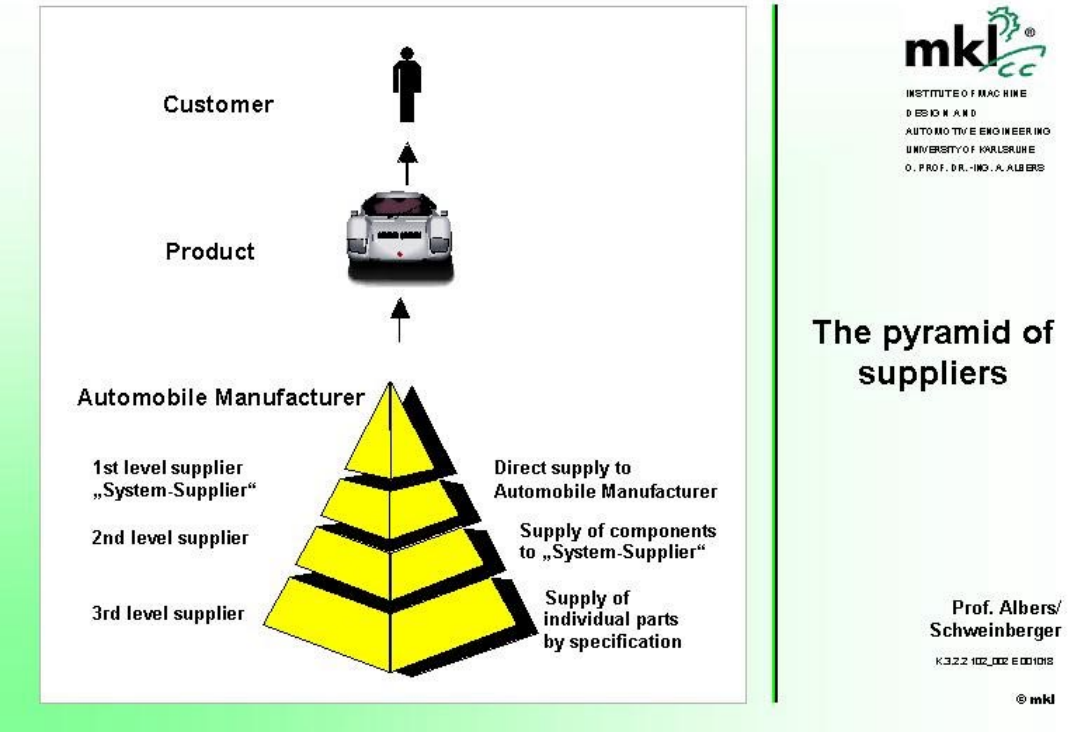

Figure 2

The situation of the suppliers is characterized by a growing development depth and an increasing constraint for innovation. The customer typically demands non-standard low-cost product solutions in high-quality. 1st level suppliers for example are forced to become system-suppliers with responsibility for product development and production [Albe-94]. Among other things this fact causes the formation of cooperation-partnerships between suppliers of different levels.

From the bottom to the top of the pyramid enterprises have to face an increasing complexity of detecting problems in the customer-supplier-relationship. Especially in phases of creating strategies for future value sourcing the cooperation with the chosen partners is recommendable. The enterprises´ strategies have to be adapted to the new situation. In the phases of reorganizing the structures of value sourcing the influence of the customer and the partner(s) have to be considered.

The position of a 1st level system-supplier and its relation-network is exemplarily explained in Figure 3.

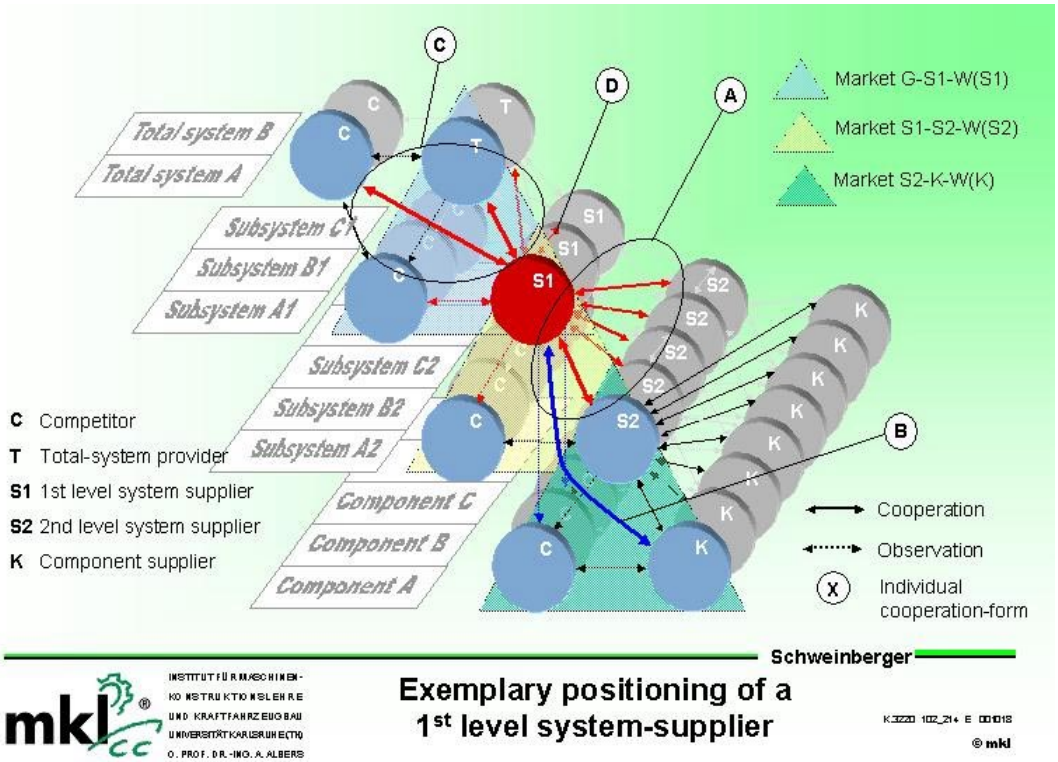

Figure 3

In this example the total-system providers are an automobile manufacturer and a manufacturer of agricultural machines. Both are positioned in the first level of the pyramid (T). In this simplified representation three levels of suppliers are positioned below. The total-system providers have directly access on the systems of the 1st level-suppliers (S1). Exemplarily they are a group of specialized companies producing clutch-systems, transmissions and brake-systems. These system-suppliers receive parts of their systems from the 2nd level system-suppliers. Typical products in this level are bearings, lubricants or clutch coatings. The application field of those products is wide and requires an extensive know-how in different application-types.

Components of those systems, for example screws or seal items, can be received from component-suppliers in the 3rd level. Independent of the positioning in this structure every company is in competition with other providers. In comparison with the own company the level of value sourcing in the ordering company is one or more levels higher. In the role of the customer those companies have the possibility to select the optimal cooperation partners. With the help of modern IT-solutions and the internet this selection expands to a world-wide process. As a result there are the described markets with the typical customer-supplier-relations. The lower the level in which a company is positioned in the pyramid the more competition can be expected. Those companies are forced to secure their positions by developing special knowledge for example in production technology. To survive successfully the companies have to observe the competitive companies continuously and to initiate appropriate measures. The manufacturer of agricultural machines possibly receives bearings from the same company as the automobile manufacturer. The produced seal items of the 3rd level supplier accordingly can be interesting for a multiplicity of system-suppliers in the 2nd level [AlSc-98].

Inside these complex relation-structures the participants fulfil clearly defined tasks. Normally the high-level companies define the hole product functionality by themselves without input from specialized suppliers. They have to coordinate and assemble a multiplicity of subsystems which are developed by different lower-level companies. This mostly leads to problems, especially between the subsystems. Missing interfaces and misunderstood development tasks cause long modification processes.

3. Cooperation as a chance

The integration of suppliers in the product development process for a common elaboration of the product design is a possibility to fulfil the requirements of the total-system providers effectively. Especially in the field of product innovation the cooperation with competent specialists of selected suppliers offers a lot of chances.

Beside the mutual influence of the product development process by different core competences the integration of selected partners has several advantages:

- The common know-how of supplier and company is a good basis for creating successful system-solutions

- Synergy-effects caused by mutual profit of knowledge and technological possibilities
- Substantial improvement of the total product regarding innovation, costs and quality
- Minimization of development time by simultaneous engineering
- Division of development risks among the partners
- Small capital requirement for financing of investments into common development-tasks
- Cost-saving in appropriation of strange know-how

There are also several risks which have to be considered:

- Risk of competence-loss by unwanted knowledge-transfer
- Risk of a unilateral dependency of the partner with loss of strategically important flexibility

An important step to avoid loss of competence is the definition of the own competences in the development-project. By achieving a trusting partnership the risk of a loss of competence can be also minimized.

4. Cooperative innovation-Engineering

Cooperating enterprises have the possibility to create crucial synergy-effects in product development especially in the early phases of the life cycle process. Merging know-how and different core-competencies of the enterprises are a good basis for product innovation [Bihn-96; Kirc-94; Rote-90; RüMH-91; WBDK-93]. For the maximization of the creativity-potential the synergy of different specialized-knowledge and social-behaviour among the involved persons has to be detected and managed. Only by this the available performance can be used optimally. Different IT-systems or special cultural behaviour for example are parameters which have to be regarded also. There are a lot of other factors which influence collaborative work. Beside exceptual features of the companies strategic aims and legal restrictions have to be taken into account. There is also the need for a lot of organizational agreements between the partners and measures for problem-solving and innovation-support.

To reach these aims the institute of machine design and automotive engineering at the University of Karlsruhe in Germany created the new research field “Cooperative innovation-engineering”. This term covers all activities in planning and managing collaborative product development between enterprises with the special focus on the organization and the management of phases with high innovation potential.

Based on elementary cooperation-management knowledge the concept of an overall software-based management-system becomes implemented step by step. Different modules support systematic

- search for potential companies
- selection of optimal partners
- estimation of cooperation-specific chances and risks
- problem-solving in the cooperation-process

For the successful implementation knowledge in mechanical engineering, information-technology, psychology and economics has to be examined and adapted to each other. Only by this a global action model for product designers in innovation-partnerships can be generated.

5. Outlook: Virtual Enterprise Assessment

Within the research field „cooperative innovation engineering“ the concept of a software for systematic partnership-initiation will be realized. The “virtual enterprise assessment” is an internet based tool which allows the world-wide evaluation of companies regarding their suitability to innovation-partnerships (Fig. 4). Analysed competences and resource-profiles of enterprises can directly be compared with a requirement-profile of the innovation-task. Individual chances and risks of partnerships can so be detected in the apron of the cooperation.

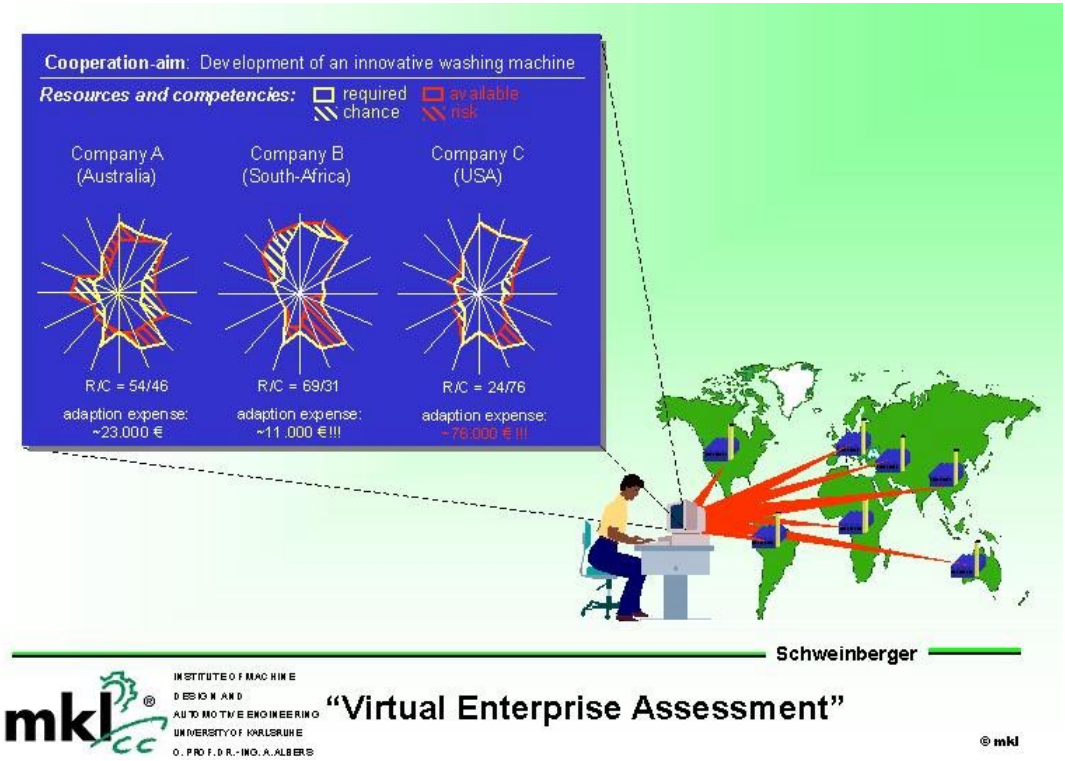

Figure 4

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