Configuration of virtual value chains

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Abstract

Networked production in rapid and dynamic interfirm co-operations gained a lot of attention in recent years. This organisational model seems to be suitable especially for SMEs to produce highly individualised goods in mutable markets. Within this environment the optimisation of the interfirm value chain becomes a main task to ensure the companies' success in short term co-operations. This paper describes the concept of competence networks as a basis for co-operations within the production sector as well as a methodology to configure the optimised virtual value chain for a specific situation. An approach to prepare companies to the requirements of competence networks is discussed and results from two research projects conducted under the scientific guidance of the institute for machine tools and industrial management (iwb) are presented.

Keywords

The virtual enterprise, supply chain management, SMEs in the supply chain, organisation of co-operation between semi-autonomous units, IT systems to support planning & control of decentralised units.

1 CURRENT SITUATION

Great demands on enterprises arise from rapid changes in national and international markets. Companies have to offer a broad range of innovative, customised products and services. In addition they have to concentrate on their core competences to improve their efficiency. Innovative forms of interfirm co-operation show new possibilities to meet these demands by offering enterprises the

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opportunity both to handle and even benefit from these changes (Hagel & Armstrong 1997).

This paper discusses organisational aspects of short term interfirm co-operations. Especially small and medium sized enterprises (SMEs) can take advantage of this new organisational approach:

- Co-operation offers companies the chance to use resources and abilities of other companies without taking the risk of additional investments.
- Co-operation enables SMEs to perform more voluminous or complex projects by collaborating with associate companies.
- Co-operation is the basis for the production of highly customised products by combining the appropriate competences offered by the participants.

2 PROBLEM DESCRIPTION

The implementation of dynamic interfirm co-operation is confronted with several problems. Initially as a rule the optimal virtual (i. e. interfirm) value chain for a certain job is not yet clear. Considering the environmental dynamics it is difficult to allocate applicable resources within different companies. To meet this challenge new organisational approaches and auxiliary tools still have to be developed. Another problem is that the companies' internal organisation usually does not meet the requirements of a co-operative relationship with other associates.

In recent years research projects in the field of short term interfirm co-operation of german SMEs were conducted with the advisory consultation of the iwb. Networks of co-operation for producing industrial goods were established under scientific scrutiny. The experience gathered from these projects made chances and problems of such co-operation evident (Mehler & Reinhart 1998).

3 OBJECTIVE

At the iwb methods and tools are being developed which support enterprises to solve the above mentioned problems. This paper describes (a) a methodology and corresponding auxiliary means to configure virtual value chains on the basis of dynamic competence networks and (b) an approach to put companies in a position for a fast and efficient implementation of the known methodology.

4 COMPETENCE NETWORKS AS A BASIS OF CONFIGURATION

Competence networks (CNs) form the basis for the set up of a specific virtual value chain. A CN consists of competence units (CUs). Those can be companies or departments of companies that feature a specific, transparent profile of competence. For a certain project, the suitable virtual value chain is composed on the plattform of the underlying CN. This value chain consists of those CUs which perform the project co-operatively.

In decentralised CNs there are no central management instances, which control the set up of value chains or the order processing. The CUs' independence is completely sustained. Thus the CUs are able to decide by themselves which role to play in a specific value chain. They can act both as a competence integrator (i. e. a company that configures and co-ordinates the value chain) or as a competence supplier (i. e. a company that contributes competence to the value chain).

According to the CUs' competence profiles, CNs can be distinguished into one- and multi-dimensional CNs. The dimensionality represents the number of different competences in the CN. In one-dimensional CNs the CUs dispose of similar competences. One-dimensional CNs can be present at the market as so called electronic production malls. In contrast to one-dimensional CNs which act only within narrow market segments, multi-dimensional CNs comprise a wide variety of competences and are thus suitable for the production of complex products. One can imagine a multi-dimensional CN as an organisational as well as IT-based combination of some one-dimensional CNs (Schliffenbacher & Lorenzen 1998).

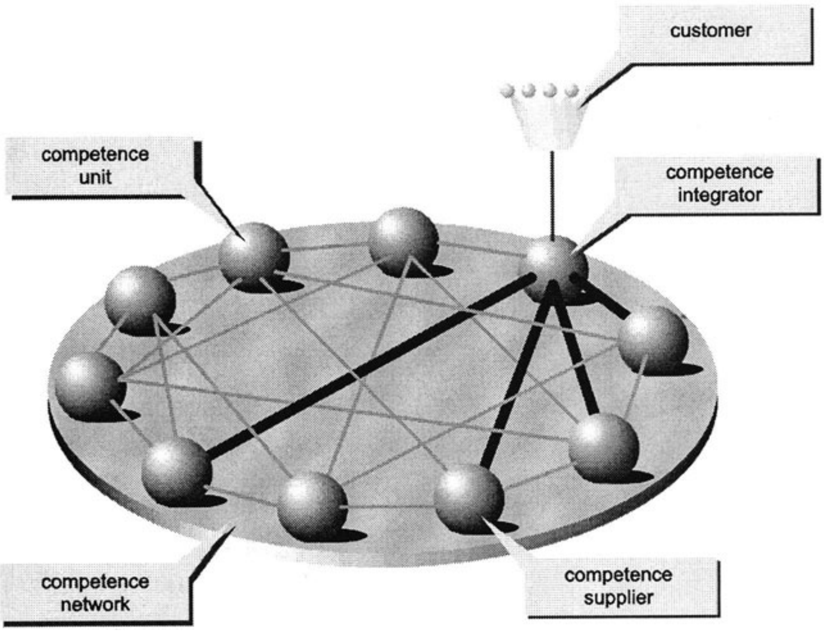

Figure 1 The competence network

5 CONFIGURATION OF VIRTUAL VALUE CHAINS

A methodology for the configuration of virtual value chains has to provide means to determine the optimal combination of competences for a customer's specific requirements. These are represented by a multidimensional requirements vector which describes the target system for the whole value chain or parts of it. It is composed of a set of criteria, whose respective peculiarity reflects their significance for the requirements' fulfilment.

The actual degree of fulfilment of a particular requirement by a specific combination of competences can be judged by its fitness. This approach is capable both for parts of the value chain and the value chain as a whole. If considering a part of the value chain, the fitness qualifies a certain CU's aptitude to perform a specific subtask. The basis for this is the CU's competence vector, which emerges from its static competence profile, a concrete offer, or a combination of both. Regarding the whole value chain the fitness is a means to judge, how well a chosen combination of competences fulfils the target system of the overall process. It can be detected by a composition of the fitness values of the sub-tasks extended by an overall process view. The combination of competences – and thus of CUs – which reaches the highest fitness value in consideration of the customer's requirements, can be regarded as the optimal virtual value chain.

To support this approach to configure virtual value chains within CNs the iwb has developed a procedure that is performed in the following three major steps:

1. define competence requirements;
2. allocate co-producers;
3. optimise the value chain.

In step 1 **"define competence requirements"** one competence integrator defines the scope of supply and services. Based on a flexible generic target system a global requirements vector for the whole task is defined. The complete task is divided into several sub-tasks that are carried out by single stages of production. A local requirements vector is defined for every sub-task. This vector describes the necessary competence and its degree of freedom as well as boundary conditions.

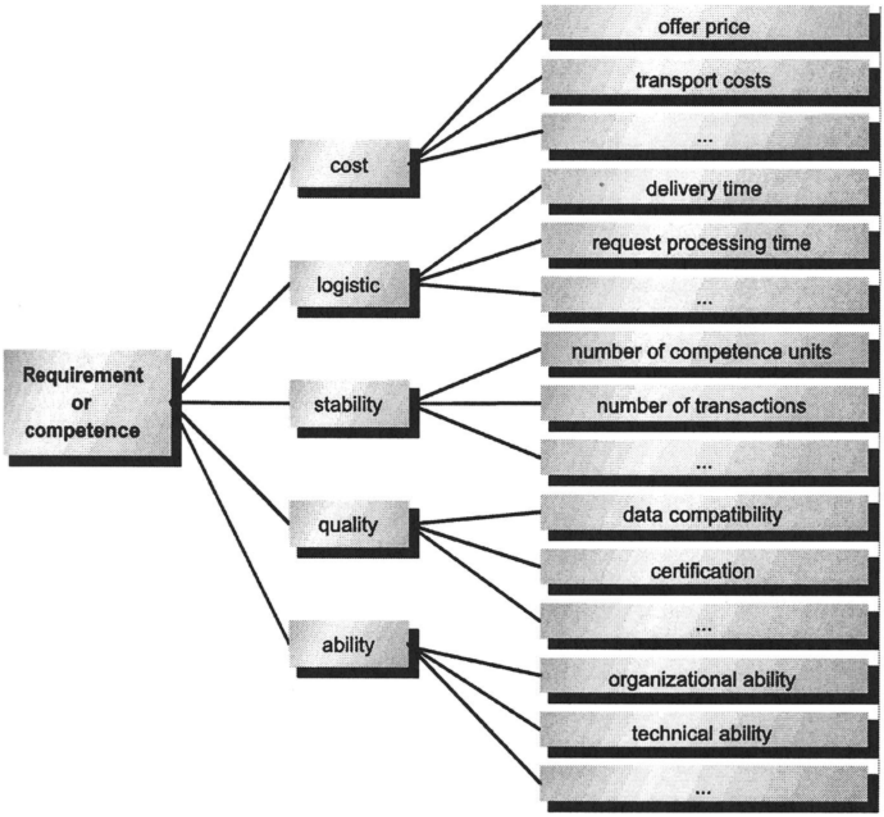

Figure 2 The generic target system

In step 2 **"allocate co-producers"** requests are generated from the local requirements vectors. Those are placed in the competence network. Prospect competence suppliers have a chance to react to these requests and place their offers. Using automated mechanisms of negotiation the exact scope of supply and services necessary to accomplish sub-tasks is matched with skills offered by competence suppliers. The goal is to find the optimal virtual value chain within the given degrees of freedom.

In step 3 **"optimise the value chain"** the most suitable combination of competence suppliers is chosen. The feasible combination of companies is automatically detected on the basis of the available offers respectively the competence profiles of prospect partners. Every combination is evaluated according to its degree of fulfilment of the requirements vectors. This evaluation leads to a ranking of all feasible value chains.

This method of configuring the virtual value chain provides an integrated basic approach for a continuous adaptation of all described steps. It is supported by a distributed internet-based software called DYNESYS.

6 REQUIREMENTS TO COMPANIES

Findings of research projects conducted by the iwb have shown that there are some prerequisites for a successful implementation of this method: (a) the knowledge about the company's competences, (b) a standardised description of this competence, and (c) a definition of applicable processes and structures of organisation in a co-operation.

First the competences of a company are rated through a core competence analysis. Core competences provide potential access to a wide variety of markets, make a significant contribution to customer's benefits and should be difficult for competitors to imitate (Prahalad & Hamel 1990). The core competence analysis is based on a methodology developed at the iwb that considers the customer's view as well as the standing of competitors (Reinhart & Grunwald 1999). In the first step of this analysis general characteristics of the product which are decisive for purchasing the product are detected. These general characteristics are examined concerning underlying technical characteristics of the product that lead to those technical characteristics which customers esteem. These technical characteristics in turn can be assigned to technical processes. So this approach allows to extract those processes of the value chain that are crucial for a customer's purchase decision.

In the next step these identified processes are rated against those of competitors. The result is a performance ranking concerning the strength of

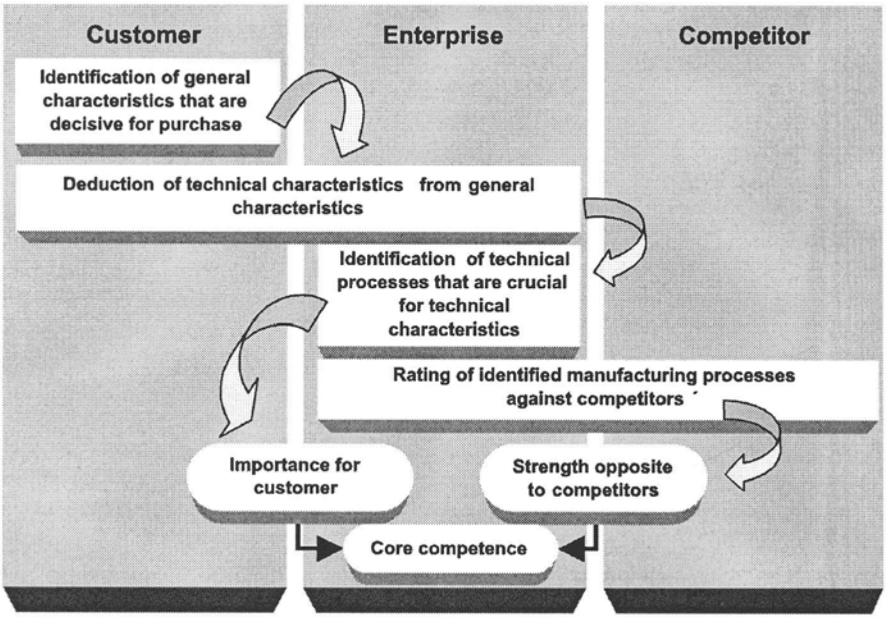

Figure 3 The core competence analysis

competences opposite to competitors. The basis of this evaluation can be internal knowledge of the competitors' competences, analysis of the marketing department, etc.

The outcome of this analysis is a customer-competitor-portfolio, which shows the company's possibilities to participate in a virtual value chain for different production processes. In case of high importance for the customer's satisfaction and good strength opposite to competitors the competence is called core competence. This competence should be integrated in virtual value chains. The strategy for competences located in the remaining three quadrants of the customer-competitor-portfolio cannot be defined unequivocal. For example competences with low importance for customers and good strength opposite to competitors can either be pushed by marketing activities to show surplus values to customers or can be contributed to virtual value chains in which the competence is needed.

The competences thus obtained are described following a network wide standardised systematic. Every single competence is defined by crucial and process specific parameters e. g. precision of a milling-process or available capacity. From those parameters different indicators for the competences are derived e. g. necessary precision or capacity. These indicators allow an unequivocal description and a rating of a special competence in regard to its qualification for participation in a planned interfirm value chain.

Generally only parts of a company's internal value chain can be included in the interfirm value chain as a component of the dynamic co-operation as examples above show. Thus enterprises have to be prepared for a dynamic co-operation to ensure a fast and efficient handling of orders (Rudorfer 1998). The adaptation of the organisational structure starts with the extraction of the processes that are affected by the co-operation. These processes have to be examined concerning various parameters such as available capacity, integration in internal processes (i.

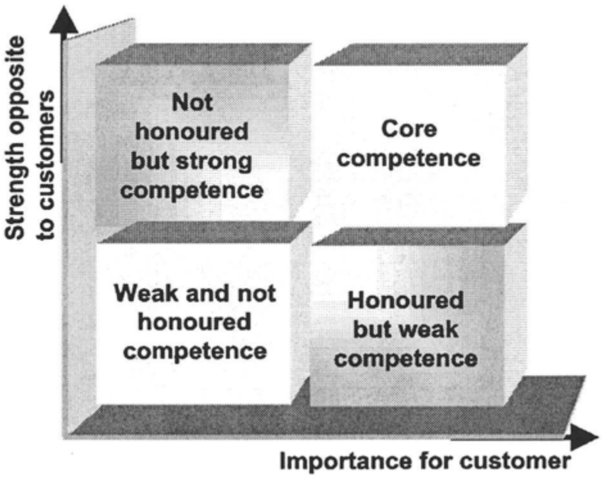

Figure 4 The customer-competitor-portfolio

e. function- or object-oriented organisation), or educational level of employees. If for example the above mentioned milling-process is part of an object-oriented cost centre it is more difficult to integrate this process into a virtual value chain than it was if the process is part of a functional-oriented organisation. This is because the whole organisation of this cost centre is designed for few special products. This leads to predications what has to be done to prepare this process for co-operation. In the case of the mentioned milling-process a matrix-organisation which integrates the internal cost centre organisation and the organisation of the virtual value chain could be a possible solution. Moreover processes are analysed in the view of interfaces with other co-operation partners. This analysis leads to measures which have to be taken to establish co-operation relationships both easily and quickly. In the given example an advanced training of the head of the cost centre could be necessary to prepare him for the new requirement of co-ordinating internal orders and orders with have been placed by other companies of the virtual value chain. So a company's decision to participate in short term interfirm co-operations can result in the necessity to change the whole organisational structure even if the co-operation relationships affect only one of its manufacturing processes.

7 CONCLUSION

At present dynamic co-operation is a well discussed approach for industrial value adding. To take advantage of this modern organisational concept it is important to reduce the set-up effort of a virtual value chain. The iwb develops new methods and internet based tools, that enable an efficient configuration of optimised virtual value chains as well as the adaptation of company-internal structures of organisation to the requirements of rapid co-operation. These methods have been demonstrated to be practically applicable in compound research projects such as "Virtueller Markt" and "RP-Net.de". Results of those projects are shown in this paper.

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9 BIOGRAPHY

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