

The Implementation of an Organizational Innovation: Examples of Mass Customizing Firms of the Capital Goods Industry

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Abstract

Mass customization can be viewed as an organizational innovation, because a realization of the strategy requests a restructuring of structures and processes in a firm. The implementation of an organizational innovation is a far more complex process compared to the one of a technological innovation. Thus, it is supposed that firms implementing an organizational innovation are heavily dependent on the acquisition of external knowledge. This paper analyses – based on German case studies – how firms of the capital goods industry proceed when introducing a mass customization strategy. At the centre of consideration are answers to the questions what kind of knowledge the firms need for the implementation, how much they depend on external knowledge and whether social, organizational or spatial proximity between the actors in the innovation process is relevant for the knowledge exchange.

Key words: capital goods industry, mass customization, organizational innovation

1. INTRODUCTION

Firms as well as the scientific community are taking more and more notice of the importance of organizational innovations. Concepts as lean production or total quality management have entered the production philosophies of many firms and provide answers to the question how firms can handle the challenges imposed on them by changing market conditions and a tightening competition [1, 2]. Firms have to cope not only with the pressures to decrease costs and to raise quality standards but also with an increasing individualization of demand [3].

The business strategy of mass customization promises a solution for how to handle these challenges. It combines elements of a mass production strategy with those of a customized made-to-order production. In that sense, mass customization seems to be a revolution in the domain of business strategies, as it combines the two generic strategies cost leadership and differentiation. Porter [4] argued that in order to be successful, a firm has to focus on one of the strategies. The key for the combination of the two generic strategies is provided by the undreamed-of possibilities which the World Wide Web and additional new information and communication technologies provide.

Although mass customization as a competition strategy has created a broad interest in the scientific community [5], firms seemingly hesitate to implement it. Our assumption was that the reason for the hesitation might

be found in the complexity of the implementation process itself, as firms fundamentally have to renew structures and processes. This requires a lot of specific knowledge, which might not be available in or not easily accessible for the firm. Therefore, we became interested in the answers to the following questions: What happens exactly in a firm which implements the strategy? Which organizational changes are necessary? How do the firms know what has to be done? And how do they know how to do it? Do they develop solutions internally or do they seek the support of business service providers or the scientific community?

We will approach these questions from an innovation research perspective: mass customization can be viewed as organizational innovation. In contrast to technological innovations, organizational innovations are delineated by multidimensionality and a high complexity. Thus, the implementation of organizational innovations in firms is a challenging task, highly dependable on the firm characteristics and the context the firm is embedded in. To implement an organizational innovation, firms often have to acquire and make use of knowledge, which is only available outside the boundaries of the firm [2].

The paper is structured as follows: in the second part of the paper, we will analyze from a theoretical point of view the questions: what is an organizational innovation? How do firms handle the complex process of organizational innovations? What kind of knowledge

is needed in the implementation process of an organizational innovation? Where do firms get it from? What enables a knowledge transfer process? The methodology of the empirical research is subject of the third part. Through conducting interviews with several actors of three focal firms which had implemented a mass customization strategy and firm-external actors, which participated in the respective implementation processes, we had the opportunity to derive three so-called innovation biographies and to contrast the findings with the theory. In the following fourth section, we will present and discuss the empirical findings. The last part of the paper summarizes the results of our research and presents some hypotheses which have been generated inductively based on the insights from the case studies.

2. MASS CUSTOMIZATION AS AN ORGANIZATIONAL INNOVATION

2.1 Organizational innovations

Generally speaking, innovations are something new in a specific frame of reference. The OECD and EUROSTAT [6] define an innovation as "[...] the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". Thus, an innovation might refer to a new product or a new service, a new process or a new method of organization. Moreover, an innovation might be new either to the considered firm, to the world, to a specific market or a specific sector.

Organizational innovations are not a new phenomenon, but due to their augmented importance for the global competition they have become a focus of attention for scholars [1, 2, 7, 8]. A reason for their augmented importance is seen in the need of firms to adapt to rapid changing market conditions [9]. Saturated and turbulent markets seem to require improved interaction processes inside firms and at the interface between customers and suppliers.

Organizational innovations in the narrow sense can be seen as organizational changes in firms. Pleschak and Sabisch [10] define them as „[...] the redesign or the improvement of the process or structural organization in firms“ [own translation]. A characteristic of organizational innovations is the close or even interdependent relationship to product or process innovations [11]. New products often need new production processes and these again need new organizational structures. Another characteristic is their social dimension: they affect the corporate culture and also the attitudes and norms of the employees.

The shape of organizational innovations can be very heterogeneous: they might affect divisions of a firm, the whole firm or even the cooperation with suppliers and customers. They might be implemented to change the socio-cultural setting, existing structures or even the strategy of a firm. In addition, they might change existing structures incrementally or radically.

Organizational innovations exhibit a multidimensional nature. The concept and implementation of an organizational innovation can be very complex. Therefore, it is not simple to imitate such changes or even copy new solutions from other firms. Firms have to find their own way to change their process and structure organization [2].

2.2 Knowledge, knowledge exchange, and the innovation process

To generate innovations and stay competitive, firms need knowledge. Knowledge is a strategic resource for the value creation and learning capability of firms. The importance of the production and use of knowledge increases with a tightening competition [11, 12].

Knowledge can be regarded as a production factor which is generated in a complicated procedure of processing, filtering and evaluating information [13, 14]. Knowledge encompasses "[...] all acquaintances and skills such as technical know-how, practical experiences and context information, which empower individuals to solve problems" [15, own translation]. Knowledge can be classified according to various criteria:

- Explicit or codified knowledge can be expressed in words and figures and can be put down on paper. In contrary, implicit or tacit knowledge is incorporated in the experiences and activities of individuals: „we know more than we can tell“ [16]. The transfer of tacit knowledge is complicated. It happens basically via observation or interaction, as tacit knowledge can not be easily expressed in words [17].
- Knowledge about facts (know-what) and about cause-effect relationships (know-why) can be codified with ease. Know-who – the knowledge about social relations and contexts – and know-how – practical skills – have a predominantly tacit nature [18].
- Knowledge can be kept by an individual, shared by a group of people or stored in an organization. Therefore, individual, collective and organizational knowledge can be distinguished.
- From the perspective of an organization, knowledge can be divided into internal knowledge and knowledge available outside the organization.

The integration of external knowledge in the innovation process requires an exchange of knowledge. Whether an individual or an organization can make use of the knowledge depends on the specific absorptive capacity which again is based on the existing knowledge base. The exchange process implies an intense communication between the knowledge buyer and supplier. Both parties have to 'feed' the process with their relevant knowledge. Through the combination and modification of knowledge pieces, the involved actors create new knowledge [19].

Usually, the implementation of innovations in firms demands the tapping of multiple internal and external knowledge sources. The access to the production factor knowledge is a determinant for the success of

innovation processes. Especially small and medium-sized enterprises (SMEs) often depend on the acquisition of external knowledge, as they are not able to provide the necessary knowledge on their own.

Knowledge can be acquired on various ways – dependable on its type – from different sources. One way, for example, is the systematic recruitment of specific experts. Other ways are market research methods, the strategic cooperation with firms or universities, or the purchase of codified knowledge for example in books, engineering drawings, licenses or CDs [13].

Especially for the implementation of organizational innovations, the utilization of external knowledge seems to be highly important. The reasons can be seen in the complexity and the fact that organizational innovations depend on the context: they can not be simply copied or imitated. They rather have to be adapted to the characteristics of each individual firm. Therefore, the assumption is that knowledge products, such as licenses or patents – which can play a substantial role in the implementation processes of product or process innovations – only have a minor relevance for new organizational solutions. The integration of experts seems to be far more crucial, especially for SMEs.

2.3 Knowledge exchange and proximity

Where do firms get knowledge from? Which role do factors like distance or trust play for the establishment and functioning knowledge-exchange in the innovation process? Despite all the globalization processes and 'revolutions' in the information and communication technologies (ICT), spatial proximity still seems to play a crucial role for inter-firm cooperation. Locally or regionally concentrated networking activities between firms haven't lost their status in the last decades [20]. Many authors have highlighted the importance of spatial concentrations of firms especially for innovation activities, such as, for example in the concept of creative milieus [21] or that of clusters [22, 23]. The identification and support of clusters has become a prominent instrument of economic policy for example in Germany or the EU.

Spatial proximity is just one of several possible proximity dimensions between actors. As the most prevalent form it describes the geographical distance between actors. Spatial proximity alleviates face-to-face-meetings and thereby the exchange of tacit knowledge. It also supports the formation of other dimensions of proximity. These refer to the cultural or institutional nearness between actors, the organizational affiliation, the closeness of a social relation or the sharing of a similar or the same knowledge base [23, 24]:

- Cultural or institutional proximity exists when actors share the same cultural or institutional background. There is for example proximity in this sense between two actors who have been socialized in the same context of formal institutions (e.g. laws) and informal ones (e.g. norms or values). A shared cultural or institutional

background eases the establishment of trust and reduces uncertainty.

- Social proximity refers to a relationship based on friendship or kinship. Actors know each other due to common experiences or feel closely committed to each other. The existing level of trust supports interaction and thus innovation processes.
- Organizational proximity is defined as „[...] the extent to which relations are shared in an organizational arrangement, either within an organization, or between organizations“ [24]. Between firms, organizational proximity exists for example when they belong to the same group. It can also be created through the establishment of networks or joint ventures.
- Cognitive proximity supports the knowledge exchange. Actors share the same or a similar knowledge base and possess the absorptive capacity to make use of the transferred knowledge.

A particular dimension of proximity is enabled by ICT: it allows a real-time communication between opposite parts of the world and the creation of virtual proximity between actors with access to the ICT-systems [20, 24].

All the mentioned dimensions of proximity fulfill a very important function: they reduce uncertainty. This is particularly important for innovation processes. Asheim and Gertler [25] claim that the increasing knowledge intensification of the economy causes a stronger spatial agglomeration of innovation activities. They quote two reasons for this process. One reason is that tacit knowledge is tied to individuals. Its mobility therefore is limited. The transfer of tacit knowledge makes face-to-face-meetings necessary [20]. As explicit knowledge is available nearly all over the world, the production and utilization of tacit knowledge makes the difference. Their second point is the escalating complexity of innovation processes: Firms need the interaction with the environment. They integrate customers, suppliers, universities or research institutes directly into the innovation process. They observe what competitors are doing or retrieve considerable news from local communication flows. Therefore, the co-location to strategic actors becomes a key factor in the innovation process. The impact of spatial proximity is even higher when it is complemented by institutional or social proximity. An in-depth discussion of the interrelation between innovation, knowledge and dimensions of proximity is discussed in the concept of regional innovation systems [26, 27].

The peculiarities of organizational innovations (multidimensionality, complexity and idiosyncrasy) lead one to assume that the need for tacit knowledge is higher than that of codified knowledge. The transfer of tacit knowledge happens in face-to-face interactions. This suggests that spatial proximity between the knowledge seeker and the knowledge provider facilitates the innovation process. The other mentioned dimensions of proximity – that's the assumption – can contribute to the establishment of trustful relationships with external knowledge providers.

2.4 Stages of the innovation process on firm level

In this paper, the implementation of an organizational innovation from the first idea until the final realization is analyzed on a firm level. It has already been discussed that organizational innovations have to be adapted to the specific characteristics of a firm. The innovation process therefore is a unique incidence each time.

The innovation process of products or services has often been modeled in the innovation management literature. There is no lack of stage models for product or service engineering processes. What is missing is a stage model for organizational innovations based on empirical evidence. In the following discussion, we use a model which was created to explain the diffusion of new ideas [28].

The adoption process of new ideas formulated by Rogers resembles the implementation process of organizational innovations. Rogers tends to describe the implementation of a new idea in a social group and divides the whole process into five stages which built upon each other (Fig. 1.). The first two stages form the initiation of the innovation process, the last three the implementation process in a narrower sense.

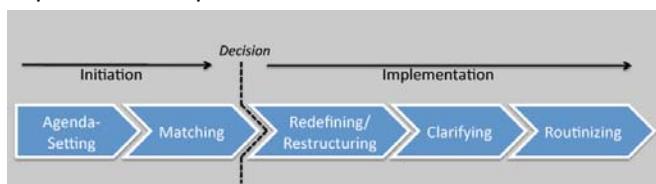


Figure 1. Rogers' model of the innovation and adoption process in organizations

- The initiation process starts with the first stage – the agenda-setting. A problem in an organization is identified and reveals a need for a new solution. The search for an innovation in the environment of the organization starts.
- In the stage of matching, it is analyzed whether the selected innovations fit the requirements for getting the identified problem solved. If not, the search has to be replicated. If the answer is yes, the innovation process enters the implementation phase.
- This phase starts with the stage of redefining/restructuring. The innovation becomes adapted to the specific context of the firm. Existing organizational structures are modified to correspond with the needs of the innovation. The mutual adaption is necessary, as an innovation rarely can be integrated into existing structures.
- In the stage of clarifying, the innovation becomes anchored in stable structures and processes. It becomes clear which units of the organization are affected and which responsibilities have to be changed.
- In the concluding stage of routinizing, the innovation has become an integral part of the activities and structure of the organization. Organization and innovation have merged to a unit.

The model does not explicitly refer to organizational innovations. But due to a lack of alternatives, we use it as a starting point to analyze how mass customization as an organizational innovation is implemented in firms. Rogers does not refer to the role of external knowledge, but it is easily imaginable that codified knowledge plays a more important role in the stages of agenda setting and matching. After these stages, tacit knowledge probably plays the dominant role, as experiences and creativity are necessary to adapt the innovation to the context of the firm.

2.5 Mass customization

Mass customization [9, 29, 30] can be treated as organizational innovation. A firm moving from mass production or from customer-ordered individual production to mass customization changes its strategy. It is obvious that this implies new processes in the production and in other departments of the firm too.

The main reasons for treating mass customization as an organizational innovation are:

- The already mentioned strategic change.
- The implementation of a mass customization strategy requires new methods and procedures and probably a new organizational structure too.
- In addition, all or nearly all of the divisions of a firm are affected as well as the interaction with customers and suppliers.
- The concept requires a modified business culture, which has to be incorporated by the employees of the mass customizer.

Mass customization is a strategy which links advantages of standardization with advantages of customized production. For this reason, the strategy is a powerful tool for firms to handle turbulent market conditions [31]. Mass Customizers come up against individual preferences with a flexible offer on products and/or services and thus are well prepared to meet the ideal point of a customer, which means the product he really wants. In ideal-point models, the assumption is that at the ideal point a consumer's preference is at its maximum. The preference depends on combinations of characteristics of a product [32].

The customization of a product or service happens before its production: in a process of interaction – that is often carried out via ICT – the customer expresses his preferences. „The foundation of the value-added process is an interactive co-design process in which producer and user agree on the individual solution“ [32, own translation]. From a given range of options, the user selects the combination of options which comes as close as possible to his ideal point by means of a configuration system.

Beneath the customer integration in the co-design process Reichwald and Piller [32] identify three additional guiding principles of mass customization:

1. The direct interaction with the customer enables the producer to adapt the size, functionality or design of his product with consumers' preferences: the firm gains a differentiation advantage over its competitors [32].

2. Despite the creation of individual products – which customers usually honor by paying higher prices - a mass customizer can achieve cost advantages compared to a mass producer. The access to user knowledge enables economies of integration and the high customer loyalty economies of relationship [33]. At the same time, a modular product or service architecture facilitates the utilization of economies of scale. Elements which are part of all product alternatives are produced on a large scale. The individual product is then created through a combination of neutral and individual product elements [34].
3. The realization of the principles mentioned above requires a solution space with stable product and process architectures. These restrict the options of individualization. But at the same time they reduce complexity and make it manageable [35].

The moment of user-integration makes different forms of mass customization distinguishable. This paper focuses on the so-called hard customization: the customization happens already during the production or assembling of products. This implies an interaction between producer and customer before the start of the final assembly [32].

The case studies listed in the Internet or published in the literature suggest that mass customization is basically a strategy of the consumer goods industry. In recent years, it has gained importance in the food industry, the cosmetics industry, and the pharmaceutical industry [36]. It seems to be less prevalent in the capital goods industry. However, Mäkipää et al. [37] in a study of the capital goods industry in Finland brought to light that many firms implement the whole strategy or parts of it without using the notion or without being aware of implementing a mass customization strategy.

It is assumed that the number of German producers of capital goods which follow a mass customization strategy is limited. This is an advantage for empirical studies of this kind: mass customizer of the capital goods industry can be regarded as so-called early birds – innovative firms of an industrial sector which implement innovations before their competitors and therefore take on a pioneering role. Such pilot projects are highly unpredictable and the success is insecure. But they offer opportunities to study the establishment of a new competitive strategy and the interaction of the early birds with their environment.

3. METHODOLOGY

Based on the conceptual considerations mentioned above, the implementation process of mass customization has been analyzed in three firms of the capital goods industry. At the time of analysis, they had already changed their strategy towards mass customization.

To do the analysis via case studies seemed to be the right way for the questions we wanted to answer. Case studies render it possible to compare the abstract and complex theoretical construct of ideas and thoughts

with the reality. As qualitative research method case studies facilitate in-depth insights into complex cause-effect relationships. They help the researcher to differentiate and modify theoretical concepts and can be a foundation for the inductive generation of theories.

For the analysis of the case studies the research approach of innovation biographies was chosen. It permits to expose the sequence of the innovation process, to identify the knowledge flows and to map the relevant actors of the innovation process.

The approach of innovation biographies is more than a method. It is a quite open and innovative approach with the target of the “[...] assessment of an innovation process from its beginning until the implementation by the use of interviews with focal persons of the innovation process” [38, own translation]. They prove especially appropriate to disclose relationship networks and interaction patterns.

Usually a certain innovation as object of investigation is selected at the beginning. Then the search for and selection of qualified dialog partners is started and the interviews are prepared. In a second step interviews are conducted with persons who played a significant role in the innovation process. The aim is to uncover the actors' network which supported the innovation process. Further interviews are conducted with network actors and the results for example illustrated in so called knowledge maps.

This scheme has also been used for the empirical proceeding of this paper. Mass customization as an innovation process which was to be analyzed was the starting point. Then a first step was to select three mass customizing firms. After that, problem-focused guided interviews [39, 40] have been conducted with executives of the three focal firms to identify the respective innovation network. In a next step guided interviews have been conducted with those actors that cooperated with the focal firm during the innovation process. Through this proceeding, detailed insights into the innovation processes of the three firms have been gained.

The three firms have been selected to make a theoretical sampling possible [41, 42]: specific cases are studied to find answers to particular questions and/or to close research gaps. To meet the research target of this paper, focal firms had to have a mass customization strategy implemented respectively to be on advanced stage of implementation and to be producing firms of the capital goods industry.

4. EMPIRICAL RESULTS

The diversity between the selected firms regarding size or corporate structure was intended to meet the criteria of theoretical sampling:

- Firm 1 is an independent SME specialized in the development and fabrication of casing, vehicle bodies and cabins as well as all sorts of metal components. The firm evolved a few years ago from the merging of a manufacturing shop and a R&D development company. It has several

production sites and a development center. The idea to introduce mass customization in an experimental and limited way came into being after the merging. Today, customers can use a web shop to order configured metal components: material, size, profile, bendings, drill-holes or millings depend on individual specifications.

- Firm 2 is a SME too but a subsidiary of a company from the US and as such part of a group. Firm 2 develops and assembles products for measurement and control. In addition, it offers product-related services. The products are sold via own selling agencies and accredited partners. A mass customization strategy has been followed for more than ten years already. The customers can use a pre-given solution space to configure via internet their individual products regarding for example the position of reading points or metering range. The order must be placed at a selling agency or an accredited partner.
- Firm 3 is a large-scale enterprise with two business segments. The case study refers to the segment of development and manufacturing of automation technology. The firm has started around twenty years ago to reorganize its production system toward a more customized and flexible production. For some products a mass customization strategy has been implemented. These products can be configured and ordered via internet.

The empirical results are presented in an order to answer four central questions. They have resulted from the theoretical framework. The results are presented in a summarized form for the three case studies. Nevertheless, to illustrate the results, we fall back for example on descriptions of decision processes or circumstances in the single firms.

The four central questions are:

- Which stages does the innovation process of mass customization exhibit in the firms?
- Which firm-internal and -external knowledge was needed for the innovation process in the firms?
- Which firm-internal and -external actors played significant roles in the innovation process?
- How important are different forms of proximity in the innovation process of mass customization?

4.1 Stages of the innovation process

The case studies provide evidence that the innovation processes of mass customization proceed very heterogeneously and have to be adapted to firm specifics. In addition, the case studies show that the innovation process in general can be segmented into stages which seem to be characteristic for the introduction of mass customization in firms of the capital goods industry. Figure 2 delineates a typical sequence of the innovation process. In reality, the stages cannot always be strictly separated as sometimes they overlap, run parallel, or are interwoven through close feedback loops.

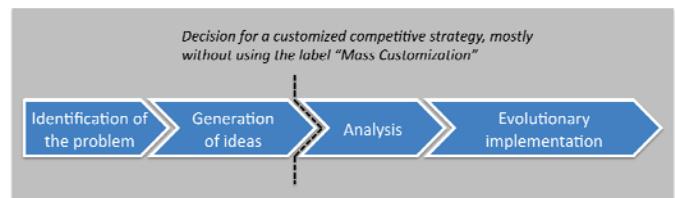


Figure 2. Typical sequence of the mass customization innovation process (own illustration)

At the beginning of each of the examined innovation processes a problem was detected. In one case the general strategy was called into question due to expected market changes. Sometimes the problems result directly from developments in the course of daily routine, which require changes. In one of the firms, for example, many of the employees asked for specific components for applications at home. Their fabrication was not really regulated. In the first instance, the firm tried to solve the problem with a special bargain: each worker was allowed to produce the components needed for a low service charge. But the project proved to be too successful and disturbed the business processes as it became too big. The consequence was the idea of a mass customization-project: „Our thought was – given the demand shown by our employees – that each do-it-yourselfer needs individually configured components.“ (General Manager Firm 1; own translation).

The problem-identification-stage was followed in all of the firms by a stage in which the generation of ideas became the central task: solutions for the identified deficits are sought. At the end of this stage a decision has to be taken: in the three focal firms it was the decision to implement mass customization. But, one has to say, the term or the concept 'mass customization' are seldom the crucial factors for the decision. We return to this fact later. Often own labels are used for the innovation. Or, alternatively, elements of a mass customization-strategy are accentuated. In the mentioned case the solution was a web shop.

The third stage, which was derived from the empirical data, is the stage of analysis. The firms have to decide what they want to target with the new strategy. Do they want to establish a new business field? Is the aim an improved productivity? Or is the main target to reduce complexity? The analysis therefore can differ: one firm analyzed the market potential for customized components, the second one examined the existing products to find out which of them are sold so often that a modularization becomes profitable. The third firm analyzed the production system to improve its efficiency.

The last stage is that of implementation. But as mass customization consists of different elements and has to be adapted to each firm individually the implementation stage has to be viewed as open-ended. Often the firms start with one partial innovation and thus – as some partial solutions build upon others – lay the bed for a path dependent development. After having implemented one partial innovation they can select between different options for the further development. In addition, processes are continually improved and the

strategy becomes more elaborated. Therefore, the stage which often takes many years can be seen as evolutional implementation.

Firm 2 for example started the implementation step-by-step: The product lines became integrated one after another in the mass customization-system. A path dependency arose as partial solutions were tested in a trial and error-process. The successful ones affected the re-design of products as well as that of processes. The modular product architecture and the targeted streamlining of production processes for example required other partial solutions like Kanban or consignment warehouses. Besides, today nearly all products are assembled in manufacturing cells. The implementation process of mass customization is still continuing.

4.2 The required knowledge

For the implementation of mass customization specific knowledge is required. It has to be existent either within the company or acquired externally. The second question, which was to be answered, referred to the nature of the necessary knowledge. As expected, know-how with a strong implicit character is of great importance, but on a different way than first thought. Remarkably, it is not know-how that refers specifically to the concept of mass customization. Consulting services which support the implementation of mass customization respectively supply knowledge to theoretical and practical aspects of the concept were almost not demanded. Only in one case a scientist was integrated to contribute with theoretical and practical know-how on mass customization.

The lack of specialized consulting services can have different reasons. The talks with the responsible actors in the companies made clear, that consultancies or Research and Technology Organizations (RTOs), which offer specific knowledge for the introduction of a mass customization strategy, hardly exist. But the main problem is that the demand for such consultancy services is weak due to an unawareness of the existence of the scientifically already well documented strategy and its contents. The label "mass customization" played in the case studies only a subordinate role and was not used at all or only at a later stage of the innovation process. Only in retrospect – through coincidence or the fact, that their new strategy became recognized by the scientific community – the firms caught that they follow a mass customization-strategy. Therefore a targeted search for the mass customization-know-how does not take place. The term seems not yet established at company level.

The conclusion made above does not mean that there is no demand at all for know-how: know how is crucial for the implementation of partial innovations. The three examined firms required assistance for following issues:

- programming of the configuration system and construction of the web shop,
- establishment of compatibility regarding the IT-solutions and integration of processes,
- organization of production and logistics,

- product development and construction (esp. platform-architecture and modularization),
- distribution and marketing.

The following description of the technical challenges in one investigated firm shows, which importance know-how can have for the technical implementation: the challenges consisted in the provision and modification of a frontend (web shop), the adjustment of the interface to the existing ERP-system, and the programming of a calculator and a configuration system (both based on CAD). Configuration system and calculator themselves had in turn to be linked with the web shop and the ERP-system.

The acquisition of knowledge needed for these areas either takes place internally or through an exchange of knowledge with external actors. This leads to the answer of the third central question.

4.3 Focal actors regarding the innovation process and knowledge flows

Some of the divisions of the examined companies took up a leading role in the innovation process. In the first two stages these have been the strategic management as well as the sales and distribution division. Once the decision for the introduction of mass customization is fallen, further decisions regarding the character of implementation had to be made: how should the user-integration look like? Which divisions will be affected? Which products should be modularized? In one of the companies the management decided to found a spin-off for experimenting with the new strategy. In the other two firms all divisions were affected by the organizational innovation.

Firm-internal knowledge-providers were in particular the divisions:

- product development / engineering,
- IT,
- production,
- sales and distribution, and
- marketing.

In all three firms knowledge had been created in the interplay between the divisions. At the same time, the firms acquired external knowledge. Regarding the external knowledge sources, the examination of the three case studies shows no uniform picture. In the first case study especially Knowledge-Intensive Business Services (KIBS) supported the innovation process. They provided essentially technical consulting services (see figure 3). The challenges in this firm have been mentioned above.

In the second case study, mainly other firms from the same group were involved in the knowledge exchange (see figure 4). The parent company supplied proposals and guidelines during all of the stages. Decisive roles in the contribution of knowledge to the partial innovations – especially the organization of production and logistics – played the sister company from the US and various group companies from Germany too. Specialists of these companies supported the implementation process – notably the establishment

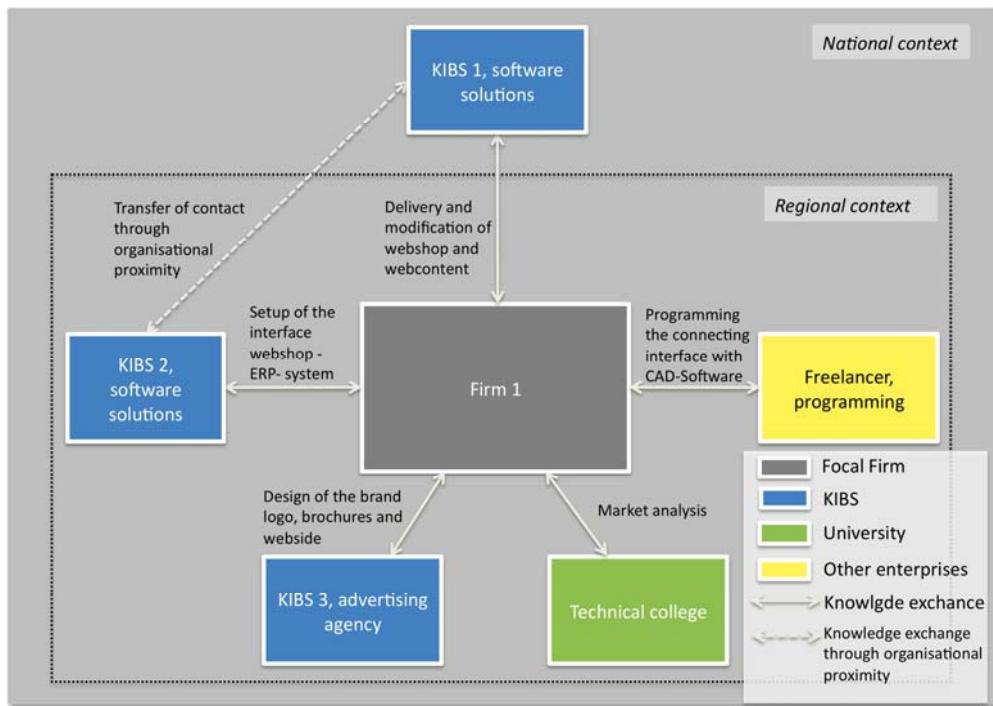


Figure 3. Case study 1 - external actors in the innovation process (own illustration)

of manufacturing cells – during many visits of several days' duration.

In the third case study, the knowledge providers were a technical consultancy, a further industrial company and a scientist from a university.

The heterogeneous results suggest that it depends especially on the size and the organizational embedding of the firms, in what frequency, how

intensively and through what channels the firms integrate external actors into the innovation process. Big companies are seemingly less dependent on the acquisition of external knowledge as SMEs when they want to introduce a mass customization-strategy. Firms, which are embedded in a group of companies, prefer apparently to use the knowledge provided within the group.

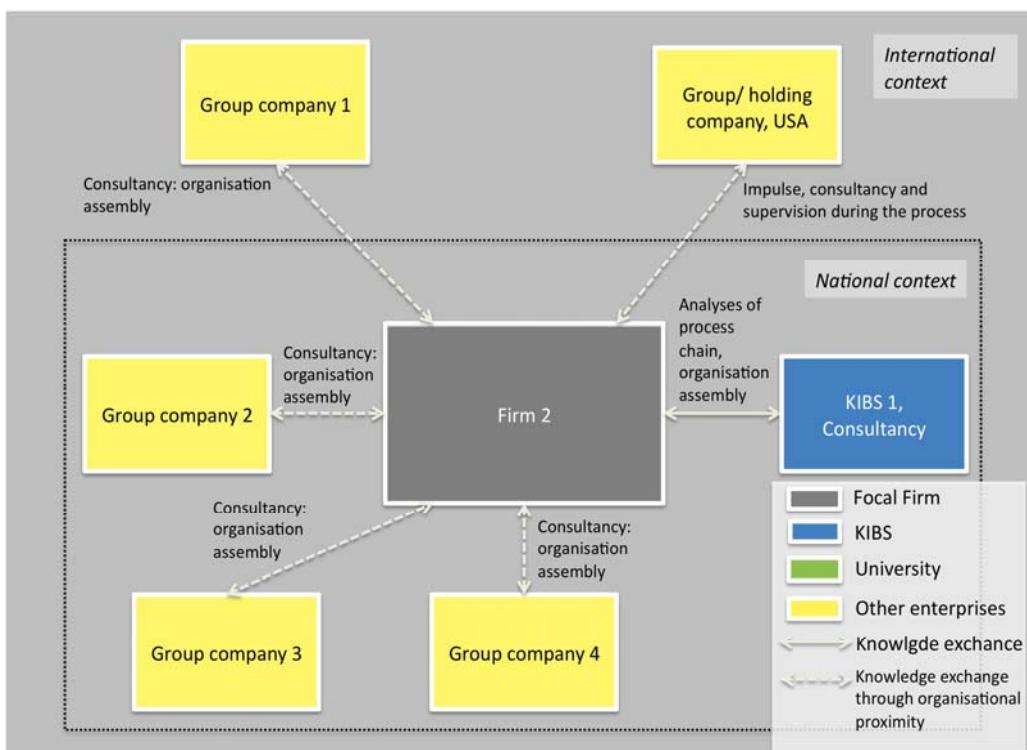


Figure 4. Case study 2 - external actors in the innovation process (own illustration)

4.4 Dimensions of proximity in the innovation process

The case studies show, that – regarding the selection of external actors – different forms of proximity between the knowledge seeker and the knowledge provider play important roles. To some extent they mutually determine or replace each other. Proximity, whether social or organizational, helps to reduce uncertainty and the cost of retrieving information within the innovation process.

The first case study shows that there must be a special relationship between spatial and social proximity. Spatial proximity seems to support the establishment of social proximity.

The second case study exposed other insights: the knowledge providers are spread around Germany, some are even located in the US. Therefore, there is no geographical proximity between them. The case study shows, however, that organizational proximity can take over a similar role as social proximity as it also supports the reduction of uncertainty and information costs in the innovation process. In this case, organizational proximity was crucial for the search and selection of knowledge providers. Geographical proximity also played a role in the implementation process: it was temporarily created when experts visited the focal firm to integrate their knowledge in the innovation process. Therefore, face-to-face-contacts seem to be crucial in the innovation process of mass customization.

In the third case study only a few external actors have been identified. But the case study also reveals a spatial proximity between them. This stresses the importance of face-to-face-contacts for the innovation process.

One can summarize, that spatial proximity is an important factor in the innovation process of mass customization since it eases the exchange of tacit knowledge. This is particularly relevant in the implementation of the partial innovations, in which the firms mainly depend on external know-how. Organizational, social and cognitive proximity facilitate the search for knowledge providers and the interaction with them. Costs and uncertainty may thus be greatly reduced.

5. CONCLUSION: SOME HYPOTHESES CONCERNING THE INNOVATION PROCESS OF MASS CUSTOMIZATION

After the presentation of the empirical findings, it is possible to generate some hypotheses regarding the innovation process of mass customization. We view them as starting points for future studies based on quantitative methodologies.

The three case studies show that mass customization strategies can occur in many different forms. Mass customization as an organizational innovation is implemented in a firm-specific manner. In two cases, for example, nearly all divisions of the company were affected by the organizational innovation. In the third

case, the mass customization project had an experimental character and was limited to a small part of the firm and its products.

Closely linked to this heterogeneity of scope is the fact that mass customization strategies can exhibit different dimensions: in two firms the implementation caused strong changes in the general strategy, the organizational structure and in social aspects. In one case, only structural changes occurred. The introduction of mass customization did not affect the overall strategy or the habits of the employees.

Beside the mentioned dissimilarities, the case studies show contrasts in the implementation of mass customization. The partial innovations which can come along with mass customization, such as modularization, configuration systems or new manufacturing concepts, were handled in a firm-specific way: the mixture in each case was adapted to the special situation and needs.

Regarding the heterogeneous occurrence of mass customization strategies, it is obvious that the innovation processes take place in a firm-specific manner too. Nevertheless, it was possible to extract a typical stage model of the implementation process of mass customization with four stages. In the last stage, the mass customization strategy is matched to the individual context of the enterprise. This fact can be transferred into a hypothesis towards the innovation process of mass customization:

- Hypothesis 1: The innovation process of Mass Customization proceeds in the four stages "identification of the problem", "generation of ideas", "analysis" and "evolutionary implementation".

Furthermore, the empirical findings show that the term "mass customization" is not widely spread in the economy. The firms seem to use it only when their knowledge about the concept has reached an advanced level. This fact leads to a second hypothesis:

- Hypothesis 2: In the implementation process of mass customization, the label "mass customization" is only used in advanced stages of implementation. In earlier stages, firms use other terms for the changes. Therefore, the demand for mass customization know-how is low.

As already mentioned, the innovation process of mass customization is matched to the individual context of the firm. Firms choose those elements of mass customization and implement them which meet their needs and implement them. These might be technological innovations (for example modular architecture of products, configuration systems and web shops) or organizational innovations, such as new manufacturing strategies or logistic concepts. This finding can be summed up in a third hypothesis:

- Hypothesis 3: The implementation of mass customization entails a plurality of technological and non-technological partial innovations mainly in the divisions IT, sales, marketing, product development and production.

For the implementation of the partial innovations, external knowledge is very important, in particular when specific expert knowledge is necessary. In general small enterprises rely more on external knowledge than big companies. These normally possess their own R&D, IT or marketing departments which develop and implement the necessary partial innovations on their own. Small firms often have to acquire this fundamental knowledge from external actors. If firms are part of a group of companies, they can benefit from knowledge which exists in the group. These circumstances lead to another hypothesis:

- Hypothesis 4: Small firms rely more on external knowledge than bigger ones. If firms are part of a group of companies, they prefer to use group-internal knowledge sources.

If there is a need for external knowledge, firms have to decide where and how to purchase it. As deduced theoretically in the second part of this paper, different modes of proximity play important roles in this context. Proximity helps to reduce uncertainty. Face-to-face contacts – which are facilitated by geographical proximity – are particularly important in the interactive knowledge-exchange-process. In addition the empirical findings show that both organizational and social proximity are conducive for the innovation process, as they reduce costs and uncertainty in the processes of information seeking and knowledge exchange. Often social and organizational proximity go along with spatial proximity. Where geographical proximity does not exist it is established temporarily:

- Hypothesis 5: In the innovation process of mass customization, organizational and social proximity simplify the exchange of implicit knowledge. Thus, uncertainty and costs can be reduced. Geographical proximity is important for face-to-face contacts. If non-existent, geographical proximity will be established temporarily.

One can conclude that this study has elucidated many characteristics and problems which the implementation process of mass customization entails. One of them is the fact that the label Mass Customization is not well-established in the industrial community yet. In future, great efforts will have to be made to advertise the label and to spread the supply of mass customization know-how. Concerning the supply, it is a challenge for intermediate organizations, such as RTOs or Knowledge Intensive Business Services (KIBS), to support the diffusion and implementation of the concept. In comparison to universities for example, these organizations are predestined for consulting and project management in the implementation process of mass customization. Thus, they could improve the innovation process by creating and diffusing their own knowledge.

In general, there is a need for greater efforts of economic, political and scientific actors to support the diffusion of mass customization as an important competition strategy of the future.

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