Ten tools for customer-driven product development in industrial companies

Hannu Kärkkäinen*, Petteri Piippo, Markku Tuominen

Abstract

Need assessment is a critical success factor of product and business development in all companies. In this paper we present 10 tools for customer-driven product and business development for companies producing industrial products. The tools help to clarify the needs and objectives of customers and to ensure that customer needs are considered when making development decisions in the different phases of product development. These tools were developed in a two-year project with small and medium-sized companies. In our paper we describe important requirements for the development of the tool set, give a short description of the tools and their usability, and introduce different practical ways to support the selection of tools. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Product development; Innovation management; Need assessment tools; Customer orientation; Industrial products

1. Introduction

Successful product development demands profound knowledge of customers and their needs. In this paper we present a set of 10 tools for customer-driven product and business development for companies producing industrial products. The developed tools help to assess customer’s needs and competitive situation, to determine targets for product concepts, and to manage the different phases of product development ensuring the competitiveness of planned product concepts. By product development we mean here all the concrete development and management activities to accomplish new or improved products. The emphasis of our paper is in the management of the early phases of product development.

Many companies wish or claim to be customer oriented. Customer-driven product development is, however, a demanding and difficult task. The voice of the customer should be taken into account in all the phases of product development, both in definition and design phases [1]. Therefore, customer-driven product development requires proper customer need assessment, which has been tailored for this purpose.

Need assessment for product development is a systematic activity of gathering and clarifying customer needs, determining product characteristics based on the clarified needs and ensuring that all the important needs will be fulfilled. The links between need assessment and product assessment are crucial.
development are analyzed in more detail in Section 2.

Need assessment is a critical success factor of product and business development [2–6]. In industrial markets suppliers can have a significant impact on their customers’ performance. Customers require increasingly more benefits and an active role from their suppliers. For these reasons, suppliers cannot be content to do no more than what customers demand in their orders, but they must also carefully assess their customers’ present and future needs. Increasingly, intensive international competition emphasizes the importance of careful customer need assessment.

Especially in manufacturing industries companies can form long business chains. A business chain consists of all the companies from which parts, machines and services needed for the final products are delivered, including also customer’s and company’s important stakeholders, the opinions and requirements of which may affect the development of a product. In this paper, we generally use the word ‘company’ to refer to an industrial organization that develops and supplies products for its customers.

Customers’ needs as well as the competitive situation and the company’s goals must be clarified in the very early phases of product development. In this way, the product development can be productive and make the greatest possible contribution for the whole company. Careful, systematic need assessment helps to focus development efforts and reduce the need for future design changes. Based on the results of careful need assessment, product development can produce more competitive products that fulfill important customer needs better than competitors or provide totally new benefits for customers.

In spite of the importance of need assessment for product development, need assessment is often implemented in an unsystematic and unorganized way in companies producing industrial products. This is partly a consequence of a lack of proper tools and lack of information about using them. According to Holt et al. [4] methods for need assessment are poorly developed compared to more technical tools for product design. Need assessment in industrial markets is carried out utilizing mainly existing relations with customers during every day contacts [4]. Free-form discussions are one of the most common ways to assess customer needs in industrial companies. Some companies, however, use guidelines and outlines to make such discussion more effective. Pilot projects with customers are also an important way to analyze customers’ needs for industrial products. Still, there is a strong need for systematic need assessment methods in the product development of industrial companies.

Many commonly used need assessment methods have originated from statistics and market research. Urban and Hauser [7] describe how different market research methods can be utilized in product development. In many cases, traditional market research does not provide sufficient understanding of user needs for industrial product development [4]. Many traditional market research methods are more aimed for marketing and consumer products than product development of industrial products and they are not so suitable, as such, for industrial product need assessment.

The purpose of this paper is to introduce need assessment tools developed particularly for companies producing industrial products. Our set of tools was developed with small and medium-sized companies producing industrial products in a two-year Technology Development Center Finland (TEKES) funded project between 1993 and 1995. The goal was to develop a set of easy-to-use tools, considering the characteristics of industrial product development and important need assessment-related problems of industrial companies, to help companies to clarify customers’ needs for product development and to manage product development ensuring that development efforts aim at fulfilling these needs. The set of tools was aimed to increase the effectiveness of product development and promote the co-operation between companies and their customers.

Useful methods for need assessment and product planning were screened from the literature and both Finnish and foreign companies as well as universities. Potential methods were tested and evaluated. The selected methods were tested further developed to better support customer-driven product development in industrial companies. The result
was a set of practical tools. The set of tools was described in a Finnish language manual [8].

In this paper we present the developed set of tools, give a short description of the tools and their usability, and introduce different practical ways to support the selection of right tools. In Section 2 we review earlier need assessment and customer-driven product development research and describe a developed need assessment process. In Sections 3 and 4 we analyze the characteristics of need assessment for developing industrial products and determine requirements for need assessment tools. Section 5 describes the developed set of tools and individual tools. Section 6 gives advice for the selection of tools and Section 7 describes our findings on the benefits and limitations of the tools.

2. Customer-driven product development and need assessment

There are many links between need assessment and product development. According to Holt et al. [4] (some of the need assessment pioneers in Europe), the starting point for product development, an innovative idea, originates from the fusion between customers’ needs and technological possibilities. Muramatsu et al. [9] have analyzed need assessment and information behavior in product development based on the Holt’s fusion model and further developed it. People in different departments of a company emphasize different factors in product development. The R&D department emphasizes design reviews and quality assurance and they tend to give priority to technological problem solving [9]. People in marketing and sales are quite often very interested in short-term customer satisfaction and do not give adequate attention to technical product characteristics. Tuominen et al. [10] have used the fusion model to study innovation management systems in Finnish and Japanese companies. According to this study there should be a clearly stated customer need assessment phase or task as well as a fusion task in the innovation management process to accomplish good fusion between customers’ needs and technology.

According to Muramatsu et al. [9] customer need assessment is a series of procedures and methods to perceive, estimate, and adopt the customers’ needs to determine product characteristics. They propose a model with four fusion processes between marketing, merchandising, technical, and manufacturing characteristics.

Links between product development and need assessment can be studied analytically when we examine both as a process. Customer need assessment is a systematic process, which gives the means to clarify customers’ needs and to ensure that the whole company works for satisfying the identified needs. The purpose of the customer need assessment process is to ensure that customer needs direct all the stages of product development. For example, Holt et al. [4] have developed a model for need assessment process including five phases. Their process covers phases from need identification up to updating and revising the determined needs.

We have divided need assessment into six phases shown on the left side of Fig. 1. Our need
assessment process was developed on the basis of our companies’ practical requirements of clearness and easiness. The process starts by defining the starting situation of a company and the goals of the need assessment. This is essential in order to be able to choose the right tools and the right extent for the need assessment activities. Then the customer needs data is gathered from different sources. Since this data is seldom very precise and in a clear form, it must be structured illustratively and analyzed. Besides mere customer data, also data concerning the competitive situation must be gathered. All this information enables the company to define development targets for product concepts and attributes. The targets must be coherent with the company’s own objectives and strategies. Finally, product development must be managed to achieve the defined targets.

Many researchers [7, 11–14] have proposed models with 5–10 phases for product development. To illustrate the links between product development and need assessment we have utilized a simple product development model based on Jaakkola’s and Tunkelo’s model with five actual development phases. This process is described on the right side in Fig. 1. Also the planning phase of product development strategies (in the strategic planning box) can be seen as a part of the product development process. In a broad sense, both the product development and need assessment processes can be seen as a part of product development.

For need assessment to be successful one must take into consideration its links to product development and strategic planning. Only then can need assessment be useful to the whole company. Fig. 1 describes these important links. The strategic planning process and its results should direct the implementation of both product development and customer need assessment. On the other hand, the possibilities and challenges observed during product development and customer need assessment have to be taken into consideration also in strategic planning.

The specific goals for product development projects are set on the basis of the strategies. Important matters in the goal setting of the product development projects to be taken into account are time schedule, available resources and extent of developmental activities. The goals of product development also define the starting situation of the customer need assessment and form a basis for the project. Strategic planning is thus very important, but it is not automatically paid attention to. If clear goals are not known before starting the customer need assessment and product development, there is a danger of performing wrong activities. All the people involved in the development activities have to understand the goals clearly and similarly and to keep them in mind during the whole development process.

Customer need assessment and product development are tightly connected. There has to be continuous and direct interaction between the activities of both areas and between the people who implement the activities. Need assessment provides information about the customer needs, which is used in implementing the product development.

The emphasis of the customer need assessment activities should be in the beginning of the product development process in order to be able to concentrate on the essential matters in the actual product development from the very beginning. The results achieved in the need assessment may result in launching totally new product development projects.

Important goals for development projects can be chosen and the concrete development targets can be defined based on the information gained in need assessment. The targets set by the customers and the competitive situation should direct the concept planning and evaluation, and the selection of the concepts should be carried out systematically based on the information produced in the customer need assessment. With the help of customer need assessment, the results of product development can be thoroughly evaluated in the different stages of the process and also the success of the developed product can be predicted. After the product has been launched into the market, customer need assessment is also needed to get out information about customer satisfaction and further development needs. Continuous follow-up of achieving the targets has to be performed when the product is already in the market in order to able to improve and develop the product immediately.
For product development to get right and unbiased information about customer needs as fast as possible, the customer need assessment and the product development have to be parallel processes. If the processes are carried out at the same time and in connection to each other, there is less danger for the information concerning customer needs to get lost and data acquisition can be directed to serve the product development activities better.

The best way of ensuring a fast connection between the customer need assessment and product development and the usefulness of the results achieved in the need assessment is to carry out the customer need assessment in a group. The groups should consist of the representatives from different functions of the company and the customer that participate in the definition of new products, develop the products, or are affected by them.

3. **Customer-driven development of industrial products**

Need assessment is a vital activity for both industrial and consumer product development. In both, customer needs, requirements, attitudes, values and expectations must be clarified profoundly and properly. The success of a company that produces industrial products is affected by the well-being of the whole business chain that the company is part of. For this reason, one of the most important goals of the company and its product development is to help its customers to increase their performance. For this task, the company needs profound knowledge of its customers' needs and business environment and tools to get this information.

In industrial markets there are often business chains consisting of complex chains or networks of subsequent customers, customers' customers, suppliers and other stakeholders. The opinions and needs of these should be carefully analyzed when carrying out customer need assessment and making product development decisions. This can offer a competitive edge when offering need-based solutions to customers. Companies are frequently expected to customize their products to an individual customer's needs. They should not remain passive but try to study possibilities to suggest new solutions based on customer needs.

In order to be able to help their customers and get profound knowledge of customer needs industrial companies need to be in close co-operation with their customers. Need information should be acquired from several persons and functions of the customer. In industrial markets many different persons, often from different functions of the purchasing company participate in the buying process and define the requirements for the product to be purchased [15]. Because of the complexity of the industrial products (see e.g. [16]), product development should have direct connections with customers and participate closely in need assessment.

Because of the different characteristics of industrial and consumer markets, the means for need assessment differ and there are different requirements for need assessment tools in the two markets. Many traditional market research methods have been originally developed for consumer markets and they are not, as such, very useful in industrial markets. Below, we will describe why there is a need to further develop need assessment tools for industrial markets.

Industrial customers produce their own products with the help of purchased products or use these products as parts of their own products, which are offered forward. According to Kotler [15] the industrial markets consist of all the individuals and organizations that acquire goods and services to be used in the production of other products or services that are sold, rented or supplied to others. Industrial customers have several characteristics that differ significantly from consumer customers' characteristics. Kotler [15] presents the following typical characteristics of industrial markets:

- fewer buyers,
- larger buyers,
- several buying influences,
- professional purchasing,
- close supplier–customer relationship.

In industrial markets there are normally fewer customers compared to consumer markets. Also the industrial products and product development differ from consumer products. According to a recent
study by Griffin [16], industrial products are generally more complex than consumer products and their development time is significantly longer.

Because the markets, the products and product development have significant differences in industrial and consumer sectors, it seems fair to think that also customer need assessment activities should take these differences into account. Still, it is by no means rare that industrial companies use customer need assessment methods which have been designed especially for consumer market need assessment and are not very well-suited for industrial need assessment. For instance, because the number of customers is small and the products and product requirements are complex, statistical methods are not always very suitable for the clarification and thorough understanding of customer needs in industrial markets.

Harari [17] has analyzed the problems of traditional market research and its methods. Many of these problems are related to producing useful information for product development. Traditional market research mainly produces information of present situation and it does not promote co-operation with a company and its customers effectively. To be useful for need assessment in industrial business chains the tools should especially be able to promote co-operation between a company and its customers effectively. For instance, because the markets, the products and product development processes are complex, statistical methods are not always very suitable for the clarification and thorough understanding of customer needs in industrial markets.

According to research conducted by Griffin [16] the best succeeding companies use significantly more qualitative market research tools than the rest for product development. Business-to-business companies use more tools (customer visits, beta site tests), that produce qualitative data than consumer companies. Also Mahajan and Wind [18] have studied the use of new product development, especially need assessment methods in the biggest US Fortune 500 firms. Twenty-four different models and methods were cited by respondents from a sample of 338 respondents from 200 Fortune 500 firms [18]. According to their survey, Focus groups was by far the most often used method in product development (68%), Limited rollout the second (42%) and Concept test the third (26%). Conjoint analysis was the sixth (15%) most cited method and Quality Function Deployment eight (9%) most cited method [18]. The major shortcomings of the tools mentioned by respondents were the long implementation time (for example QFD and Limited rollouts) and the incapability of tools to capture the complexity of markets (for example conjoint analysis and focus groups). About 36% of the respondents suggested that new product development process could further benefit from more formal approaches.

Prior to the development of our need assessment tool set, we interviewed more than 10 successful Finnish companies producing industrial products (see [8,19]) screening common need assessment problems, which included for instance too few contacts between the company and the customer, and difficulties in communicating customer information within the company (see Table 3). According to our interviews, many industrial companies in Finland have tried some traditional market research and need assessment methods in product development. Many of these methods have not remained in continuous use, because these methods have not been useful enough, they have been too difficult, or the expectations have been unrealistic.

Product development often has to exploit customer need information gathered for other than product development purposes, e.g. marketing purposes. Product development should get as useful information as possible for its own purposes in order to be able to develop competitive products for industrial markets. For this reason, the above-mentioned characteristics and typical differences have to be considered carefully when planning customer need assessment activities for industrial product development.

Industrial products are usually purchased by professional buying people who consider a number of different criteria when making the buying decisions. They often have to acquire plenty of information from the industrial products and evaluate the different alternatives objectively. This is one reason why the competitive situation has to be taken carefully into account in customer-driven development. There are not many competitive assessment tools especially designed for product development purposes. To effectively focus development efforts, product development needs information about
their and their competitors’ relative competitive situation on an interval scale in order to determine concrete development targets.

4. Requirements for customer-driven product development tools in industrial business chains

In this section we present essential requirements for the development of a need assessment tool set for companies in industrial business chains. These have been derived from the need assessment process and its links to product development process and strategic management (Section 2) and the characteristics of industrial business chains, products and product development. We also utilized the clarified common need assessment problems of companies (see Section 6) when deriving the requirements. Even though not fully separable from each other, the requirements have been divided into general requirements for the tool set, customer-related requirements and company-related requirements.

4.1. General requirements for the tool set

A starting point for developing the tools was to find ways to produce essential and useful information for product development of industrial companies. This should be done continuously and systematically, not only as a single activity in the beginning of the product development process. The need information should accumulate gradually in the process. The tools should make this kind of operation possible.

The tools must support the gathering, organizing, analyzing, and prioritizing of need information. They should also help to set practical targets for product concept development based on this analyzed and prioritized need information and support in achieving these targets. The tools should be designed to allow the resulting information from the earlier tools to be flexibly utilized in the subsequent tools.

It should be possible to use the tools efficiently in groups because group work is a good way to promote mutual understanding, communication and commitment. Group work can essentially promote the communication of need information within the company and particularly with the customers. By increasing the participation and interaction of different persons it can also improve commitment to decisions based on the results of using the tools and guarantee good results.

The tools should also be able to handle systematically information or expertise that is qualitative and even intuitive. A significant part of need-related information is not very explicit, especially the information concerning trends, future needs and competitors. Still, it is very important to exploit this kind of information.

The tools should be able to provide a common language. Different persons in different functions and especially in different companies often use a very different language. This includes also that different people may understand the same terms and words very differently. Communication inside the company and with the customers can be promoted significantly with the right tools.

4.2. Customer-related requirements

Quite often in industrial companies, a rather small part of customers can be distinguished as key customers. Particularly the expertise of these key customers should be exploited carefully and their needs understood properly. A customer’s real needs can be understood properly only when customer’s business, business environment and objectives are carefully understood. In order to achieve this, a regular, systematically organized and intensive interaction is needed. The achievement of the former kind of intensive interaction should be supported at least when assessing the most important key customers’ needs.

If the suppliers wish to emphasize their active role towards customers, supporting the co-operation, trust, mutual understanding and commitment to mutual goals are important considering the standpoint of business chains. The customers’ important stakeholders, especially their customers and the product’s end users, should be assessed carefully. In this way, trends and future needs can be predicted more easily and the active role of the supplier be emphasized in product development. Also managing the large amount of complex and
controversial requirements from different stakeholders in the business chain should be taken into consideration. Requirements that are derived from remote stakeholders via customers to the company can be very hard to trace without careful and systematic analysis.

When the background for the customer’s needs is properly understood and documented, the needs can be better understood and the changes in needs and requirements more easily predicted. In addition, the tools should also capture hidden and future needs and try to predict the situation at the moment of a new product’s launch.

There are not only one but several decision-makers whose opinions should be clarified when carrying out need assessment concerning industrial companies. For example, buyer’s opinions are naturally assessed during the every day selling operations. Quite often there is, however, not too much other customer need information than buyer information for product development. The role of buyers and their opinions might be over-emphasized even in long-term research and development. For this reason, the views of several functions of industrial customers like production, product development, marketing and corporate planning should be clarified as well, when carrying out need assessment. It is important to clarify the preferences of all the industrial customer’s representatives influencing the buying process, especially the preferences of those persons and functions that are the most affected by the R&D decisions. The tools should be able to handle the possibly controversial opinions and demands of different persons and functions, for example by getting a common, shared view from all the customer’s representatives involved.

4.3. Company-related requirements

There should be different kinds of tools to be used in different situations, depending e.g. on the objectives, resources and time available for product development and need assessment. A too large number of available tools can, however, be confusing when selecting a suitable tool. The number of tools should be kept to a minimum, still covering different kinds of situations and allowing the industrial companies to solve their most essential need assessment related problems.

People carrying out need assessment should be able to step into a customer’s role and listen carefully to the customers. The need assessment tools should support this. In careful listening it is important to take into account and understand customer’s background and values, map customer's business problems and opportunities, and to notice unspoken concerns [20].

Customer need analysts often select and interpret a customer’s comments, ideas and requirements according to their own way of thinking. This can lead to the selection of less important signals and misunderstandings. For this reason, it is important to make the customers themselves to describe, organize and select their most important requirements. Also the competitors’ and company’s competitive position concerning the most important customer needs should be tried to be seen from the customer’s point of view, which helps to set realistic goals for product development.

Proper communication of customer need information is challenging not only between the customers and the company, but also between the different departments of a company. The meaning of need information changes easily and a part of the information disappears.

A large representation from product development would be desirable in need assessment: in order to get unbiased information about customer needs in as useful form as possible, product development itself should participate in carrying out need assessment in several stages of product development. Close interaction between the representatives of the customer and product development is fruitful in other ways, too: having the experts of both needs and solutions to interact together can effectively facilitate the achievement of innovative results.

5. Set of 10 tools for product development

In order to develop the tool set, information about presently used methods and tools in customer need assessment and new product development was collected from companies and
The tools have been selected to cover the most important phases in industrial customer need assessment process described above in the paper. This includes planning of need assessment (tool 1), gathering (tools 2 and 3), organizing and analyzing (tools 4 and 5) and prioritizing (tools 6 and 7) customer needs and ensuring that customer needs really direct the product development (tools 8–10).

The Need assessment outline helps industrial companies to plan their customer need assessment according to the goals of product development and the state of the present knowledge. When using the Creative group interview a group of company’s and customer’s representatives from different departments (marketing, production, product development, purchasing, corporate planning) works together to get a common, broad-structured view of the needs and demands of the customer (see [19]). The Framework for 1-on-1 interviews helps to make right, future-oriented questions about the customer and his business environment by providing a broad interview framework. The Trace matrix for business chains helps to describe complex business chains and trace back requirements for the company from even remote customer’s stakeholders and trends.

The Voice of customer interpretation table helps to analyze the customer’s demands, opinions, attitudes, values and strategies in order to find the real needs behind them and consider the criteria by which the customer evaluates the different suppliers. Industrial customers tend to describe their requirements in technical terms. This tool gives a concrete device to discuss and clarify the real needs behind these requirements together with customers. The Competitive position assessment helps to find out the customer’s opinion about the company’s and its competitors’ competitive position concerning the most important needs and set development goals for these needs. The House of Quality provides a common language for different functions to prioritizing product attributes based on important customer needs. The Pugh concept selection table gives an illustrative way to combine, develop and choose the best product concepts taking the customer needs into account. The Problem source assessment provides a creative way to extract possible defects, problem sources or other negative images in an early stage of product development that can originate for example from unexpected conditions or ways of using a product. The Assessment of future competitiveness helps to estimate the competitiveness of the concepts in the planning stages and be better prepared for the future situation. This can eliminate the preparation of unnecessary prototypes.

Many of the tools are widely known, like the House of Quality (QFD) [21–23] and Pugh’s concept selection table [24]. In these cases, however, the tools have been tried to be made as easy to use as possible, with precise guidelines on how to apply the tools effectively in industrial companies based on literature and our company experiences. In some cases, some general methods have been applied and transformed to better suit to customer need assessment purposes. For example tool 2, the Creative group interview tool is based on OPERA [25], a creative problem solving tool developed in Finland. Tool 9, the Problem source assessment, is based on negative brainstorming [4] developed in Norway and some other generally known creative problem solving tools. Some tools are a collection of checklists, guidelines and general tools like tools 1, 3, 5 and 6, in which cases there are several innovative ideas from the authors that have been integrated in the tools. The tools have been designed to be used integratively and the results of one tool can be combined with the use of other tools.

Group work aspects have been stressed strongly when selecting and designing the tools, even if many tools can be applied also individually. Group
<table>
<thead>
<tr>
<th>Tool</th>
<th>Goal of the tool</th>
<th>Needed input information</th>
<th>Received output information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Need assessment outline</td>
<td>To ensure that the planned customer need assessment activities are as useful as possible for both R&amp;D and the whole company</td>
<td>The goals and starting points of product development and the strategies of the company are clearly understood</td>
<td>Presentation of markets and important customer segments, Quick picture of available customer information in the company</td>
</tr>
<tr>
<td>2. Creative group interview</td>
<td>To form a structured picture of customer's needs and demands by customer's own words</td>
<td>The most important customers for the company are known</td>
<td>Picture of customers objectives and problems, Picture of important requirements and needs</td>
</tr>
<tr>
<td>3. Framework for 1-on-1 interviews</td>
<td>To give a framework for getting a broad, structured picture of customer's business environment and needs</td>
<td>There is a reasonable consensus on the company's important customers and overall picture of the business chain</td>
<td>Broad picture of customers' business environment, requirements and needs for the company</td>
</tr>
<tr>
<td>4. Trace matrix for business chains</td>
<td>To analyze a business chain network of customers and stakeholders, trace back and illustrate their requirements for the company</td>
<td>There is basic knowledge about company's customers and important stakeholders and their links with the company</td>
<td>Structured picture of business chain and even remote stakeholders, Picture of potential future requirements and needs even from remote stakeholders</td>
</tr>
<tr>
<td>5. Voice of customer interpretation table</td>
<td>To analyze the voice of customer, find out his real needs and represent them in a structured way</td>
<td>There is gathered information (voice of customer) about customer's requirements, opinions and redamations</td>
<td>Structured picture of customer's real needs, background information for technical requirements and comparison criteria for suppliers</td>
</tr>
<tr>
<td>6. Competitive position analysis</td>
<td>To find out the customer's view of the competitive position and his most important needs</td>
<td>Preferably a structured picture of customer's needs</td>
<td>Information of needs that should be given special attention and target levels for their fulfillment</td>
</tr>
<tr>
<td>7. House of quality (QFD)</td>
<td>To find out the most important product attributes based on customer's needs</td>
<td>Preferably a structured picture of customer needs, their importance and the competitive situation</td>
<td>Common, prioritized view of most important customer needs, competitive situation and product attributes</td>
</tr>
<tr>
<td>8. Pugh concept selection table</td>
<td>To develop, combine and choose the best concepts based on the most important customer needs</td>
<td>A structured picture of most important customer needs and product characteristics</td>
<td>The most vital product concepts, Strengths and weaknesses of concepts</td>
</tr>
<tr>
<td>9. Problem source assessment</td>
<td>To find out the product's/product concepts' problem sources or potential negative image sources as early as possible</td>
<td>A picture of customer's needs, requirements and values, Good picture of product concept</td>
<td>The most probable problem sources and customer's possible negative views of the product and rough estimate of probability</td>
</tr>
<tr>
<td>10. Assessment of future competitiveness</td>
<td>To form a picture of the probable competitiveness of the new product</td>
<td>Preferably a structured picture of customer needs, A good picture of product concepts and their competitors.</td>
<td>Estimate of product's competitiveness in the market, Position by most important criteria compared to competing products</td>
</tr>
</tbody>
</table>
work can essentially promote communication within the company and with the customers, improve commitment to decisions based on the tool results and guarantee good results in many other ways.

We have considered the integration of creative features and methods into the developed tools important in order to, for example, find new and hidden needs and possible problem sources in the concepts. In addition, tools that support effectively both creativity and group work

- help to raise problems and development needs in a positive manner while not allowing direct criticism,
- help to democratically bring out all participants’ opinions, committing them better to achieved results, and
- encourage the generation of also new and wild ideas, helping to discover new and hidden needs.

The standpoint of business chains has been taken into consideration. Tools help to clarify customer’s needs in considering also the standpoint of their further customers and in this way help the company to increase its customers’ performance. Supporting the co-operation, trust and mutual understanding between a company and its customers are important features of the tools. Also the viewpoint of managing a large amount of complex requirements from different stakeholders of the business chain has been included.

The tools have been selected and designed to be easy to use and understand. They are largely qualitative in nature and are more intended to promote understanding than produce statistical data, which is not always very helpful in the effective understanding of the real customer needs and their background.

6. Selection of tools

In order to get real benefits from the developed tools for need assessment in product development, it is necessary to be able to select the right tools for a certain task and use them in a correct way. The purpose and goals of need assessment, the present phase of product development and need assessment, available resources and the schedule for need assessment, present level of knowledge and the most important problems faced in need assessment should be considered in the selection. We have developed four selection aids in the form of tables to help the selection of tools. The tool selection can be seen from the purpose, process, problem and resource based views. In addition to these, one of the goals of the Need assessment outline tool is to help to select the right tools for need assessment. It is also vital to check if a group or the whole company are mature enough to use certain tools.

Table 1 describes the goals of the tools, required input information and received outputs. To select which tool to use one should first find a tool that produces the desired outputs and best fulfills the company’s goals. It should then be checked whether there is necessary input information for the tool. If the required inputs are not available, it is necessary to find another tool that produces such information. It is essential to check the required input information for the successful use of the developed tools.

Table 2 describes the process based selection aid. The phases of need assessment process described in chapter two are shown in the top columns and the assessment tools in the left-most rows of the table. From this table, appropriate tools can be chosen for need assessment according to the process stage the need assessment is in. For example, if a company wants to collect customer need information there are two available tools, the Creative group interview tool and Framework for one-on-one interviews in the need assessment set to be selected from. In most cases, there are some options to choose from and the decision should thus be based on the practical situation the company is in. We have developed a minimum number of tools for each phase that still cover different situations and requirements of companies executing customer need assessment.

Table 3 presents some common need assessment-related problems in getting the customer needs to be properly included in the product development. These examples deal with customer relationships, company’s internal communication, competitor analysis and development activities. The problem situations described in Table 3 are
Table 2
Selection table for tools in the different phases of the customer need assessment process [8]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Need assessment outline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Creative group interview</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Framework for 1-on-1 interviews</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Trace matrix for business chains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Voice of customer interpretation table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Competitive position analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. House of Quality (QFD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. PUGH concept selection table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Problem source assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Assessment of future competitiveness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Colours:
- A solution to a problem
- A useful tool

based on company interviews executed in Finland [8]. The given tools in the table are recommendations for solving these problems, based on our company experiences. There may be several suitable tools in each case. For example, if there are few contacts between a company and its customers, the Creative group interview tool and Framework for 1-on-1 interviews might improve this situation effectively. If a company has difficulties to distinguish the important needs from the less important ones, the Competitive position analysis tool can help to decrease this problem.

The fourth selection aid describes the needed human resources and a rough estimated time for using or implementing a certain need assessment tool. It has been described in more detail in a Finnish-language customer need assessment manual [8].

7. Discussion and further research

Very few tool sets have been developed that comprehensively cover the customer need assessment process and are useful in the different phases of product development. Ulrich and Eppinger [26] and a Japanese research group [27] have reported somewhat similar types of tool sets, even though the groups have worked independently. However, we have found few individual tools and no other tool sets that were designed especially for the need assessment of industrial companies and industrial business chains. We have developed a comprehensive set of customer need assessment tools for industrial companies in particular. The tools were generally selected and designed to effectively support group work and other requirements derived from the characteristics of industrial business.
Table 3
Selection table for need assessment tools in common need assessment problems [8]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The concept ‘customer’ is not clear – whose needs should be met?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. What is known about customers and their needs – what more has to be known?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. From which sources can information about customer needs be found?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Customer does not see the customer orientedness of a company</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. There are few contacts between company and customer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Needs and goals of customer are unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Customer is not able to express his needs / needs are not understood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. It is difficult to see the whole picture of customer needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Customer business chain is long or complex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Difficulties to distinguish the important needs from the less important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Communication</td>
<td>11. Information about customers is not properly communicated in the company</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Employees are not committed to satisfying customer’s needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitors</td>
<td>13. Competitive situation is not known or evaluated systematically</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development activities, Product development</td>
<td>14. Time is wasted in development meetings to irrelevant issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Distinct goals for product development are difficult to be set</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Customer needs are not sufficiently taken into account in development stage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. There are difficulties in choosing the best concepts from many alternatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. There are difficulties in assessing the competitiveness of a new product</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Lots of defects usually occur after the launch of the product</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Colours:
- Dark grey: A solution to the problem
- Light grey: A useful tool

chains, products and product development, and the common problems of customer need assessment in industrial companies. Some of the individual tools, for instance Creative group interview and Trace matrix for industrial business chains have been developed for the special problems of industrial companies from general decision making methods and tools. We also developed and reported new
kinds of practical and useful ways to help the companies to select most suitable tools for their need assessment.

The tool set was originally developed together with Finnish companies in a plastic injection moulding business chain. Tools have been utilized together with and introduced to a large number of Finnish companies, both SMEs and larger companies. An example of a business chain that the tools have been rather lately applied to in successfully attempting to recognize new customer needs is that of a tractor producer (see [28]), where the analyzed business chain included for instance tractor producers, farmers, food industry, stores, consumers and government regulations.

Generally, companies have experienced the tools introduced in this report to be quite useful and to solve important problems particularly concerned with the assessment of customer needs in industrial companies and industrial business chains. The pilot companies continued to use the tools independently after the tool development project. Clear positive effects in the business results were noted in the pilot companies. For example, one pilot company made a customer satisfaction survey to their key customers before and after the project. According to the survey, whereas the company’s total customer satisfaction used to be clearly (ca. 11%) below the competitor level, in about 2.5 years after starting the process of implementing described systematical tools, the satisfaction had climbed up to be well (ca. 6%) above the competitors’ level, measured with the same satisfaction criteria. Also, the use of the tools has spread to a number of other small and large companies; approximately 1000 manuals describing the developed tools have been sold so far. Many tools have also been further studied and developed on the basis of practical experiences received from later close co-operation with several Finnish companies.

Of the tools that we have ourselves developed particularly for industrial customer need assessment for instance from generic decision making tools and principles, particularly Trace matrix for business chains and Creative group interview have commonly been very well-received and felt as quite useful by a large number of companies. They have been experienced to solve important problems in the customer need assessment of industrial companies. Trace matrix for business chains has been found to support the clarification of customer needs originating for instance from distant stakeholders by helping to illustrate the complex links between the stakeholders [28]. Creative group interview has helped to clarify the way of thinking and the important objectives of customers, and to form a shared view of the needs and requirements of the representatives of customer’s different departments [19]. Companies have generally experienced these tools to be quite easy to adopt and use, and they have continued to use them after their introduction.

Need assessment for product development should be understood as a broader task than it is seen at the moment in companies. Need assessment is not only a single activity in the beginning of a product development project but should extend to cover all the essential phases of the product development process. Need assessment should be carried out continuously in order to get need information early enough for product development decisions. In this way, the need information can be cumulated and be iteratively made more precise. The need assessing company should carefully recognize and consider the different links of need assessment to the strategic management and goals of product development when planning need assessment activities.

According to our experiences, the developed set of tools can be used to produce useful need information for both short-term product development to increase customer satisfaction and long-term product development to increase the actual competitiveness. The use of the developed tools makes customer need assessment more systematic, organized and explicit. It helps to focus the company’s resources effectively and to create higher quality products. The regular use of the developed need assessment tools presented in this research promotes co-operation and commitment both inside the company between the different functions (for example marketing, product development and production) and between the company and the customer. By using the tools, the customer can be better integrated in the process of making concrete product development related decisions, and
the voice of the customer and the real needs can be found out. The tools help to direct discussions, supporting the more profound understanding of the customer and customer’s future needs.

The developed tools can be used separately, but the tool set has been designed in the manner that the utilization of different tools can be effectively combined. The developed tools are rather easy to learn, use and understand, even though the use of some tools is clearly facilitated by an experienced leader. According to our experience, both the product development and need assessment processes should be clearly understood and mature enough in order for a company to be able to utilize the tools usefully and effectively. Also, successful need assessment requires the commitment of top management and sufficient resources. Systematic need assessment can take much time in the implementation phase, but however, the demanded time will decrease rapidly during the course of practice.

An interesting research topic is the transforming of the tool set into an electronic form. In this way, the tools and the tool set can be made more easy to use and more educative. It can also support the work of geographically distant groups. A further important topic for future research is the exploitation of Group Decision Support Systems (GDSS) in the need assessment for product development purposes. There is a GDSS facility in Lappeenranta University of Technology and it has already been broadly utilized in these kinds of applications.

Acknowledgements

This paper is one result of the Strategic Aiming and Assessment of R&D (TOP—abbreviation from the Finnish name) research project funded by Technology Development Center Finland (TEKES). The tools were originally developed in previous NASTA (Need assessment systems for technological applications) project also funded by TEKES. In the TOP project we have utilized the developed tools and further developed them. The authors thank professors Knut Holt from Norwegian Institute of Technology and Takaya Ichimura from Nihon University for their significant contribution to the development of the tools by sharing their profound knowledge on need assessment methods.

References


