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Using patent information for identification of new product features with high market potential

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Abstract

The current situation in planning and executing of innovation projects within industrial companies still contains considerable drawbacks such as the lack of the tools for systematic task definition for short to long term innovation or low reliability of market success prediction for new product concepts in the early stages of innovation process. Despite the best efforts to reduce risk of failures, the majority of all industrial innovation initiatives offers only incremental improvements compared to the products on the market. The attempts to incorporate customers into new product development require time-expensive customer interviews or extensive field research and seldom deliver significant competitive advantages. The paper discusses the possibilities of fast systematic identification of underserved customer needs, innovation tasks and new product features based on the internal competences of companies, on the analysis of the patent databases and the verification through market tests. The new approach focuses on identification and evaluation of customer needs, understood as solution-neutral benefits, which are expected by the customers. It proposes to enhance the function and contradiction analysis of technical systems and the analysis of the customer working process with the identification of customer benefits obtained from the patent databases. Similar customers' working processes in various industrial sectors often have different levels of technical and technological evolution. This fact gives the opportunity to identify and to transfer customer needs known in one sector to another sector where these needs are still latent. Using patent information makes the customer needs transfer feasible and manageable.

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Keywords: identification and trasfer of customer needs; innovation strategy formulation; new product development; patent information; TRIZ

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1. Approaches for identification of customer needs

This paper is addressing the main needs of the industrial sector regarding the definition of innovations tasks in the very early stage of the innovation process. This initial phase of new product development faces serious difficulties within working teams, which are often unable to find a consensus in understanding of true customer needs and to select the right set of innovation tasks crucial for innovation success. In accordance to (Bettencourt and Ulwick, 2008, p. 62-68) the majority of companies cannot confidently uncover customer needs, as there is no agreement within companies what a customer need is.

In our approach we define customer needs as solution-neutral benefits, which deliver to customers advantages in performing their working process. Such benefit-based innovation planning belongs to the best practices in running innovation process over the past years (Ulwick, 2002); (Livotov, 2011). The concept of focusing on customer benefits in innovation was introduced in the marketing by Haley (Haley, 1968). The customers judge the value of products based on the jobs they can potentially perform with them (Christensen et al., 2007) and on resulting outcomes (Ulwick, 2002) or benefits. The capturing and final formulation of the customer benefits is based on different approaches under consideration of the following core features:

a) Benefits are independent from technical solutions and therefore deliver true customer expectations or needs. For example: "minimize connection time of two electric cables" is a customer benefit which can be realized by means of various plug connectors, cabling boxes, wireless technologies or other solutions.
b) Benefits are stable over time and finite in number, once captured they serve as basis for new product development.
c) Benefits are measurable and their metrics possess an ideal and/or sub-ideal value. For example, *the ideal connection time is 0 seconds*. The sub-ideal value depends on specific application, and could be *1 second.*

For the identification of the customer benefits the following major techniques have to be mentioned.

1.1. Voice-of-the-customer methods

The voice-of-the-customer approaches, e.g. interviews, focus groups, ethnographic studies, help to capture the voice of the customer and to translate it into customer benefits and new product features (Griffin and Hauser, 1993); (Christiano et al., 2000). Practical experience of the companies shows that the traditional voice-of-the-customer methods are very time- consuming, often unsystematic and are not able to reveal completely the opportunities for innovation. The main difficulty of these methods is that customers' requirements are often un-precise. Customer ideas often relate to already existing products or known solutions as customers don't possess experience or knowledge in use of new technologies.

1.2. Analysis of system functions and properties

This approach (Livotov, 2008) uses the description of all essential components of technical system with their useful functions and all undesired or negative properties as a basis for the formulation of complete list of benefits. These benefits can be identified in two ways:

- further improvement of positive functions or properties,
- elimination of negative functions or properties.

The example in the Table 1 presents one positive function and one negative property of a packaging machine which help to identify two customer benefits.

Table 1. Customer benefits derived from functions (example).

Function or property	Customer benefit	Ideal value
High number of run product formats in one machine (*positive*)	Increase number of run product formats	unlimited [-]
High consumption of compressed air (*negative*)	Reduce compressed air consumption	0 [l/min]

1.3. Analysis of the customer working process

Analysis of the customer working process with a technical system, machine or product from the customer's perspective includes identification of all tasks to be fulfilled, possible problems and current solutions. Bettencourt and Ulwick define this approach as "job mapping" and emphasize that the goal is to identify what customers are trying to get done at every step, not what they are doing currently (Bettencourt and Ulwick 2008, p. 109-114). They underline, that each customer process has universal process steps: defining what the job requires; identifying and locating needed inputs; preparing the components and the physical environment; confirming that everything is ready; executing the tasks; monitoring the results and the environment; making modifications; concluding the job and cleaning the workplace. Almost for any step of the customer process one can formulate typical benefits such as reduce preparation time, increase accuracy in executing a process step, reduce material consumption, minimize energy losses, avoid waste etc.

Table 2. Customer benefits derived from working process (example).

Process step	Customer benefit	Ideal value
Change product format in the packaging machine	Reduce time losses for format change	0 [min]
Clean guidance of movable parts in the machine	Avoid contamination of products in the machine	0 [-]

This method is complementary to the method 1.2 and also requires a comprehensive knowledge of the customer process, which is often not available in detail in the R&D departments of the companies. Both approaches 1.2 and 1.3 can also assist to perform and analyze the voice-of-the-customer surveys more systematically.

1.4. Analysis of market and technological trends

Application of the mega trends, market or technological trends, TRIZ patterns of system evolution and trends of needs evolution can be used to forecast future customer benefits. However at present the trend analysis delivers too general or to obvious results and can be considered as supplementary method only. The new TRIZ based approaches are too general or solution-oriented. For example, one method evaluates the relationships between market trends and TRIZ evolution patterns (Litvin, 2005). Based on the TRIZ laws of system evolution the universal trends of needs evolution can be formulated and applied for identification of hidden needs and for forecasting of new needs of customers (Petrov, 2005).

1.5. Analysis of patent information

In addition to the mentioned approaches this paper proposes using of patent literature for identification of customer benefits. A valuable source of information to identify unsolved problems and to derive customer benefits is constituted by patent databases, which in fact is not available in any other source. The advantage of patent analysis is that it can be executed without time-consuming customer surveys and even without deep knowledge of the customer processes. With the help of the modern tools for patent text-mining the information can be obtained more quickly and precisely. Moreover with the patent analysis one can easily access and retrieve information for general inventive tasks and thus for benefits for the products from different industrial sectors with similar customer working processes.

Patent information enhanced through computer-aided classification and retrieval contributes significantly to the acceleration of innovation processes. The automatic retrieval of problems (Souili et al., 2011) or technical contradictions (Cascini and Russo, 2007) helps experts to reduce the time needed for finding solutions. Analyzing and categorizing patents according to the TRIZ evolution patterns assists to identify the evolutionary potential and

possible improvements of products (Verhaegen, 2009); (Yoon and Kim, 2011). Text- mining of patents can extract information for technology roadmapping (Lee et al., 2008), competitor monitoring, R&D portfolio management, identification and assessment of potential sources for the external generation of technological knowledge (Ernst 2003). Patent analysis is applicable for forecasting emerging technologies, even if no historical data is available (Daim et al., 2006), and also for developing acquisition strategies (Moehrle and Geritz, 2004).

2. Using patents for identification of customer benefits

The proposed method for identification of customer needs consists of following three major steps and is illustrated with help of a case study dealing with a hand-held fastener driving tool with magazine for nails (for example, see Fig. 1).

The first step is always a description of the customer working process and the identification of technical systems with similar working processes such as a) obviously, hand- held fastener driving-tools for screws, bolts, anchors, pins or clips; b) mobile or stationary fasteners with feeders; c) other devices using magazines, for example magazines in cigarettes packaging, in surgical equipment or firearms with magazines.

The second step is formulation of queries for topical full- text search with freely selectable keywords in several languages and/or with IPC-codes of the International Patent Classification. In the case study about 1000 relevant patent documents were retrieved in several on-line queries in English and German and classified according to the estimated invention tasks, whereby more than one task could be assigned to one document.

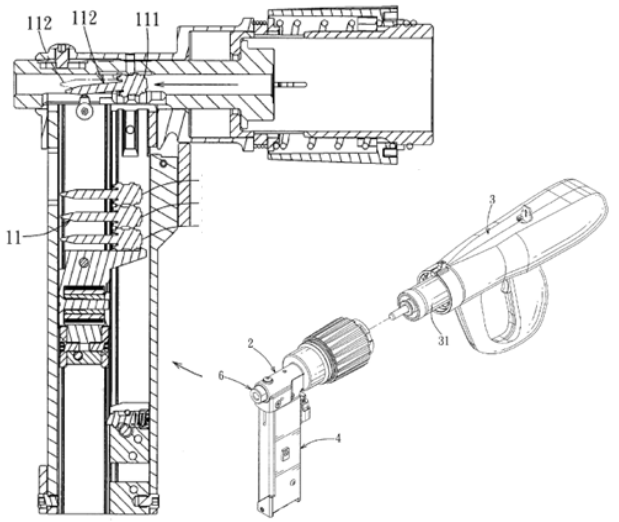

Fig. 1. Example of a driving tool with magazine for fasteners (Lee, 2013).

The third step is structuring and condensing the tasks and their translation to the customer benefits as solution neutral and measurable customer expectations. The Fig. 2 illustrates a part of the analysis regarding the fastener magazine, based on 100 patents. The derived benefits are listed in accordance to the number of the times they were mentioned in the patent documents, whereby benefits may be mentioned multiple times in one patent document. When benefits are mentioned often this may confirm the high importance of that benefit. As a rule such benefits have also a high level of customers' satisfaction, i.e. are "well-served". On the contrary the low number of mentioning reveals specific benefits, which come from other sectors or are relevant for a small amount of applications where customers are unsatisfied and expect a better solution.

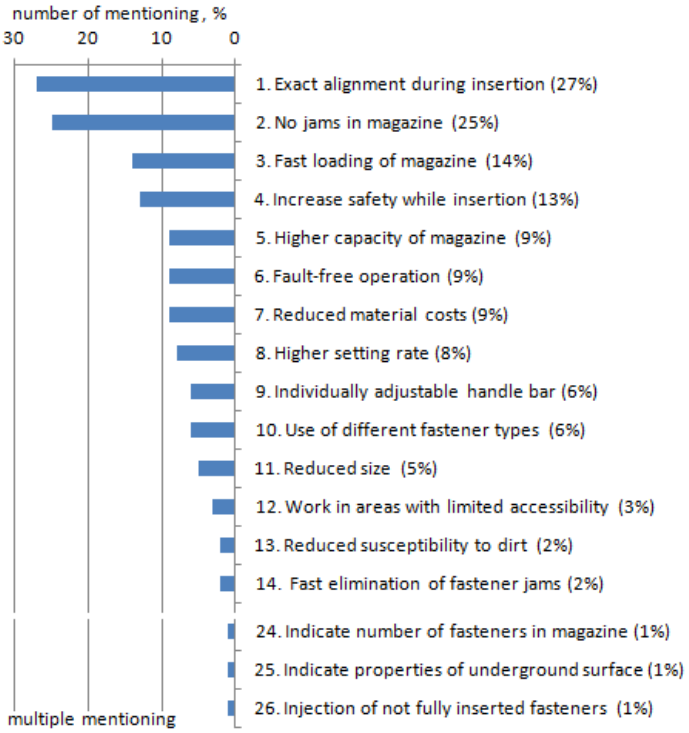

Fig. 2. Number of mentioning of benefits identified from 100 patents.

As a next step, these assumptions must be proved by experts and customers as described in the section 3 below. Customer benefits with higher market potential are recommended then for shaping new product features.

3. Evaluation of market potential for customer benefits

Depending on the kind of products and customer processes the complete number of the identified customer benefits may vary from 30 to 100. In order to select customer benefits with high market potential one can determine their importance and also the satisfaction with current technical solutions. The satisfaction can be also defined as performance level of products or in general of technical systems. The idea to evaluate benefits in light of how important they are and how satisfied each customer is with the performance of the current solution was originally proposed in (Ulwick, 2002) together with a method for calculation of *opportunity* as an indicator of the market potential. The formula for opportunity takes into account the impact of satisfaction only if estimated satisfaction level is lower than the corresponding importance of a benefit. Therefore a new advanced computation algorithm (Livotov, 2008) includes a regression model which is suitable for calculation of the market potential as a function of importance and satisfaction for all values of the input variables. The formulas used in calculation are presented in the Appendix A.

After the capturing of customer benefits is completed, the importance of each benefit and its current satisfaction has to be evaluated, from a customer's point of view, using a scale from 0% to 100% (100% - very high level of importance or satisfaction, 75% - high, 50% - middle, 25% - low, 0% - extremely low importance or satisfaction). For the objective statistically robust assessment an expert group should consist of about 30 technical experts, engineers, sales managers etc. (internal experts) and of at least 30 customers as users of analyzed technical system (external experts). Comparative analysis of internal and external evaluation may be valuable to recognize the differences of opinion and contradictions between customers and providers. Based on the statistical evaluation of gained information following parameter can be estimated:

- the total product value in %, which can be also interpreted as measurable definition of the ideality of technical system, or product from the customer's perspective;
- the market potential of each benefit in %, which reflects possible contribution of each benefit to the total product value growth.

Identifying benefits with high market potential helps to formulate new product features with higher market success. The resulting innovation strategy must include several strong features and thus assure the anticipated growth of total product value of minimum 6% for mature products and 15% or more for the emerging products based on new technologies. A fragment of market potential analysis for the hand-held fastener driving tool is illustrated in the Table 3. The benefits are sorted in accordance to their market potential. The current total product value in the example is 67% that is typical for a mature technical system. The top 6 benefits have a total market potential of 13,6%. Improving the satisfaction level with these benefits will increase calculated total product value of the driving tools from 67% to 80,6%. These benefits as innovation tasks define the innovation strategy and their solutions will shape a promising innovation concept with higher total value and predictable innovation success.

Table 3. Benefits of the driving tool users (fragment of the case study).

Customer benefit	*Impor-tance*	*Satis-faction*	*Market. potential*
25. Indicate properties of underground surface	79%	46%	2,6%
12. Work in areas with limited accessibility	82%	52%	2,4%
18. Avoid wrong setting parameters	73%	47%	2,2%
5. Reduce interruptions at work (e.g. through higher capacity of magazine)	85%	57%	2,2%
10. Use of different fastener types in one device	79%	53%	2,1%
21. Exact distance between setting points	71%	48%	2,1%
...	...	...	...
15. Reduce waste	61%	75%	0,4%
3. Rapid loading of fasteners in magazine.	78%	83%	0,4%

4. Conclusions and outlook

In various industrial sectors or applications with different levels of technical and technological evolution one can find similar customers' working processes. This fact gives the opportunity to identify and to transfer customer benefits known in one sector to another sector where these needs are still latent. Using patent information makes this approach of *customer needs transfer* feasible and manageable. The accessible huge amount of patent documents and available tools for computer-aided text-mining make it possible to identify the information about customer benefits in a comprehensive manner, fast and systematically. The obtained data can be used in the early stage of innovation process for the formulation of innovation goals and desired new product features.

Moreover, as the retrieved benefits are linked to the corresponding inventions and solutions, the obtain data can be also applied for idea generation, benefit-focused creation and management of intellectual property, competitor monitoring and technology transfer on the later stages of new product development.

This paper provides an evaluation of the current status of the ongoing research. The first applications show that not all benefits could be retrieved with the applied algorithms and tools for text-analysis. A significant part of the analysis and classification has still to be performed "manually". Future investigations including the comparison with other methods for capturing benefits will allow to evaluate the effectiveness of the approach more precisely and to determine measures for its further development.

Appendix A. Computation of market potential

Obtained importance and satisfaction values allow one to calculate the market potential for each benefit p_i (1), defined as its maximum contribution in the total growth of current total product value V (2).

$$p_i = \frac{(W_i + a\, W_i\, (W_i - Z_i))\ (1 - Z_i)}{\sum_{i=1,n} (W_i + a\, W_i\, (W_i - Z_i))} \qquad (1)$$

$$V = \sum_{i=1,n} \frac{Z_i\, (W_i + a\, W_i\, (W_i - Z_i))}{\sum_{i=1,n} (W_i + a\, W_i\, (W_i - Z_i))} \qquad (2)$$

p_i - market potential of benefit, %;
V - total product value, %;
W_i - importance of benefit, 0…100%;
Z_i - current satisfaction of benefit, 0…100%;
n - total number of benefits, n = 20…80;
a - adjustment coefficient, a = 1 recommended [13].

Selected customer benefits with high market potential p_i form the innovation strategy with higher market success and create a pool of problems for systematic idea generation with the help of TRIZ inventive principles and other tools.

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