ISSN 1330-3651 (Print), ISSN 1848-6339 (Online)
DOI: 10.17559/TV-20150603223629

IDEA MANAGEMENT IN PRODUCT INNOVATION – THE EMPIRICAL RESEARCH RESULTS

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Original scientific paper
The competitiveness of the economy to a large extent depends on its ability to innovate. There is a consensus between researchers and business practices on the high importance of innovation management process, particularly in the earliest stage when it is necessary to identify business opportunities and find the best possibilities for their realizations. In the process of innovation management, many authors emphasize the critical role of idea management and efficient ways of creating, gathering, evaluation, promotion, selection, and implementation of ideas. As part of the research project "Models and methods of knowledge management in product development", by the Croatian Ministry of science, education and sport, a survey was conducted on a sample of Croatian companies which have product development in their production process. The conducted survey attempted to determine the situation in the area of product innovation, as well as in the field of innovation and idea management in the economy and to compare data with best practices. The collected data show when and how the ideas are collected, which motives and purposes are drivers for the collection of ideas and how companies are organized and trained for this demanding job. This paper presents the results of the survey, which suggest ways to improve product development, and sources and methods of collecting ideas. Publication of the outcome of this and other research on product innovation aims to spread the knowledge about this very important but under-explored area.

Keywords: *front-end of innovation; idea management; idea evaluation and selection; innovation management; product development*

Upravljanje idejama u procesu inovacije proizvoda – rezultati empirijskog istraživanja

Izvorni znanstveni članak
Konkurentnost gospodarstva u značajnoj mjeri ovisi o njegovoj sposobnosti da uvodi inovacije. Između istraživača i poslovne prakse postoji suglasnost o velikoj važnosti procesa upravljanja inovacijama, osobito u najranijoj fazi kada je potrebno prepoznati poslovne prilike i pronaći najbolje mogućnosti za njihovu realizaciju. U procesu upravljanja inovacijama, mnogi autori ističu presudnu ulogu upravljanja idejama, odnosno učinkovitog načina stvaranja, prikupljanja, vrednovanja, unapređenja, selekcije i implementacije ideja. U okviru znanstvenog projekta "Modeli i metode upravljanja znanjem u razvoju proizvoda", MZOS RH, provedena je anketa na uzorku hrvatskih tvrtki koje u svom proizvodnom programu imaju razvoj proizvoda. Provedenom anketom pokušalo se odrediti stanje na području inovacije proizvoda, te na području upravljanja inovacijama i upravljanja idejama u gospodarstvu i usporediti podatke s podacima najbolje prakse. Obradom prikupljenih podataka ustanovljeno je kako i kada se ideje prikupljaju, koji motivi i potrebe su pokretači za prikupljanje ideja te kako su tvrtke organizirane i osposobljene za taj zahtjevni posao. U ovom radu prikazani su rezultati provedene ankete, koji ukazuju na načine unapređenja i razvoja proizvoda, te izvore i načine prikupljanja ideja. Objavljivanje rezultata ovog, kao i drugih istraživanja o inovacijama proizvoda, ima za cilj širenje znanja o ovom, izuzetno značajnom ali i nedovoljno istraženom području.

Ključne riječi: *priprema razvoja proizvoda; procjena i odabir ideja; razvoj proizvoda; upravljanje idejama; upravljanje inovacijama*

1 Introduction

In a global business environment, innovation, especially product innovation, is prerequisite for market success, and often for the survival of the company. This is why innovation is found on the top of the agenda for many companies around the world. A global study of innovation management [1] found that more than two-thirds of the 1356 global respondents considered innovation either *"extremely important"* or *"highly important"* for their organizations today. Those impressive numbers seem modest when compared to respondents' predictions. About half of respondents think that innovation will be *"extremely important"* for their organizations in the next ten years and 35 % say that it will be *"highly important"*.

From 2002 to 2014, the leading 1000 global companies ranked by R&D investments, have increased their investments from $353 to $647 billion a year. However, annual investment in R&D, after a significant increase from 2002 to 2011 (10,3 % in 2011), experienced a slowing of growth in recent years (9,7 % in 2012; 3,8 % in 2013; 1,4 % in 2014) [2]. The budget for R&D for the 20 leading world companies, has reached more than $150 billion annually. At the same time, among the 10 leading companies from the list of "consumers" of funds for R&D, only two to three companies over the last ten years were also on the list of top 10 companies in the perception of their innovation, measured by financial indicators (revenue growth, market growth and EBITDA) [3]. This confirms the hypothesis that the success of innovation is not only reliant on investments in R&D, but also that success depends on other factors such as innovation strategy, innovation culture and management of innovation processes. Therefore, it is expected that in the future companies will have to be much more efficient in stimulation and management of the innovation process. To succeed, they must become more effective in disseminating innovation culture, understanding the management process, evaluating innovations, assessing the necessary resources, and election of the best business strategy [4]. The study by Arthur D. Little, *"Results of a global study"* [5, 6] which is based on so-called *"good practice"*, shows the impact of innovation on business results in best companies in relation to the average business results of the group. Research shows significant differences in both, in the results according to various industry groups, and between the best and the average within each group. Companies which belong in the „*top innovator"* group achieved significantly higher revenues from products that are less time (up to one year, three years, five years) on the market than all average together with the much shorter development time of the new product compared to the mean values.

Following the research efforts based on cases of *"good practices"* through the implementation of empirical research in Croatian companies engaged in product development, the goal was to ascertain what the driver of

innovation in Croatian companies is, i.e. what views they have on their innovation activities. Our goal was to explore how certain activities related to product development, especially related to the early stage of development (preparation of product development), were ranked by the participants of the process. Authors considered that is important to establish: (1) which financial and human potentials are available to the company, (2) which forms of products are mostly represented in their development, (3) what is the driver for the product development and how to successfully protect the results of R&D, (4) which features substantially determine the performance of the product, (5) what would most contribute to enhancing the development capacity, (6) whether there is an organized way of gathering ideas as a basis for innovation activities, (7) when the ideas are collected, (8) in which way, and from which sources are the ideas collected, (9) how and by whom were the ideas generated. For each of the objectives, certain initial expectation was formed, which was checked with collected data. Where it was possible, the results were compared with the known data from other empirical studies to point perceived similarities and differences [7].

2 Research backgrounds

Product innovation is risky and uncertain process [8]. A large number of factors are relevant for product innovation, but researchers quite agree that, at this point, the innovation management system is the key, particularly at the earliest stage when it is necessary to identify business opportunities and find the best ways and ideas for their realization. Innovation management process demands cooperation of various individuals and departments within the company, all related to the processes of research and development, marketing, sales, production, etc. [9] and the satisfaction of many, vague or unclearly specified goals. Innovation management is a multi-dimensional, non-linear process, and requires access to data and expert knowledge from different, often heterogeneous fields [10].

The process of Product Innovation (PI) is usually divided into the process of Preparation for Product Development (PPD), the process of New Product Development (NPD) and the process of Product Commercialization (PC) [11]. Preparation of Product Development (PPD) [12] (in the literature is often seen as the Fuzzy-Front End (FFE) [13] or Front-End of Innovation (FEI) [11]) precedes the formal process of product development (NPD) [11, 14, 15]. The main activities during the PPD are: identification and assessment of business opportunities, creation, evaluation and selection of ideas, and the development and testing of new product concepts [11, 16, 17, 18]. Because of the crucial importance of new, creative ideas for the success of product innovation, the management of ideas is imposed as extremely important, and, according to some authors, a key process during the preparation of product development [7, 10, 14, 19]. Therefore, the process of idea management is an object of interest for a significant number of researchers [7, 20÷23].

Idea management is a relatively old process, which in certain elements can be found in practical use for many years (*Toyota has a history of over 30 years of innovation management oriented towards the capture of ideas* [24]). Idea management process is the subject of a vast number of researchers. According to Summa [20], idea management includes the following: idea generation or ideation, idea gathering, idea evaluation, idea development, idea implementation, idea follow-up and rewarding, and the author mentions idea evaluation as a critical step in managing innovation. Another way of defining the phases in the idea management process can be found in the work [21] where authors point out the following processes: inspiring and involvement, generation and capturing, development and enrichment, evaluation and selection, implementation, post-implementation learning and feedback. In the paper [24], the authors divide the lifetime of ideas in five sections: idea generation, idea improvement, idea selection, idea implementation and idea deployment. In accordance with the current system of open innovation, the authors in all periods of idea's lifetime, except for the period of selection of ideas, suggest possibilities of participation and interaction of participants both inside and outside of the company (clients, communities, customers, competitors, partners, and academia). According to Malik [23], idea management process includes the following phases: idea genesis and gathering, idea evaluation and selection, idea feedback and recognition, idea implementation and idea bank. In his study Glassman [22], defines idea management as the process of capturing, storing and organizing ideas. Also, idea management can be used to perform preliminary evaluation and screening of ideas as well as diffuse ideas across the company.

The impact of idea management on the results of the process of product innovation is the subject of numerous studies [17, 25, 26, 27]. Ideas, as the basis of innovative activities and results of the implementation of innovation are subjects of a large number of periodic and continuous processes of collecting and analysing data on the impact of innovation on business results [1, 5, 6, 28, 29, 30].

In the last ten years in Croatia, a number of studies on the topic of measuring *"degree of innovation"*, *"innovation quotient"*, *"level of innovation"*, *"ranking the innovation of an enterprise"*, *"innovation ranking of countries"*, *"competitiveness indicators"*, etc. have been done [31÷35, 37]. Surveys are conducted among the companies sampling particular geographical area and/or certain categories of manufacturing and/or service features.

Almost all surveys are an attempt to measure business results at one observation point, depending on the number of innovations in a reference period, and the impact of innovation on the financial performance indicators. At the same time significant ambiguities remain, ambiguities that cannot be included in the research, such as: what would happen if there were no innovations, what would happen if they carried out another innovation, what would happen to the innovations implemented in another way, or how crucial the innovation was for the company's business?

There are considerably fewer number of studies focusing on the product innovation process, and there are no known studies dealing with elements of early stages of product development and the manner of implementation of activities in companies at that stage of development.

The degree of innovative activities in Croatian companies is shown in the study by Andrijević-Matovac [31]. As expected, the study found that the innovative activities of Croatian companies are poor. It proved the assertion that companies with a high investment in knowledge, and research and development have a greater competitive advantage. The organizational and managerial practices have been compared, and recommendations proposed. The sample consisted of 300 large Croatian companies by total revenue. The questionnaire was answered by 91 companies, up to March 2002. According to the survey the most important sources of ideas for innovation are: research and development department, customers or clients, company's management, sales and marketing department, and production department.

The papers [32, 33], examined the factors upon which the effects of innovation activities in small and medium-sized enterprises in Croatia (ownership, market orientation, strategic implementation, management and marketing changes) are based. The study [34] examined the possibilities and results of innovation processes in Croatian companies. The study [35] examined the innovation capacity of Croatian companies, through the determination of a national innovation quotient. The basic issue was to determine the state of innovation in the Croatian economy. Two surveys were conducted, one in 2011 and another in 2013. The report of the second study compared the results of both studies. Contrary to expectations, in the past years research activities have been reduced.

In contrast to the results of innovation research, the results of research on methods and methodology of product innovation management process are poorly available globally, and big unknowns are the results of the research of idea management process and the early stages of the product development process.

3 Empirical research

Since it is impossible to consider the entire population that is the subject of research interest, the analysed properties are estimated based on a survey of attitudes of some members of the population, or sample. The sample is representative if its basic characteristics are similar to the population (a reduced picture of the population). The sample leads to estimates of population characteristics, and statistical methods to determine the reliability and accuracy of the estimate. For the survey, it is necessary to draw up a clear and precise plan for the selection of elements in the sample. The plan includes research objectives, statistical collection, and the frame of choice, the data to be collected and the model sample.

3.1 Participants and questionnaire

Participants in the study were selected from the *"Register of Business Entities"* database, kept at the Croatian Chamber of Commerce, in which companies in Croatia are registered. For the study, companies from a certain group of activities were considered (group C-processing industry, according to the national classification from 2007). The selected group consisted of 13 158 active companies in 2010, with 213 316 employees, of which 18 911 possessed higher education (8,87 %) [36]. From the selected group, a collection of 6710 companies with higher levels of business activity (population) was chosen, from which a set of 1329 companies was randomly selected (Tab. 1). The sample was randomly chosen and was not selected according to any additional criteria.

Data collection was carried out by an online survey in late 2011 and early 2012. We sent an email to all participants in the survey, with the following information: who is carrying out the research, to which project does the research belong and what are the research objectives. Respondents were supposed to activate the attached link and fill out the survey. From 1329 who received the invitation to the questionnaire, about 800 participants read the message (approximately 60 %). Of this number approximately 240 participants participated in some way in the survey (partially or completely filled the questionnaire), which is approximately 30 % of reached recipients.

Table 1 Structure of the participants and the survey sample

NKD	Description	POP	Sample
C25	Manufacture of fabricated metal products, except machinery	2679	200
C26	Manufacture of computers, electronic and optical products	750	200
C27	Production of electronic equipment	374	200
C28	Production of machinery and equipment	813	200
C29	Production of motor vehicles and trailers	131	129
C30	Other transport equipment	492	200
C31	Manufacture of furniture	949	100
C32	Other manufacturing industries	522	100
		6710	1329

After the validation of the questionnaires by the criterion of completeness, for the purposes of this study 123 completed questionnaires were accepted (the collected questionnaires provide sample with margin of error less than 9 %, confidence level 95 %, response distribution 50 %). The fraction of response (*f*) for the conducted research is 0,0183 (ratio of the number of sample units and units in the basic group), meaning that approximately one in 55 respondents from the basic group filled out the questionnaire.

The questionnaire is divided into four parts, according to groups of variables, for which the attitudes of respondents were collected. At the beginning of the questionnaire, every respondent was familiarized with the way of completing the questionnaire, followed by groups of questions. The study involved four groups of variables: (1) The variables on the state of the company and how to improve the product development, (2) Variables on how to come up with ideas for product development, (3) Variables about the method of assessing the value of ideas, (4) Variables about the company and its market

orientation. The conceptual model of research is shown in the figure (Fig. 1). These four groups containing a total of 106 variables grouped into 35 questions to which respondents gave their answers.

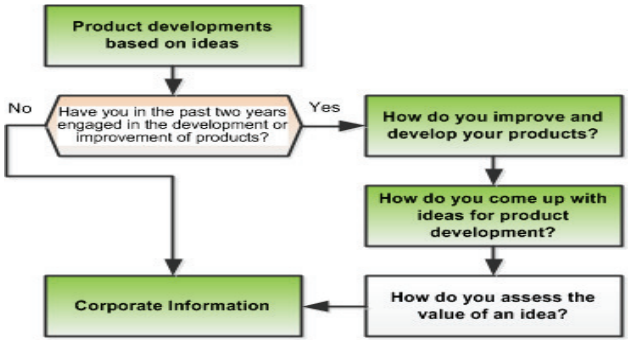

Figure 1 The concept of the research

Below the research result for the groups (1), (2), and partly (4) are presented in tabular form. When showing the collected data the specific expectations were highlighted, along with the comment on basic data collected.

In the table the results will be presented in two forms: for simple questions that respondents could answer by selecting one or more from the available responses, the frequency and/or percentage of all responses against all the answers will be given. For more complex questions where the respondents had to rank the value of several variables the Likert's scale was used. The frequency and/or percentage of all responses will be given, together with some of the basic statistical measures such as: the number of elements in the series (n), rank of a variable according to the arithmetic mean of the results (R) and standard deviation ($StDev$).

3.2 Variables about a company and the market orientation of the company

The condition of participation in the study: Only companies pursuing product development or product improvement in the previous two years could participate in the study. For the above question, 84 % of respondents (103 companies) said yes, 8 % of respondents said no, while 8 % of respondents said they do not have any products. Companies who declared that they were not engaged in the product development and/or improvement were eliminated from the sample.

The number of employees (Tab. 2): The research involved small, medium, and large enterprises according to the criterion of number of employees and gross income in the previous calendar year.

Table 2 Approximate number of employees in the company

		No.	%
1	Less than ten	28	23
2	From 10 to 50	46	37
3	From 50 to 100	18	15
4	From 100 to 500	24	20
5	More than 500	7	6
Standard Deviation = 1,203		123	100

Overall, nearly a quarter of participating companies have up to ten employees, 37 % have from ten to fifty employees, while only 6 % of respondents have more than five hundred employees. The results obtained are largely referential and an indicator of small and medium-sized enterprises (SMEs).

Gross income in the previous year (Tab. 3): The surveyed companies present a well-structured sample about the gross income of the previous year. This structure of the sample, with adequate structure of the sample in terms of number of employees, allows the analysis of the results of the overall level and analysis of the results in the categories of small, medium and large enterprises. Most small businesses according to the number of employees (78 %) have a gross income of up to 5 million kunas (665 000 €).

Table 3 Gross revenue in the previous year

		No.	%
1	Up to 66 500 €	8	7
2	From 66 500 to 665 000 €	40	33
3	From 665 000 to 3 330 000 €	31	25
4	From 3 330 000 to 13 300 000 €	22	18
5	More than 13 300 000 €	22	18
Standard Deviation = 1,219		123	100

Most medium-sized companies according to the number of employees (83 %) had a gross income from 5 to 100 million kunas (665 000 ÷ 13 300 000 €), while 96 % of large companies have reported that their gross income is higher than 25 million kunas (3 330 000 €) and 62 % more than 100 million kunas (13 300 300 €).

Qualifications of employees (Tab. 4): The presence of highly educated employees should indicate greater innovation capacity. In the same sample, most companies have more than 15 % of highly educated employees in the total number of employees, that is, according to statistics, slightly more than the average for the entire population (8,87 %). It is necessary to point out that more than 15 % of highly educated workers were employed by 56 % of small businesses, as well as in 31 % medium-sized companies, while only 21 % of large companies had more than 15 % of university graduates. The data indicates a significant representation of low-qualified workers in production in large, and to some extent in medium and small enterprises, that correlates with the products types (single production, small series) and points to the technological level of the respective companies.

Table 4 Share of employees with high education

		No.	%
1	Up to 5 % of employees	28	23
2	From 5 % to 10 %	24	20
3	From 10 % to 15 %	21	17
4	More than 15 % of employees	50	41
Standard Deviation = 1,210		123	100

Number of new products or improved existing products (Tab. 5): The condition of participation in the study was that the company was engaged in the product development and/or improvement in the past two years. Most of the surveyed companies said that in this period they had developed or significantly improved two to five products (54 %). It is important to point out that 34 % of large companies said that they had developed or significantly improved more than 10 products, which is

considerably higher than the initial hypothesis that the Croatian company annually develops a maximum of 2 ÷ 3 products.

Table 5 Number of new or improved products in past two years

		No.	%
1	Developed or improved 1 product	11	11
2	Developed or improved 2 ÷ 5 products	56	54
3	Developed or improved 6 ÷ 10 products	11	11
4	Developed or improved more than 10	23	22
5	Others (I do not know exactly)	2	2
Standard Deviation = 1,228		103	100

3.3 Variables on the product improvement and product development

Where the product development is conducted (Tab. 6): The product development is in most cases carried out within the company. As high as 75 % of small firms, 73 % of medium and 69 % of large, rely on their development. Within the group (group) in which the companies themselves carried out the product development, 23 % were large enterprises and 12 % were medium. In total, 73 % of companies developed the products within the company, 11 % of the group, 9 %, in cooperation with other companies, while only 4 % do so in cooperation with educational institutions and institutes, and a negligible 2 % use the services of other companies or institutions.

Table 6 Where product development is conducted?

		No.	%
1	Within the company	75	73
2	Within the group (includes the company)	11	11
3	In cooperation with other companies	9	9
4	In collaboration with institution	4	4
5	In other companies or institutions	2	2
6	None of above	2	2
Standard Deviation = 1,134		103	100

The exclusive focus on their resources significantly reduces innovation capacity and certainly is one of the important indicators of slowed innovation. Also, it is important to point out a slight proportion (4 %) of companies that developed products in cooperation with scientific institutions and institutes. These results are also somewhat different in relation to the initial hypothesis of a greater research representation and educational institutions in product innovation, i.e. the greater transfer of knowledge and technology on the specified route.

The number of employees in product development (Tab. 7): The perception of companies that develop their products suggests the need for a larger number of employees working in research and/or product development. However, in companies surveyed, 57 % have up to three employees in development, and 29 % have three to ten employees. In small companies the product development is usually done by three employees (86 %). In mid-sized businesses up to three employees work in 48 % and three to ten in 42 % of the companies. In large companies, the distribution is not so pronounced: from three to more than 20 employees work in the development in 19 % of large companies, three to ten worked in 38 % and from ten to twenty employees in 23 % of large companies.

Table 7 Number of employees in product development

		No.	%
1	No one	1	1
2	Up to 3 employees	59	57
3	From 3 to 10 employees	30	29
4	From 10 to 20 employees	6	6
5	At least 20 employees	7	7
Standard Deviation = 0,889		103	100

The drivers of product development (Tab. 8): Expected customer orders (negotiated procedures) as well as business strategy based on the development, are the most common triggers of product development in 30 % and 28 % of the companies. Program development is driving the development of only 19 % of large companies; for small and medium enterprises the development program is almost not even present in the initiators of development. A total of 41 % of respondents find the driver of product development in the customer orders or expected customer orders, from which it is clear that companies are trying to avoid the commercialization of products and most often turn to familiar customers, and that certainly does not deal with systematic product innovation, but primarily meets known customer needs.

Table 8 The most common triggers of product development

		No.	%
1	Previous customer orders	11	11
2	Expected customer orders	31	30
3	The need for the improvement of product	21	20
4	The program of product R&D	7	7
5	Business strategy based on R&D	29	28
6	None of above	4	4
Standard Deviation = 1,496		103	100

Respondents' answers confirm the initial hypothesis of market induced innovation. Respondents' answers largely coincide with the responses in the survey [1] when respondents gave the same response to a similar question placing the consumer needs in the first place, then increase in revenue and profit, as well as new products development and increase market share. The reasons for this focus may be found in the absence of strategy, inadequate organization of innovation management and lack of resources and knowledge necessary for the development and successful commercialization of the product. However, it should be noted that the model of innovation based solely or only in part on the market demand has ceased to be the dominant model over thirty years ago in scientific terms, and that great reliance on orders as a driver of innovation processes does not indicate the use of current scientific knowledge.

The product's complexity (Tab. 9): Among the respondents, the majority represented medium-complex products (circuits) 38 % and very complex (machinery, equipment) 39 %. 18 % of them mostly produce, in their view, very complex products, while 18 % of respondents have products in mass production.

According to company size, the relative proportion of small businesses is highest in medium complexity products, while the relative share of large enterprises is

greater with the largest complexity products in mass production.

Table 9 Product's complexity

		No.	%
1	Simple products –one part products	7	7
2	Medium complex products (assemblies)	39	38
3	Complex products (machinery, equip.)	40	39
4	Very complex products	19	18
5	Products in mass production	19	18
6	None of above	5	5

Multiple choices allowed. Total respondents: 103. *StDev* = 1,263

The size of production batches (Tab. 10): Individual production is represented in 45 % of respondents. After that, most respondents (27 %) produce in medium-sized series from 20 to 1000 products per month. 13 % of respondents had production series of the size of more than 1000 pieces per month, so it can be said that, in the sample, were almost no companies that produce large series of products.

Table 10 What are the most common product batch sizes?

		No.	%
1	Individual production	46	45
2	Small (fewer than 20 products per month)	18	17
3	Medium (20 to 1000 products per month)	28	27
4	Large (>1000 products per month)	13	13
5	Continuous production	7	7

Multiple choices allowed. Total respondents: 103. *StDev* = 1,279

Protection of products (Tab. 11): In terms of protecting intellectual property, as well as measuring the degree of development of product innovation, the situation is rather disappointing. As high as 59 % of respondents stated that they have no protected products while only 17 % say they have the patent law as a form of protection of products.

Table 11 Intellectual property protection

		No.	%
1	We do not have proprietary products	61	59
2	Copyright law	15	15
3	Patent	18	17
4	Trademark	11	11
5	Industrial design	23	22
6	Others	3	3

Multiple choices allowed. Total respondents: 103. *StDev* = 1,642

This indicates a low level of product protection in the local and in the global market, lack of knowledge and resources to protect in larger geographical areas and, indirectly, a low degree of authenticity in the products themselves.

The influence of the product's features on its market success (Tab. 12): Respondents believe that for the product market success the most important factor is adhering to customer requirements (which corresponds to the initial hypothesis), followed by product quality and punctuality of the delivery. Being innovative is ranked fifth in the opinion of respondents, which is contrary to the initial hypothesis, and the results of other studies [28], where innovation was usually placed on the first or second place. Such an opinion is a continuation of the attitude of customer orders as the most important drivers of product development, and directly correlated with low levels of innovation and competitiveness of Croatian companies.

Table 12 The influence of the product's features for its market success

		Mean	Rang	*StDev*
1	Quality of products	4,57	2	0,824
2	Product price	4,26	4	1,120
3	Suitability of products	4,59	1	0,810
4	Punctuality of product delivery	4,38	3	0,971
5	Product innovation	3,47	5	1,320
6	The existence of a good service network	3,33	6	1,587
7	The offer of additional services with product	3,27	7	1,402

The Likert's scale from 1 to 5. Total respondents: 103.

The impact of modernization on the market success of the product (Tab. 13): Most of the respondents evaluated their research and development as the most important for their products market success. This is followed by investment in education and staff training, improvements of the organization's operations, and marketing and sales improvement. This is consistent with the initial hypothesis of a high degree of isolation of Croatian companies in the process of product innovation.

Table 13 The impact of modernization on the product's market success

		Mean	Rang	*StDev*
1	Purchase of modern machines, equipment, ICT	3,54	5	1,349
2	Acquisition of knowledge that is outside of the company	3,06	6	1,413
3	Own research and development activities	4,30	1	1,110
4	External research and development service	2,42	7	1,361
5	Education and training of staff	3,97	2	1,184
6	Improvement of business organization	3,95	3	1,248
7	Improvement of marketing and sales	3,80	4	1,353

The Likert's scale from 1 to 5. Total respondents: 103.

In the study [37] respondents ranked the following modernizations as essential (in descending order): investment in machinery and equipment, modernization of production, new products development, and development of personal strategies, organizational strategies, sales promotion and marketing.

3.4 Variables about the sources and methods of collecting of ideas

Source of ideas (Tab. 14): For 53 % of respondents the sources of ideas for product development are mainly internal, while for 32 % of them they are mostly external. Under internal sources, employees of the company are explicitly specified and under external sources all who are not employees of the company are listed. According to a study [29] leading innovative organizations have a large number of partners who participate in the creation of ideas, and have established a system to collect ideas from different sources, and significantly stimulate the use of the Internet in the process of collecting ideas. In the

present study the leading organizations get about 56 % of ideas from internal sources, and about 44 % of ideas from external sources.

Table 14 Sources of ideas for product development

		No.	%
1	Only internal sources	12	12
2	Mostly internal sources	55	53
3	Only external sources	3	3
4	Mostly external sources	33	32
Standard Deviation = 1,064		103	100

This is extremely important, given that in today's world there is no organization that is large enough or innovative enough to innovate independently without cooperation with partners. The spread of knowledge about a particular problem is much greater outside of a particular enterprise than in itself, and limitation to specific frames significantly reduces the field to solve a specific problem. Access to positions such as "we have enough smart employees", or "if we develop ourselves, we will be the first to market" and "we need to control our intellectual property so competitors would not benefit from it," indicate poor knowledge of global conditions and the unwillingness to participate in market trends in today's stage of development. Therefore, disclosure of the source of ideas for product development is a crucial link in the innovation management development.

A formal place for idea collection (Tab. 15): In 29 % of companies there is no formal place for anyone with an idea to come forward. In 28 % of respondents the ideas are collected at the level of informal groups and in 13 % there are individuals who are informally responsible, mostly from the Research and Development department.

Table 15 Formal place for idea collection

		No.	%
1	Yes, formal group/team/department	21	20
2	Yes, a formally designated individual	10	10
3	Yes, an informal group/team/department	29	28
4	Yes, informally designated individual	13	13
5	Does not exist	30	29
Standard Deviation = 1,478		103	100

Adams-Bigelow's [22] found that 54 % of the ideas from companies were generated through informal activities, and of these 25 % were generated informally and without a particular purpose. Of the 46 % of ideas that come from formal idea generation activities, only 33 % were generated to fill gaps in the product portfolio. This support Tucker's claim that idea generation is sometimes applied sporadically.

According to the study [35], for only 17 % of companies there is a formally designated person, team or office that is responsible for innovation, while in 27 % of the companies this function is informal. In 25 % of companies such a function does not exist. This is consistent with the initial hypothesis about the low level of formal implementation of the product innovation process in Croatian companies.

Starting the process of idea collection (Tab. 16): Most of the companies (57 %) stressed that continuously collect ideas for product development, while 30 % declared that the idea collecting process is driven by estimation that current product could be improved. For 9 % of respondents these proceedings were initiated by an order of products. Such a large number of companies saying they continuously collect ideas is in conflict with the previous question about the existence of a formal place for idea collecting, and points out that the idea collection takes place outside the clearly defined processes.

Table 16 Starting the process of idea collection

		No.	%
1	Always, we continuously collect all ideas	59	57
2	When we have an order for a product	9	9
3	When we estimate that we can improve the product	31	30
4	When we have a technology that is not utilized	1	1
5	We never start such a procedure in an organized manner	3	3
Standard Deviation = 1,001		103	100

The above interpretation is confirmed by the results of the study [35], which states that as high as 55 % of companies have no organized system to encourage and collect ideas of employees, they are the result of a spontaneous process or the ambition of individuals. Modern methods [22], are poorly or not at all represented

Company needs for ideas gathering (Tab. 17): Fulfilment of customer's desires is the basis of the need for new ideas in product development. After that, there is the improvement of existing products and increased product offerings, while at the back there is increased capacity and environmental protection. This is also in line with the initial hypothesis of the high importance of customer orders for innovation and low level of innovation conditioned by research and development. In the study [1], respondents also noted (in this order) customer needs, increase efficiency, increase in profits and earnings, new product development, increase of market share and better use of technology.

Table 17 Company needs for idea gathering

		Mean	Rang	*StDev*
1	Increasing the supply of products	5,85	3	1,271
2	Improving existing products	5,89	2	1,145
3	Penetrating new markets	5,58	4	1,390
4	Increasing the share in existing markets	5,52	6	1,342
5	Mastering new technologies	5,04	8	1,533
6	Reducing production costs	5,58	4	1,445
7	Increase production capacity	4,88	9	1,767
8	Environmental protection	4,81	10	1,783
9	Meeting standards and norms	5,43	7	1,649
10	Complying with the customers wishes	6,40	1	1,003

The Likert's scale from 1 to 7. Total respondents: 103

Company motives for ideas gathering (Tab. 18): The new needs of customers are the fundamental motive that drives companies to look for ideas. Following that, are new expectations of the market and in the third place is the assessment of market expectations in the future. New technological possibilities are in the fourth place and competition is the fifth lowest ranked position.

Table 18 Company motives for ideas gathering

		Mean	Rang	*StDev*
1	New capabilities of technology	5,14	4	1,541
2	New needs of our customers	5,74	1	0,970
3	New market expectations	5,60	2	1,396
4	The emergence of other products on the market	4,88	5	1,555
5	Trends (stay current)	5,18	3	1,537

The Liker's scale from 1 to 7. Total respondents: 103

This is consistent with the initial hypothesis of innovation driven by orders in Croatian companies.

Sources of ideas (Tab. 19): For the participants of the study, employees, according to the view that internal sources are the dominant source of ideas, are the most common source of ideas. After them, external sources of ideas were ranked, mainly customers, clients, and potential product buyers. In the fourth place are fairs and expos, and at the back are the expert groups and enterprises specializing in research.

Table 19 Sources of ideas for product development

		Mean	Rang	*StDev*
1	Employees	5,43	1	1,499
2	Suppliers	3,41	5	1,438
3	Customers and clients	5,25	2	1,210
4	Consultants	2,42	8	1,550
5	Universities, institutes, academies	2,48	7	1,533
6	Companies specializing in research	1,87	10	1,333
7	Conferences, meetings, journals	3,35	6	1,643
8	Expert groups	2,05	9	1,555
9	Fairs and exhibitions	4,36	4	1,685
10	Potential buyers	5,04	3	1,427

The Likert's scale from 1 to 7. Total respondents: 103.

In the presentation of research [38], as the most important source of ideas, they note customers (about 50%), followed by marketing and sales (18%) and employees (11%). Participants in the study [39] responded similarly. After customers, they ranked internal sources, competition, sale, university, etc. According to the study, [28] the most important internal sources of ideas are employees (approximately 42%), external business partners (approximately 38%) and customers (about 36%). Apart from them, only consultants and competition was represented by more than 20%.

Table 20 The technique of idea gathering

		%	Rang
1	By e-mail	51	2
2	By phone	23	4
3	By voice mail	1	10
4	By mail (letter)	10	6
5	By company's WEB site	8	8
6	By suggestion box in the company	10	6
7	Write it down and send it to someone	24	3
8	On the internal meetings	67	1
9	Through an internal info. system	19	5
10	None of above	6	9

Multiple choices allowed. Total respondents: 103. *StDev* = 3,162

The method of idea gathering (Tab. 20): Gathering ideas through debates in meetings (67 %) is the primary source of ideas for product development in the companies that participated in the survey. This is followed by ideas collected via e-mail (51 %), ideas reported by phone (23 %) and presented to the superior employee (24 %). In terms of organized management processes, these results are quite devastating. They indicate spontaneity, randomness and disorganization in the process of generating ideas, especially when considering that the respondents could choose more techniques to collect ideas in their environment.

Stimulation for the proposers of ideas (Tab. 21): A significant number of researchers studied the importance of stimulation and rewarding for participants in the innovation process. Some of them, in their works, recommend financial rewards, the other social rewards (position, praise, influence, and benefits), etc. All in all, recognition of participants is an important motivator for the ultimate success and must be met for success in the innovation process [22].

Table 21 Stimulation for the proposers of ideas

		No.	%
1	Yes, pretty much guaranteeing their share of the profits	4	4
2	Yes, mostly they are guaranteed some kind of prize	2	2
3	Yes, it is stimulated through the salary of the employee	60	58
4	Yes, it is stimulated through other benefits	43	42
5	No, employees ate not additionally rewarded for it	28	27
6	None of above	7	7

Multiple choices allowed. Total respondents: 103. *StDev* = 1,021

According to [35], rewarding gives employees an additional motive and they are more prepared to offer new ideas. The authors of this study point out that in Croatia the basic way of rewarding the creators of ideas is through increased wages, bonuses and cash prizes (59 %), while a considerably smaller share of rewards consist of faster promotion or praise from superiors. Respondents in the survey also point to stimulations through salary (52 %) and other benefits (42 %). Also, there's a significant proportion (27 %) of those participants in the creation of ideas that are not further stimulated by their ideas (this primarily applies to employees in small and medium companies). In the already mentioned study [1] on a similar question, respondents said that: innovation is not rewarded (26 %), innovation is encouraged through non-financial rewards (21 %), interesting work and autonomy (19 %), personal bonuses and wage increases (18 %), promotional activities (9 %), team bonuses (4 %), the increase of teams and means for financing (2 %).

4 Discussion

The research indicates that companies attach relatively high priority to innovation in their business, but at the same time most of them (only a subset of companies that have had innovative products in the last two years have been observed) do not have an organized and managed innovation process. A significant number of companies face the attempts of innovation exclusively with their own capacities (product development is largely internal, generating new ideas is primarily due to

customer orders, ideas are generated primarily from internal sources). Companies have insufficient financial and human potential. A substantial majority of companies have three people working on product development, which can be considered inadequate. In their development, too few products are based on new technologies (very complex products are present in less than 20 % of respondents). The development of new products is determined to a great extent by customer orders, so that the potential of innovation is limited by the requirements of a particular customer's needs. Customization of products to customer needs is the highest ranked feature of the market success of the product. The need to improve the product, which adds at least an incremental new value to the product, is represented in only one fifth of respondents. .

Organized and systematic process of innovation management, more specifically the idea management process is almost non-existent. Only in a minority of cases there is no formal group and/or individual responsible for the collection and verification of ideas. However in the process of idea gathering, in many cases (three-quarters) the orientation is on internal sources (within the company). The above is correlated with the fact that companies usually resort to new ideas to express needs of customers and users, and market demands. Orientation to the internal sources of the idea is also correlated with the fact that the greatest company's need for ideas is for the sake of complying with the customers' wishes, or improving existing products. It is interesting to recognize that the material stimulation of employees for ideas is well represented, which corresponds to the trend, but a way of gathering ideas (meetings, mail), in many cases does not leave a clear ability to detect the owner of the beneficial idea, which can have a detrimental effect on the impact of stimulation.

Research results show that Croatian companies are at a very substantial turning point. The companies are aware of the situation. Estimating that for market success the greatest contribution would be given by the activities of research and development, education and training of employees, indicates familiarity with the causes of low levels of innovation. A significant number of companies that participated in the survey have a perspective, but urgently need to organize in accordance with contemporary models of innovation management, in order to significantly increase their innovation capacity. The current high level of spontaneity in the new product development and the entire innovation process in general, has come to the point where it is not enough anymore. Without a clear and robust organization through business strategy (product strategy), management (leadership) of the portfolio of innovation, culture of innovation, and resources management it is hard to expect that a large number of Croatian companies will be able to follow trends in the process of product management.

5 Conclusion and future work

Existing models of innovation management of products have been changed, largely influenced by globalization and the new situation in the world market. Some of the important reasons for this are significantly greater mobility of engineers and scientists, greater importance of the possibilities of engaging capital, greater amount of knowledge in the world, increased quality of university research, the growing rivalry between the companies on the common market, and so on. All these reasons have given rise to a new division of labor, behaviour and the change of focus from research and development to the new area of innovation systems. Today the innovation development is based on a large feedback loop in which the technological development is in interaction with the social and market models and needs. Cyclic, continuous innovation generates new social and market needs, new competition and new technology development. Innovative models are trying to keep the cyclic flow on a desired level of well-known "S" curve.

For the bettering of the innovative potential, it is necessary to develop primarily key drivers of product innovation: Leadership, Innovative Culture and Business Strategy. In doing so, the need to strengthen the elements that constitute the totality of the innovative environment should be noted in particular, in which we can include: focusing on customers and users, teamwork and cooperation, adequate resources, business communications, the ability to select ideas that have the greatest potential for innovation, the ability to recognize and reward creative individuals, freedom for innovation, the ability to measure the innovation results, encouraging the continuous creation of large and small ideas, a culture of tolerance, an organizational structure that encourages innovation, diversity, and finally the strategic balance of trying to create incremental and radical innovation.

It is hard to forecast with certainty whether the need for market adaptation will influence the importance of managing the innovation process and innovation priorities of Croatian companies. Therefore, the results of a new research cycle planned to be implemented during 2015 and 2016 with the aim of assessing new situations in the management of ideas and innovation, both in Croatian and foreign companies.

Acknowledgements

Presented research was funded by project "Models and methods of knowledge management in product development" supported by the Ministry of Science, Education and Sports of the Republic of Croatia, and MinMED project (www.minmed.org) funded by Croatian Science Foundation.

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