1 Innovation development in leading Croatian enterprises: Review of the most important findings

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Abstract

There is much talk in Croatia about the capability of Croatian companies to innovate. However, there is a lack of systematic studies on innovations development in Croatia. This paper aims to bridge that gap by reporting on a study that was performed on 100 leading Croatian companies. The paper addresses the structure of innovation in surveyed leading companies, and examines the novelty level of new products and processes. It explores whether firms of different sizes differ in their innovation output, and whether the continuity with which firms perform research activities has any impact on their innovation output. The sources of new product ideas are explored, as well as some preconditions for the new product success. As managing new product development improves the success rate, this paper examines the prevalence of such processes in companies. The impact of the new product development process on the innovation output is explored.

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1 Introduction

Innovation plays a crucial role in the transformation of economic structures and industrial sectors in transition countries through development of new products, services and processes. Product and service innovation[1] that responds to user needs makes it possible for a company to compete and survive in global markets. Process innovation introduces new resource-saving techniques into production, and thus either enables faster and cheaper product development leading to incremental product improvements, or may pave the way for new technological solutions in production that can lead to new products of high novelty. A capacity for innovating successfully is expected to create improvements in the country's competitiveness and social welfare.

Companies in Central and Eastern European countries (in further text: CEECs) face a challenging task of improving their capacity for innovation. The economies of CEECs were closed economies that encouraged incremental innovation targeted mostly at the local market (Radošević and Kutlača, 1999). In order to catch up with technologically advanced countries, companies in transition countries will have to break away from that pattern by generating innovations that can be successful in global markets. Improving innovative capabilities will require a transfer and adoption of new technologies and their integration in any firm's existing activities. It is expected that this technology adoption will first be reflected in the process innovation, and then carried on to the product innovation.

Improving innovative capabilities will also require the adoption of advanced business practices. Firms in transition economies find this challenging because business skills required for successful innovation were not considered important in the centrally planned economies. Accordingly, these skills including marketing, management, human resource management etc. were often neglected in past. This lack of experience in modern business practices may act as an impediment in reaching desired innovative capability, and

[1] *In the rest of this paper, "new product" refers both to new products and new services (this is conventional in new product literature).*

consequently in reaching a desired level of competitiveness. The companies in CEECs have become aware of the importance of adopting advanced business practices, including those aimed at innovation development. As a result, in the last decade the companies in CEECs have started adopting new product management tools and practices and integrating them into the business routine (see Mickiewicz and Radošević, 2001).

Innovation is of great importance for CEECs. Most papers on that topic focus on innovation indicators or innovation policy. For example, Radošević and Kutlača (1999) examine general innovation indicators for those CEEC countries that were candidates for accession to the EU (and have since become members), and Radošević and Auriol (1999) analyze changes in R&D and innovation activities based on S&T indicators. The other stream of literature deals with innovation policy in transition countries (Bučar and Stare, 2002; Havas, 2002; Muller, 2002; Švarc and Lažnjak, 2003). However, there are fewer studies that deal with micro-aspects of innovation development. A study by Koschatzky et al. (2001) examines structural characteristics of the Slovenian manufacturing industry and its innovative behavior. A study by Bojnec (2001) analyzes business and managerial start-ups in Slovenia during economic transformation, and their innovating activities compared to the traditional enterprises. Bonin and Abel (1998) link a change in innovating activities in Hungarian firms with a change in managerial incentives.

There is much talk in Croatia about the capability of Croatian companies to innovate. However, there were no systematic studies on the innovations development in Croatia, and there is an absence of data on that topic. This paper aims to bridge that gap by reporting on a study that was performed on 100 leading Croatian companies in the spring of 2002. The purpose of the study was to explore several issues related to the innovations development in leading Croatian firms as seen by the upper management.

This paper contributes to the literature by examining the innovations development in Croatia, a transition country that was not previously researched in that context. The paper addresses the structure of innovation in surveyed companies, and examines the novelty level of new products and

processes. It explores whether firms of different size differ in their innovation output. Next we will look into the relationship between the innovation output and a continuity of research activities in the firm. Sources of new product ideas are explored, as well as some preconditions for the new product success. Managing the new product development by using a new product development process can improve the innovation success rate, hence this paper examines the prevalence of such processes in companies (this is something none of the previously cited studies on CEECs have considered). The impact of the new product development process on the innovation output is explored.

The paper is organized in the following way: Section 2 explains the survey methodology, Section 3 talks about the structure of innovations in surveyed firms, Section 4 explores the prevalence of new product development processes, and Section 5 concludes the paper.

2 Survey

The study was performed on leading Croatian companies from all sectors of the industry. The companies were chosen in such a way that the share of firms from a certain industry in the sample equaled that industry's share of employment. This study was part of a larger survey that investigated how CEOs of companies in Croatia perceive various topics including technology, government and the public sector, public institutions, infrastructure, etc.

This survey was targeted at leading firms in Croatia. These firms were defined as fulfilling the following criteria: either the company has more than 100 employees, or its income exceeds 40,000,000 HRK (equivalent to about $ 6,000,000). In addition, each company was required to have some international experience. Companies were drawn from two sources. One of the two sources was "400 Najvećih" ("400 Largest"), a list of firms ranked by their annual income. The list is published annually by the Privredni Vjesnik business newspaper. The second source was ZAPI, which has the register of all firms in Croatia. The sample did not discriminate between companies regarding their ownership; it included both predominantly Croatian-owned companies and

those that are predominantly foreign-owned. Firms of various sizes were included in the sample.

The field study took place in the spring of 2002 through a survey that was conducted through face-to-face interviews. Out of 150 contacted companies, 100 companies responded. This very high response rate of 66 percent is most likely due to the fact that the larger survey was endorsed by the Croatian Competitiveness Council, a group of prominent businessmen and leaders.

Data collection took a little over a month. The informants were CEOs of chosen companies. Survey questions were based on a literature review and the results of previous in-depth interviews with several companies. Questions mostly sought multiple choice or scale position answers. The questionnaire was pretested on six firms before the onset of the survey.

3 Structure of innovation in the Croatian industry

The first step in this study was to gain understanding about the structure of innovation in leading Croatian companies. The author was interested in finding out how many companies in the sample innovate and at what level of innovativeness. For that purpose innovations were divided into two groups according to their novelty level. Products or processes of low novelty were described to respondents as similar to those already existing on the market, while innovations of high novelty were described as those significantly different from already existing products and processes[2]. Companies were asked to specify the total number of new products and processes, as well as the number of new products and processes of both low and high novelty introduced in the three years prior to spring 2002.

A little less than three quarters (precisely 74 percent) of firms in the Croatian survey report product innovation in the three-year period prior to spring 2002.

[2] *Product newness can be viewed from two different viewpoints (Dolan, 1990), i.e. newness to the market (judged by consumers) and newness to the firm (judged by the firm). In this study newness is viewed from the firm's perspective.*

Out of all the firms in the sample, 65 percent report product innovations of low novelty and 65 percent report product innovations of high novelty. Almost all the firms (precisely 64 percent) that introduced incremental product innovations also introduced product innovations of high innovativeness (1 firm reported only low novelty innovations, and 1 firm reported only high novelty innovations). A share of 9 percent of firms in the sample gave us data about the total number of product innovations, but did not provide any information about their novelty level.

Regarding process innovation, 59 percent of firms report introducing new processes in the three-year period prior to spring 2002. More than half of the firms in the total sample (precisely 51 percent) introduced process innovations of both low and high novelty. Again, 8 percent of firms reported process innovations, but did not supply any information on their novelty.

More than half (precisely 53 percent) of the firms in our sample introduced both product and process innovations in the three-year period between spring 1999 and spring 2002. A share of 21 percent of firms in the sample carried out product innovations only, while 6 percent implemented process innovation only. These numbers are very similar to those presented in the study by Koschatzky et al. (2001), where authors find that in a three year period prior to 1996, a share of 53.4 percent of Slovenian manufacturing companies performed both product and process innovation, while 17 percent performed product innovations only and 6 percent process innovations only.

According to empirical studies of product innovativeness performed on the US industry (Cooper, 2001; Booz, Allen and Hamilton, 1982; and Kleinschmidt and Cooper, 1991) only up to 30 percent of the products can be categorized as new to the world or new product lines[3]. The same pattern exists in this sample of leading firms in Croatia, namely innovation consists to a large extent of products and processes of low novelty, while products and processes of high innovativeness amount to a much smaller share of all innovation. The data shows that 32 percent of all products introduced from

[3] *Exact percentages vary across studies and industries.*

spring 1999 to spring 2002 are reported as being significantly different from already existing products and processes[4]. Looking at the average number of products and processes, we can see again that firms, on average, report a smaller number of highly innovative products and processes compared to all innovations. Please see Table 1 for details.

Table 1. **Average number of new products and processes**

	Total	Low level of innovativeness	High level of innovativeness
New products	11.973 (N=74)	8.10769 (N=65)	3.92308 (N=65)
New technological processes	7.33898 (N=59)	5.01961 (N=53)	3.03922 (N=53)

3.1 Firm size and innovation in Croatia

There is a large body of literature devoted to examining the relationship between the firm size and its innovative activities. For manufacturing industry, some studies justify the existence of a positive effect of the firm size on the innovation activity (Cohen, 1995; Freeman and Soete, 2001). Opposite arguments have also been suggested in Scherer and Ross (1990), Acs and Audretsch (1990) and Pavitt et al. (1987). For services, a study by Arias-Aranda et al. (2001) found that the firm size is positively related to the innovation.

In this study the firm size is measured by the number of employees. We divided firms in our sample into 5 groups: the first group were firms with 50 employees or less, the second group included firms with 51 to 100 employees, the third group included firms with 101 to 500 employees, the fourth group consisted of firms with 501 to 1000 employees, and finally in the fifth group were firms with more than 1001 employees. There are 14 firms in the first group, 9 in the second group, 38 in the third group, 15 in the fourth group and 25 in the fifth group (please see Table 2).

[4] Since this study did not utilize the same descriptions of new products as the cited studies, this result should be used for illustration only rather than for direct comparison.

An interesting question is whether the structure of innovation in Croatia depends on the firm size. Larger firms have more resources that can be devoted to innovations development, which can result in their ability to develop and commercialize a larger number of new products than smaller firms. This should hold true in particular for incremental new products, where economies of scale, power in distribution channel and better management and marketing skills are more important. When it comes to radically new products, one could again make the case for large companies. The Croatian industry is for the most part capital intensive, and small firms do not posses adequate resources for investment that is required for radical innovation. In addition, radical innovation usually requires research proficiency. Many small firms simply do not have enough research "man-power", because the majority of active research scientists who are employed in the industry work for large companies.

To determine if the firm size has any influence on innovation for Croatian companies, the ANOVA analysis was performed. The analysis does not show a relationship between the firm size and the number of incremental products and processes. Hence, the hypothesis that large firms can use their resources and advantages to turn out, on average, a larger number of incremental innovations is not supported by the Croatian data.

Regarding radical innovations, there is no relationship between the firm size and the average number of radical new processes. This is surprising, because one would expect that larger firms can introduce more radically new processes due to their better access to financial and other resources needed for the adoption and use of new technologies that often serve as the basis for a radical process innovation. Although there is no relationship between the firm size and the number of new processes of high innovativeness, data shows that there is a connection between the firm size and the number of radically new products. The ANOVA analysis shows that companies with more than 1001 employees introduced, on average, a larger number of highly innovative products than smaller firms. Table 2 shows the number of innovations by novelty and firm size.

Table 2. **Total number of innovations by firm size (Spring 1999-Spring 2002)**

Number of employees	Number of firms in the sample	Number of product innovations			Number of process innovations			Average percentage of income
		Total	Low novelty	High novelty	Total	Low novelty	High novelty	
50 employees or less	14	59	41	18	24	8	16	Between 20% and 30%
Between 51 and 100	9	70	57	8	2	1	1	Between 20% and 30%
Between 101 and 500	38	276	179	77	199	139	57	Between 20% and 30%
Between 501 and 1000	15	168	67	27	40	23	4	Between 10% and 20%
More than 1001	25	313	183	125	168	85	77	Between 10% and 20%

An indicator of the realization of new product innovation is the share of new products and processes in a firm's revenue. One would expect that large companies, due to their marketing and management skills and financial resources, are better at commercializing their products and that they would derive a larger percentage of their income from innovations. However, no correlation between the firm size and its percentage of income from innovations is found, which shows that the expected effect is not present in the Croatian industry. From Table 2. we can see that companies with more than 501 employees actually obtain, on average, a smaller percentage of revenue from innovations, but ANOVA did not show that this effect is significant.[5]

It may be possible to gain additional insight into new product/process market success by examining whether the percentage of income coming from innovations is related to their level of novelty. In order to determine if there is any connection between product/process novelty and percentage of income derived from them, a correlation analysis and univariate polynomial

[5] *Correlations with the exact number of employees and ANOVA with 5 classes of firms according to their size were performed.*

regressions were performed. Interestingly the data shows no relationships between percentage of revenue from new products and processes and the number of new products or processes, both of low and high level of innovativeness.

The data shows that there is a correlation between the number of new products and the number of new processes introduced from spring 1999 to spring 2002. This finding indicates that new products and new processes go together; namely the firms that develop new processes also develop new products. In particular, a strong and significant correlation is found between the number of new products of low novelty and the number of processes of low novelty.[6] In other words, companies that introduce a large number of incremental product innovations also introduce a large number of incremental process innovations. This relationship remains true even when analysis is performed for service firms and manufacturing firms separately. There is also a significant correlation between the number of radically new products and the number of radically new processes.[7] This reflects the fact that it is not possible to realize new products of high novelty without improving firm's outdated technologies and processes. This finding indicates that development of radically new products requires radically different ways of doing things. Again if service firms and manufacturing firms are considered separately, the same relationship still holds. As radically new processes are usually connected with new technologies, this might suggest that highly innovative products cannot be created in firms that do not invest in new technologies.

3.2 Continuity of research in innovation development

If we understand innovation as a continuous process in which companies search for new products and processes, then the continuity of research and development plays a crucial role. To determine to which extent this continuity

[6] *r = 0.79, p = 0.000 for full sample, r = 0.83, p = 0.000 for manufacturing firms, r = 0.73, p = 0.000 for service firms.*

[7] *r = 0.68, p = 0.000 for full sample, the same for manufacturing and service firms*

exists in the Croatian industry, companies were asked how frequently they perform R&D activities aimed at new product or process development.[8] On the scale from 1 (never) to 7 (constantly), 63 percent of surveyed companies answered 5 or above, 41 percent of companies responded with 6 or 7, and 28 percent responded with 7. This finding suggests that the majority of firms (63 percent) carry out research with the above average regularity, while more that one-quarter of all the firms performs research constantly. Out of 24 percent of firms that engage in research with less than average regularity, 70 percent are service firms. This reflects a lack of structured development research in the Croatian service industry.

An interesting question is whether there is a connection between the firm size and the frequency of research, as reported by Croatian companies. Generally speaking, larger firms possess adequate financial and human resources to engage continually in research aimed at the development of new products or processes. A correlation analysis was performed on the data, but no significant relationship was found between the firm size and the frequency of research activities. Thus, it is not possible to conclude that larger firms in Croatia perform research on a more continual basis than smaller firms. This particular finding might have been caused by a weakening of research and development capabilities in the Croatian industry that took place in the 1990s through a breakup of several industrial institutes and scaling down of various R&D departments. There is no doubt that this event has had a negative impact on the research capability of larger firms. While this should have benefited the SME sector through a transfer of R&D personnel from the dismantled industrial departments to newly founded privately owned small companies, it is not clear to which extent this really happened (there is no data on this "demographic shift"). The author believes that this result on research continuity was caused by a weaker research capability of the large industry, rather than improvement in the research capacity of SMEs.

[8] *The question was phrased as: "How frequently does your company engage in research aimed at development of new products and processes?" Answers were offered on the scale from 1 (never) to 7 (constantly). The average answer in our sample is 4.92 (st.dev 1.82, median 5), which shows an above average research frequency in development activities.*

It is symptomatic that no relationship is found between frequency with which firms perform research aimed at new product development, and the percentage of income derived from new products.[9] This can be explained by the fact that most innovations in the surveyed firms are incremental and as such do not require research. Interestingly, there is a significant correlation between the frequency of research and both the number of radically new products and the number of radically new processes[10]. The latter result shows that the firms that engage in continual research are better at developing highly innovative products or processes, which underlines the importance of development work.

3.3 Sources of new product ideas and preconditions for the new product success

The new product success depends in part on how successfully it can address the existing need in a market (Urban and Hauser, 1990). Most firms understand the importance of customer input in the new product development. Firms often engage in market research in order to understand their customers and their needs, and develop ideas for new products accordingly. Firms also may get new product ideas from suppliers, other companies which are neither suppliers nor customers, from universities or scientific institutes, and finally from their own employees.

In Croatia most companies report their employees and their customers as the most frequent sources of new product ideas. A 94 percent share of firms in the sample use customers sometimes or regularly as a source of new product ideas, while 90 percent of firms use employees in that capacity sometimes or regularly. Suppliers are mentioned by 79 percent of firms as a source from which ideas come sometimes or regularly. Data shows that a much smaller percentage of companies get the ideas for new products from other firms that are neither suppliers nor users. Even a share of 42 percent of firms never get ideas from other companies. This is caused by a general lack of collaboration

[9] *Polynomial regression gives $F = 2.56$, $p = 0.92$, adjusted $R^2 = 0.078$.*

[10] *$r = 0.31$, $p = 0.037$ for radical new products, $r = 0.32$, $p = 0.031$ for radical new processes; both for the full sample.*

among firms in Croatia (for illustration, in Croatia, as in other CEE transition countries, there are very few clusters.) More worrisome is the finding that 52 percent of firms in the sample never use universities and research institutes as a source of new ideas, while a small 7 percent of firms use them on a regular basis. This reflects a problem that is well recognized in Croatia (as in other transition countries, see Radošević, 2001); namely, the absence of meaningful collaboration between universities and companies. For details please refer to the following Table 3.

Table 3. **Sources of new product ideas**

	Frequency		
	Never	Sometimes	Regularly
Customers or users	3	64	30
Suppliers	18	62	17
Other companies that are neither suppliers nor users	42	49	4
Universities or scientific institutes	52	38	7
Employees	3	54	36

Some preconditions for the product success were identified in existing studies (Koschatzky et al., 2001), and further confirmed in preliminary interviews with managers. These preconditions are market analysis, experience with existing products, in-house R&D, collaboration with other companies, collaboration with academics, and licenses (please see Table 4.). Knowing to which extent firms find these activities important will allow a better insight into their new product development.

The companies involved in the Croatian study were asked to rate how important they consider the preconditions listed above[11]. The data shows that the preconditions fall into four groups according to the imputed importance. On average, firms impute the highest importance to market analysis, which is rated significantly higher than all the other items. This result indicates that firms are customer-oriented and is consistent with the previous finding that

[11] *Answers were offered on the scale from 1 (not at all important) to 7 (very important).*

most companies use customers as the source of new product ideas. As the second important precondition firms rate their experience with existing products, and that is evaluated significantly higher than the remaining four preconditions. After the experience with existing products, follow in-house R&D and collaboration with other companies. These two preconditions are not significantly different from each other, but are significantly different from the last group, which consists of collaboration with academics and licenses.[12] The latter two items are not significantly different from each other. Details are presented in Table 4.

Table 4. **Some preconditions for the innovation development and their importance**

Preconditions for innovation	Mean value	Number of companies that answered 1, 2 or 3	Number of companies that answered 4	Number of companies that answered 5, 6 or 7
Market analysis	6.071429	21	16	62
Experience with existing products	5.693878	5	21	72
In-house R&D	4.857143	33	25	41
Collaboration with other companies	4.704082	18	23	57
Collaboration with academics	4.122449	40	17	42
Licenses	3.969388	13	28	57

These figures show that the firms rely primarily on customer input, then on their own experience with their existing products, and less on research (both their own and that imported from academic institutions). This is consistent with the previous result that most new products are of incremental nature.

It is interesting to note that the same order of precondition importance is present when the analysis is repeated for the manufacturing and the service industry separately.

By analyzing the preconditions' importance ratings, together with sources of innovation ideas, it is possible to conclude that Croatian companies rely

[12] *Statistical significance was determined by using first a t-test for dependent samples and then the same results were obtained using a sign test. The significance level is 5%.*

mostly on their internal competencies in the new product development. Collaboration with external partners, whether those partners are academic institutions or other companies, is not considered very important, and accordingly they are rarely a source of innovation ideas. This is consistent with the situation in other transition countries.

4 Innovations development practices: NPD process

To keep up with market demands and competitive pressure, firms need to acquire the capability of sustainable successful innovating. Companies today are under increasing pressure to reduce development time while at the same time striving to improve the new product success rates. To meet these difficult demands, many firms have adopted product innovation processes. Copper and Kleinschmidt (1991) in an empirical study of US companies found that firms use formal development processes for three main reasons. The first is to improve cooperation, coordination and communication among people involved in a new product project. The second main reason is to improve the quality and timing of the activities that make up the project. The third main reason is a desire for more control and information.

The new product development process is a conceptual and operational model for moving new product or service projects from the idea to the launch and beyond. It is a blue print for managing new product or service projects, improving their efficiency and effectiveness (Cooper, 2001). Although product development processes have a longer history in manufacturing firms, in the last decade service firms have started using them for new service development (Griffin, 1997). According to the PDMA[13] best practices study, the best companies are more likely to use some type of formal NPD process than the rest (Griffin, 1997). Several studies found that a structured product development process is one of the key factors of the new product success (Cooper 1990a, 1990b; Cooper and Kleinschmidt, 1986, 1991).

[13] *PDMA stands for Product Management and Development Association.*

Transition countries lag behind the European Union countries in many innovation and R&D indicators (Radošević, 2001), so it is natural to assume that they would trail behind developed economies in new product development practices as well. However, one would imagine that a certain number of firms in transition countries have adopted the advanced practices due to increased market pressure and intensified contact with foreign firms. To determine the nature of new product development practices in Croatia, respondents were asked to which extent they would agree that their companies practice a well-structured new product development.[14] Although the range of answers is large and reflects heterogeneity in innovations practices, more than half of the respondents answered that they agreed somewhat or more. For details please see the following Table 5.

Table 5. **Existence of a well-structured new product development process**

"Company practices a well structured NPD process"	Count	Percent
Completely disagree	2	1.98
Disagree	4	3.96
Somewhat disagree	11	10.89
Neither agree nor disagree	17	16.83
Somewhat agree	19	18.81
Agree	23	22.77
Completely agree	24	23.76
Mean = 5.12, median =5, st.dev.= 1.58		

The fact that more than half of the companies in the sample answered above average to this question shows certain satisfaction with the structure of NPD process. To find whether this satisfaction is founded on facts, interviewers probed deeper by describing the most commonly found development practices and asking respondents to choose the description closest to their firm's development activities. Five NPD process descriptions were listed, starting with "we have no standard approach to new product development", and followed by "there is no formally documented process, but we have clear understanding

[14] *The question was worded as "Do you agree with the follwing statement: in my company there is a well structured new product or service development process?" Answers were offered on the scale from 1 (completely disagree) to 7 (completely agree).*

of the steps that need to be taken". These two options represent the lowest levels of new product development sophistication, namely the process that is not formalized. A description of a more advanced process offered to the respondents was "we have a formally documented process in which business functions perform development tasks sequentially". The two descriptions that represent the most advanced forms of new product development outline a formalized process involving cross-functional teams. These are "we have a formally documented process where a cross-functional team performs a set of development tasks, management reviews the outcome and gives a go-ahead", and "we have a formally documented process where development is divided into phases (stages) where some stages may overlap; a cross-functional team performs evaluations after the completion of each phase and decides on project continuation". The last statement describes the most advanced of the five offered types of NPD process.

The data shows that 30 percent of leading firms in the sample have no formally documented NPD process (good news is that only 4 percent of firms have no standard approach to new product development). This 30 percent share is similar to the share of 38.5 percent from the PDMA empirical study on new product development practices in the USA (Griffin, 1997). A 20.8 percent share of firms in Croatia practice a formally documented process, in which business functions perform development tasks sequentially. It is encouraging that 43.56 percent of firms practice advanced types of new product development. Compared to the US study (Griffin, 1997), which finds that 69 percent of the best firms and 52 percent of the rest use a multifunctional stage gate process, a 43.56 percent share among leading firms in Croatia does not seem bad. More precisely, 26.73 percent of firms in Croatia have a formally documented process where a cross-functional team performs a set of development tasks, management reviews the outcome and gives a go-ahead, while 16.83 percent of firms in Croatia practice a formally documented process where development is divided into phases (stages), some stages may overlap, and a cross-functional team performs evaluations after the completion of each phase and decides on a project continuation. Please see Table 6. for details.

Table 6. **Type of new product development process practiced in a respondent's company**		
	Count	Percent
We have no standard approach to new product/service development	4	3.96
There is no formally documented process, but we have clear understanding of the steps that need to be taken	27	26.73
We have a formally documented process in which business functions perform development tasks sequentially	21	20.79
We have a formally documented process where a cross-functional team performs a set of development tasks, management reviews the outcome and gives a go-ahead	27	26.73
We have a formally documented process where development is divided into phases (stages) where some stages may overlap. A cross-functional team performs evaluations after the completion of each phase and decides on a project continuation	17	16.83

To simplify further analysis, development processes are divided into three groups according to the level of sophistication; namely, when no formally documented process exists, when there is a formally documented process but without the involvement of cross-functional teams, and finally a formally documented process performed by cross-functional teams.

Respondents' perception of the structure of their NPD process should correspond with the reported description of a practiced process. Any deviations from this may suggest that companies do not have a realistic view of their product development. Unfortunately, this does seem to be happening to companies in the Croatian sample. When respondents' perceptions are compared with the process descriptions, certain discrepancies become obvious (please consult Table 7.)

Table 7. **Comparison of respondents' perception of the development process and its description**

	Statement: Respondent's company practices a well structured new product/service development		
	Respondents who do not agree[15]	Respondents who neither agree nor disagree[16]	Respondents who agree[17]
No formally documented new product process and no multifunctional teams	8 (25%)	5 (16%)	18 (58%)
There is a formally documented new product process but no multifunctional teams	3 (14%)	4 (19%)	14 (66%)
There is a formally documented new product process involving multifunctional teams	5 (11%)	7 (16%)	32 (72%)

There is a large percentage of respondents who believe that their companies practice a well-structured NPD process, while not recognizing their company in the description of such a process. The most serious case is the group of firms that report that they use no formally documented NPD process, however, 58 percent of them claim that they have a well-structured NPD process. This finding can be interpreted only as caused by the lack of knowledge about modern innovation development methods, which is worrisome and potentially dangerous, taking into account the role of innovations in achieving economic growth.

4.1 Continuity of research and the new product development process

Implementing an advanced development process requires serious organizational commitment and good resources. Firms that invest in such a demanding project usually are innovation-oriented and are very well aware of how important it is to regularly conduct research for the purpose of innovation development. This leads to a hypothesis that the continuity of

[15] *These respondents gave answers 1, 2 or 3 on the scale from 1 (strongly disagree) to 7 (strongly agree).*

[16] *These respondents gave answer 4 on the scale from 1 (strongly disagree) to 7 (strongly agree).*

[17] *These respondents gave answers 5, 6 or 7 on the scale from 1 (strongly disagree) to 7 (strongly agree).*

research aimed at new product development is positively correlated with the sophistication of NPD process.

Interestingly, in the Croatian sample no significant difference is found in research continuity among the three groups of firms with different development process sophistication levels.[18] However, the average answers to this question do increase with the process sophistication. Although this effect is not statistically significant, the frequency with which companies engage in research is higher for firms that practice advanced product development than for firms that use development processes of low sophistication (exactly what one would expect). This result suggests that a statistically significant hypothesized pattern might be emerging in the future.

Since the absence of a hypothesized relationship might be due to heterogeneity in the data, the same analysis was performed for firms of different sizes. Again, no significant relationship was found. To check for the effect of industry type, the same analysis was performed on manufacturing firms and service firms separately, but again no significant association emerged.

4.2 Innovation output and the new product development process

One of the motives for adopting a structured development process is improvement in a firm's capability for sustainable commercially successful innovating. Therefore, one would expect that the companies that use advanced NPD processes enjoy higher revenue from their commercialized innovations. However, data shows that the percentage of revenue coming from new products and technological processes introduced in the three-year period prior to spring 2002 does not depend on the sophistication of the innovation development process.[19]

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[18] Averages increase with the development process sophistication, namely they are 4.52, 5.14 and 5.18. These numbers are not significantly different (ANOVA p=0.25).

[19] Answer to this question is categorical (1 stands for "less that 10%", 2 stands for "between 11% and 20%", etc. and 10 stands for "greater than 91%"). The relationship with the level of development process sophistication was examined using Pearson chi test (p=0.66).

The sophistication of the NPD process also plays no role in creating a larger number of innovations, although one would expect that the firms using more advanced NPD processes are able to introduce more new products. In the Croatian data, no relationships between the type of the NPD process and the number of new products or processes can be established. This is true for products and processes of both low and high level of innovativeness.

All these findings may suggest that, on average, the firms where advanced NPD processes are in place have failed to produce a marked difference in comparison with the firms that employ less sophisticated practices. There are two possible explanations for what might have caused these effects. First, most firms in transition countries, including Croatia, have not had a long experience with advanced development processes. It is plausible that after a period of fine-tuning we will indeed in the future start observing that the firms practicing advanced NPD processes have a better innovation output. The second explanation is that companies do report to practice advanced product/service development, but in reality these processes cannot really work because they are either poorly designed or poorly performed due to lack of expertise, lack of skilled people, organizational deficiencies or simply managerial incompetence.

5 Conclusion

This paper reports on a study that was performed on 100 leading companies in Croatia in spring 2002. Respondents were CEOs of chosen companies. The purpose of the study was to examine several issues related to innovations development. This is the first study of new product development practices in Croatia and one of the first for CEECs.

This study shows that most leading firms in Croatia have innovated in the three-year period prior to spring 2002 (74 percent of firms report product innovation and 59 percent of firms report process innovation). These numbers are very similar to those reported for Slovenia (Koschatzky et al., 2001). Majority (about two thirds) of product and process innovations are recorded

as being of low level of innovativeness. This number is consistent with the existing studies on US companies.

The study indicates that large firms in Croatia are not using their existing resources efficiently and effectively in innovation development and commercialization. For example, one would expect that large firms are better at introducing incremental improvements of existing products due to their marketing and management skills, financial resources and power in the channel. However, this hypothesis is not supported by Croatian data. One would also expect that large firms would derive a larger percentage of their income from innovations due to the fact that their resources give them necessary advantage in commercializing their new products. However, no correlation between the firm size and the percentage of income from innovations is found.

Although the data suggests that large firms do not use their resources in the optimum way when it comes to incremental new products, they develop a significantly larger number of new products of high novelty than smaller firms. However, large firms do not differ in the number of new processes of high novelty, which is surprising taking into account that large firms should have advantage over small firms in the financial and human resources needed to acquire new technologies that are often the basis for a radical new process innovation. This could be explained by the fact that the Croatian industry has not invested much in new technologies in the last decade due to problems associated first with the war, and then with restructuring and privatization. These events have eroded the technological capability of large firms, which is reflected in the lack of radical process innovation.

Although about two thirds of all innovations are incremental, most firms in the sample (a 63 percent share) carry out research aimed at innovation development with an above average regularity, while more that one quarter of all the firms perform research constantly. Among the 24 percent of firms that perform research with less than average regularity, the majority are service firms. Interestingly, there is no relationship between research continuity and the percentage of income coming from new products, which is most likely due

to the fact that majority of the innovation output is of incremental nature and does not require continual research. Data indicates that the firms that do engage in continual research are better at developing highly innovative products or processes. Radical innovation is very risky, but the firms take that risk because successful radical innovation can be a significant source of income for the firm. By combining the previous two findings, this study points out that Croatian firms may lack capability to successfully commercialize radical innovations, which puts them in an unenviable position of having to bear the risk and expenses but not of reaping the rewards. This may act as an incentive to focus further on the incremental product innovation and discourage radical innovation in the long run.

This study examined to what extent companies in Croatia implement modern product development practices, the NPD process in particular. Since the product development is a complex and risky procedure, many firms in advanced economies have adopted product innovation processes to help them manage the risk and complexity. The NPD process is proved in empirical studies to be one of the most important factors in the new product success. In Croatia a 30 percent share of firms in the sample have no formally documented NPD process, 20.8 percent of firms practice a formally documented process in which business functions perform development tasks sequentially, and 43.56 percent of firms practice a formally documented process performed by empowered cross-functional teams. Interestingly, one cannot conclude that large firms in Croatia are more sophisticated in their NPD process than small firms. A plausible explanation for it is that since the sample consists of leading firms, these small firms from the sample have a better access to the resources needed for the NPD process implementation and are more motivated to adopt advanced business practices than other small firms.

Although more than half of the companies in the Croatian sample have some type of formally documented NPD process in place, it seems that these processes have failed to produce a statistically significant difference in comparison with the firms that employ less sophisticated practices. For example, data shows that the percentage of revenue coming from innovations

introduced in the three years period prior to spring 2002 does not significantly depend on sophistication of the innovation development process. Similarly, there is no significant relationship between the NPD process and the number of new innovations, regardless of their novelty level. Although data shows that an expected pattern between the innovation output and sophistication of the new product exists, this relationship is not statistically significant. The reasons why NPD processes in Croatia have had no significant impact on the innovation output are not clear. One reason may be that these processes were only recently implemented in the Croatian firms. Another explanation may be that these processes are formally in place, but the firms that implement them still lack the capabilities necessary to run them properly. In both cases significant correlations might emerge in the future.

All the findings in this study indicate that the Croatian industry takes innovation seriously, but still lacks skills and capabilities to make it really commercially successful (this is particularly true for radical innovations). It is promising that firms in Croatia are recognizing their weaknesses and are willing to adopt modern business practices. However, they might be discouraged by the absence of expected improvements because the lack of necessary skills might act as a barrier to a proper integration and functioning of these tools. This is a problem that appears in various degrees in all transition economies.

This study is the first step in examining the innovation development in Croatia by exploring the structure of innovation, the prevalence of a structured NPD process in Croatia and its impact on the innovation output. Although this study is performed on companies in Croatia, the results offer insights into the problems faced by most companies in transition countries.

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