

Ljiljana Božić\*

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## CONSTRAINTS TO INNOVATION ACTIVITIES IN CROATIAN ENTERPRISES

*Croatian enterprises report relatively low level of innovativeness. The objective of this paper is to identify factors that constraint innovation activity of Croatian firms. The analysis is focused on the impact of constraining factors on the decision to abandon and delay innovation development employing Croatian Community Innovation Survey 2006 (CIS2006) data. Exploration of factors leading to abandonments or delays of innovation projects relies on 1041 enterprises that reported any form of innovation activity. The results of the analysis reveal the differences in sensitivity to various constraining factors when it comes to decision to abandon and delay innovation development.*

*Key words: constraining factors, abandonment, delay, innovation activity*

### 1. Introduction

Innovations are considered one of the means of achieving economic growth and improving business performance especially in the long run. This notion is widely acknowledged in the literature. Development of innovation and its intro-

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\* Lj. Božić, Senior research assistant; The Institute of Economics, Zagreb. (e-mail: ljbozic@eizg.hr)

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duction to the market along with modifications of existing products help the enterprises to cope with intensive competition and changes in customer preferences and needs.

Innovation development is a process that requires various resources, both financial resources and appropriate skills and knowledge. Literature on factors determining innovation activities is very broad (Atuahene-Gima, 1995; Danneels and Klienschmidt, 2001; Hult, Hurley and Knight, 2004; Laursen and Salter, 2006; Trott, 1998; Conner and Prahalad, 1996; Eisenhardt and Martin, 2000). Apart from factors that contribute to innovation activities, enterprises often face many factors that constrain them. Constraining factors can be related to financial issues, costs, knowledge and capabilities of enterprise, market and other external factors.

In this paper the factors constraining innovation activities in Croatian enterprises are addressed. This issue is especially relevant in Croatian context since the enterprises report relatively low level of innovativeness. According to European Innovation Scoreboard 2006 (EIS 2006), Croatia is listed among trailing countries meaning that innovation activities in Croatia lag behind EU-25 (Eurostat, 2008). In the period 2004-2006 only 33.59% firms conducted innovation activities (i.e. had R&D activities and/or introduced new product innovation and/or process innovation of any type). Two thirds of firms did not make any effort to innovate (calculation based on CIS 2006 data).

Especially troublesome is the fact that only 33 per cent of innovative firms developed an innovation that was new to the market. This means that most of the firms focus innovation activities on modifying and copying product innovation developed by other firms.

In this paper the reasons of low level of innovativeness are explored by studying constraints to innovation activities. The objective of paper is to identify factors that hamper innovation activities of Croatian firms that are willing to innovate. The aim of the analysis is to understand how to stimulate innovation activities.

The structure of paper is following: after the brief introduction in Section 1, in Section 2 a literature review is given and Section 3 describes methodology. Results of the analysis are presented in Section 4. Section 5 concludes.

## **2. Literature review**

The literature on constraints to innovation activities generally focuses on the presence of internal and external constraints in enterprises, their intensity and impact on the level of innovativeness and the outcome of innovation activities.

Studies on obstacles to innovation activities report one interesting finding: innovative enterprises report more obstacles in comparison with less innovative firms (Hadjimanolis, 1999, Radas and Božić, 2009). Hadjimanolis (1999) explains that finding by stating that innovative firms tend to overcome the obstacles while non-innovative enterprises may underestimate the obstacles since they do not make an effort to innovate. Mohnen et al. (2008) consider the perception of obstacles endogenous and co-determined by the same factors that determine innovations that makes more likely for innovative enterprises to perceive obstacles.

Among various factors constraining innovation activities, financing related issues are the most relevant factor. In the study on technological innovation in enterprises in Italy, Sirilli and Evangelista (1998) find that the lack of appropriate sources of finance was regarded as very important obstacle in service firms. Findings of CIS for United Kingdom indicate the financial constraint the second most important constraint, after high cost related to innovation development (Stockdale, 2002). Tiwari et al. (2007) confirmed in their study the strong and significant impact of financial constraints on R&D investment. The impact of financial constraints is found to be stronger in comparison to other obstacles (such as market uncertainty, institutional constraints and organizational rigidities) although authors have found that they are less binding when other constraints are present.

Indeed, there are studies that argue the possibility of simultaneous occurrence of various obstacles in enterprises especially those that face financial constraints (Mohnen et al., 2008). Hewitt-Dundas (2006) has found the presence of wide range of human, organizational and financial constraints in firms that are constrained by lack of internal skills.

Financial constraints cause delaying, postponing and not starting innovation development process especially in risky and less profitable industries (Canepa and Stoneman, 2002). They also increase probability of prematurely stopping, seriously slowing down and not starting innovation development project but they are not significantly related to probability of abandonment (Mohnen et al. 2008).

The impact of constraints varies across sectors. Low-tech manufacturers and knowledge-intensive services are more sensitive to changes in the perception of barriers compared to high-tech manufacturing firms (Segarra-Blasco, Garcia-Quevedo and Teruel-Carrizosa, 2008). Main constraints to innovation in high-tech manufacturing are costs of innovation and factors such as difficulties in finding partners and getting accesses to innovation flows.

In the literature authors often point out the importance of findings on constraining factors in terms of designing policies for promoting innovation activities. Mohnen and Röller (2005) find that probability of becoming an innovator and intensity of innovation are related to different constraints. They also find the complementarities among the constraints for the intensity of innovation, but the

same constraints act as substitutes for propensity of becoming an innovator. These findings imply the necessity of designing innovation policies suitable for different phases of innovation.

Following the results of their research, Galia and Legros (2004) emphasize the importance of integrating complementarities among constraints on innovation in innovation policy in order to encourage innovation activities in firms. Based on the findings of the study on the barriers on innovation in high-tech and low tech manufacturing firms and knowledge intensive services, Segarra-Blasco, Garcia-Quevedo and Teruel-Carrizosa (2008) argue the importance of taking into account barriers to innovation in designing regional innovation policy.

The findings of various studies presented in this review give a valuable insight into the influence of various constraints to the innovation activities. Concerning the low level of innovativeness in Croatian enterprises it is important to investigate the factors constraining innovation activity in Croatian firms and intensity of their influence. Thus, the focus is on determining the relationship between constraining factors and abandonment and delaying innovation projects in Croatia.

### 3. Methodology

This study is based on data from Croatian Community Innovation Survey 2006 (CIS2006). The survey covers data on innovation activities in Croatian firms from year 2004 to 2006. CIS 2006 database contains data on product and processes innovations developed in three-year period, as well as data on innovation projects that were abandoned (in the stage of concept development and/or after the project has started), delayed and not completed.

Total sample consists of 3093 enterprises. It includes both innovative and non-innovative firms. In our study the focus is on firms that have performed innovation activities (regardless of the outcome). Only enterprises involved in innovation activities could experience failure of the project in the form of either abandonment or delay. Besides, the previously mentioned findings according to which innovative firms report more constraints and are more aware of the presence of constraining factors since they are more involved in innovation activities (Mohnen et al., 2008; Hadjimanolis, 1999) are acknowledged in this study. Including the non-innovative firms that are not aware of constraints and their intensity could cause misleading conclusions. Therefore, exploration of factors leading to abandoning or delaying innovation projects (i.e. probit regression) relies on 1041 enterprises that reported any form of innovation activity. Prior to probit regression, a descriptive analysis is conducted in order to identify the presence of constraining factors in all firms (i.e. 3093) and in innovative firms (i.e. 1041 firms) separately.

For the purpose of this study the definition of an innovator is very broad: firm that reported innovation activities in terms of developing either product innovation or process innovation, and/or conducting innovation activities that are not finished within three years and/or that invested in internal R&D, or any other activity related to innovation development (such as expenditure in acquisition of machinery or knowledge, expenditure on training, on market introduction of innovation). In other words, not only successful innovators, but all firms that make an effort to innovate are included in the analysis.

The impact of nine constraining factors on abandoning and delaying the project is studied. They are: (1) lack of internal sources of finances, (2) lack of external sources of finances, (3) costs too high, (4) lack of qualified personnel, (5) lack of information on technology, (6) lack of information on markets, (7) problems with finding a partner for innovation development, (8) incumbent dominated market and (9) lack of demand. Their importance is measured on the scale from 0 to 3, where 0 indicates no experience, 1 low level of importance, 2 medium and 3 high level of importance. This scale reflects respondents' perception of the importance of factors constraining innovation activities. Similar set of constraints was employed in other studies on the topic (e.g. Mohnen et al., 2008; Segarra-Blasco, Garcia-Quevedo and Teruel-Carrizosa, 2008). This enables comparison of our findings with the results of research conducted in other countries.

In order to research the impact of nine constraints on abandoning and delaying innovation projects, we employ a probit model. First equation examines the impact of constraining factors on the probability to abandon innovation. Second one examines their impact on probability to delay innovation development.

## **4. Results**

### ***4.1. Constraints to innovation – descriptive analysis***

According to data presented in Table 1, the greatest number of firms faced lack of internal finances and lack of qualified personnel. Approximately 60 per cent of firms in the sample reported lack of internal sources of finances and lack of qualified personnel. This indicates that internal constraints are present in large number of firms. On the other hand, number of firms that had problems with finding co-operator for innovation development is lower compared to other constraining factors. Only 44.6 per cent of all firms in the sample report having this problem.

Table 1:

## THE PRESENCE OF CONSTRAINING FACTORS

	No. of firms				Abandoned (n=257)		Delayed (n=221)	
	All (n=3093)	%	Innovators (n=1041)	%		%		%
Lack of internal sources of finances	1846	59.7	838	80.5	235	91.4	188	85.1
Lack of external sources of finances	1559	50.4	707	67.9	199	77.4	154	59.68
Costs too high	1745	56.4	829	79.6	231	89.9	193	87.3
Lack of qualified personnel	1844	59.6	856	82.2	236	91.8	206	93.2
Lack of information on technology	1688	54.6	794	76.3	231	89.9	201	91.0
Lack of information on markets	1662	53.7	774	74.4	225	87.6	190	86.0
Problems with finding co-operator	1380	44.6	624	59.9	188	73.2	171	77.4
Incumbent dominated market	1575	50.92	726	69.7	217	84.4	171	77.4
Lack of demand	1532	49.53	715	68.7	208	80.9	169	76.5

Among innovators, the greatest number reported the presence of problems related to lack of qualified personnel. Interestingly, more firms report lack of qualified personnel than lack of internal financial resources. Along with that problem, firms report presence of lack of information on technology (76.3 per cent) and on market (74.4 per cent). Very high percentage of firms in the sample report having problems with internal sources of finances. 80.5 percent of all innovative firms lack internal finances for innovation activities. Innovators report least the problem with finding partner for innovation activities.

Data in Table 1 show that in 235 (91.4 per cent) cases reporting an abandonment of innovation, the lack of internal finances was present. The number of cases that delayed innovation development and faced lack of financial resources within the firm is slightly lower (188 firms or 85.1 per cent). Also, lack of external finances is less faced by the firms that report existence of abandoned innovation. Lack of qualified personnel is the problem that occurs in 236 (91.8 per cent) firms that have abandoned innovation projects. The same problem is reported by 206 (91.0 per cent) firms that were forced to delay innovation development process.

Results on the perception of the importance of faced constraints show the highest importance of the lack of internal finances (mean 1.311) and high costs of innovation development (1.267). Problems related to finding partners for innovation are perceived as less important (mean 0.774). Among constraints whose intensity is, in general, perceived at lower level are lack of information on market, lack of information on technology and lack of demand. The mean perceived intensity of constraining factors for innovative firms is higher for all nine constraints.

Table 2:

MEAN INTENSITY OF CONSTRAINING FACTORS

	Mean – all firms	Mean – innovators
Lack of internal sources of finances	1.311	1.723
Lack of external sources of finances	1.038	1.369
Costs too high	1.267	1.727
Lack of qualified personnel	1.115	1.530
Lack of information on technology	0.822	1.140
Lack of information on markets	0.813	1.115
Problems with finding co-operator	0.774	0.988
Incumbent dominated market	0.958	1.254
Lack of demand	0.819	1.056

**4.2. Results of probit regression**

Results of the probit regression are presented in Table 3. Both models are statistically significant. Two constraining factors are found to be significantly related to probability to both abandon and delay innovation development. Those are lack of external sources of finances and lack of information on technology.

According to the results of analysis, the perception of the intensity of four constraints is significantly related to the decision to abandon innovation development project. Those are: lack of both internal and external financial sources, lack of information on technology and incumbent dominated market. Constraining factors whose intensity significantly influences the delays of innovation development projects are lack of external financial sources, lack of qualified personnel, lack of information on technology and problems with finding co-operators for innovation development. Other constraints are found to be non-significantly related to abandoning innovation activities and delaying it.

Table 3:

PROBIT MODELS OF THE INFLUENCE OF CONSTRAINING  
FACTORS TO THE PROBABILITY TO ABANDON  
AND DELAY INNOVATION DEVELOPMENT

	<b>Abandonment</b>	<b>Delays</b>
Lack of internal sources of finances	0.158 *** (0.059)	-0.008 (0.061)
Lack of external sources of finances	-0.094 * (0.052)	-0.095* (0.043)
Costs too high	0.043 (0.053)	0.060 (0.056)
Lack of qualified personnel	0.017 (0.059)	0.187*** (0.060)
Lack of information on technology	0.172 ** (0.076)	0.136** (0.078)
Lack of information on markets	-0.069 (0.073)	-0.027 (0.074)
Problems with finding co-operator	0.059 (0.052)	0.192*** (0.053)
Incumbent dominated market	0.114 ** (0.053)	0.029 (0.054)
Lack of demand	0.092 (0.060)	-0.009 (0.063)
Constant	-1.394*** (0.115)	-1.455*** (0.120)
<b>Number of observations</b>	<b>1041</b>	<b>1041</b>
<b>LR chi2(9)</b>	<b>65.04</b>	<b>70.26</b>
<b>Prob &gt; chi2</b>	<b>0.0000</b>	<b>0.000</b>
	<b>-549.274</b>	<b>-503.0487</b>
<b>Pseudo R2</b>	<b>0.0559</b>	<b>0.0653</b>

\* significant to 0.1 level

\*\* significant to 0.05 level

\*\*\* significant to 0.01 level

Standard errors in parenthesis

Table 4 gives marginal effects after probit. Marginal effects indicate change in probability of occurrence of decision to abandon or delay innovation project if the perception of the intensity of constraints changes for one degree.



The highest change in probability to abandon innovation development project is found in the case of increased perception of lack of information on technology. It increases the chance for abandoning even more than lack of internal finances. In the case of project delay, the greatest increase of probability is caused by problems with finding co-operator and lack of qualified personnel.

Interesting finding is that for both decisions, lack of external finances is significant constraint but the signs of marginal effects (and coefficients) indicate that growth in its intensity causes less probability to abandon/delay innovation development projects. This might indicate that successful innovators (enterprises that developed and launched or implemented innovations) perceive this variable as high constraint to innovation activities. Their perception can be a result of prior experience with obtaining external finances for innovation activities. Another possibility is that they have no prior experience but perceive this as very important factor that hamper innovation activities. This issue calls for further research on factors that cause such perception of this variable because the results clearly indicate that it decreases the probability of abandonments and delays.

Apart from the above-mentioned factors, probability to delay and probability to abandon are both significantly related to lack of information on technology. Lack of information on technology will raise the probability of abandoning innovation development as well as the probability of delaying. In addition, lack of qualified personnel leads to increase in probability to delay.

Probability of delaying is found to be sensitive to difficulties in finding co-operator for innovation development. Delaying is not affected by external constraining factors such as lack of demand and the fact that market is dominated by incumbent. However, the latter factor is found to be significantly related to the decision to abandon.

Table 4:

MARGINAL EFFECTS AFTER PROBIT

	<b>Abandonment</b>	<b>Delay</b>
Lack of internal sources of finances	0.048 *** (0.078)	-0.0002 (0.017)
Lack of external sources of finances	-0.029 * (0.016)	-0.026 * (0.015)
Costs too high	0.013 (0.016)	0.017 (0.015)

	<b>Abandonment</b>	<b>Delay</b>
Lack of qualified personnel	0.005 (0.018)	0.052*** (0.016)
Lack of information on technology	0.053 ** (0.023)	0.038 * (0.021)
Lack of information on markets	-0.021 (0.022)	-0.008 (0.021)
Problems with finding co-operator	0.018 (0.016)	0.053*** (0.015)
Incumbent dominated market	0.035** (0.016)	0.008 (0.015)
Lack of demand	0.028 (0.018)	-0.003 (0.017)

\* significant to 0.1 level

\*\* significant to 0.05 level

\*\*\* significant to 0.01 level

Standard errors in parenthesis

## 5. Conclusions

Innovation development is in its nature very complex activity often hampered by various constraining factors. In this paper the impact of constraining factors on the decision to abandon and delay innovation activates in firms in Croatia is analysed. There are several important findings of the analysis.

The results of the analysis reveal the differences in sensitivity to various constraining factors when it comes to decision to abandon and delay innovation development. Although both decisions are affected by lack of external sources of finances and lack of information on technology, they differ in sensitivity to perceived intensity of other constraining factors. Three factors are related to neither the probability to abandon, nor to delay: costs too high, lack of information on market and lack of demand.

In comparison to findings of other studies, financial issues in Croatian firms are found to be less significant. Descriptive statistics shows the presence of financial issues in Croatian firms but further analysis has showed interesting results on relationship between financial problems and abandoning and delaying innovation development projects. Particularly, lack of financial sources within firm is found to be significantly related to decision to abandon an innovation development, while the same variable is not significant when it comes to delaying innovation development.

So, firms are likely to abandon projects that cannot be financed. This is damaging to overall innovativeness but not necessarily bad for overall business performance. By doing so, they direct financial resources on other projects with better prospect for successes and that consequently influence business performance positively.

Lack of external sources of finances is significant predictor of abandonment and delays but findings suggest lower probability to abandon and delay in the presence of high lack of external finances. This finding indicates that successful innovators perceive availability of external finances as constraining to innovation development. It is possible that availability of finances outside of firm for financing innovation development is scarce and not suitable to the needs of innovative firms. One thing should be kept in mind. It is the uncertainty related to innovation development that makes this activity very risky. Consequently, it is always difficult to access external sources to finance innovation development. Lack of external finances and its influence on innovativeness of Croatian firms should be a subject of future research.

As discussed in literature review, the great body of literature studies effects of financial constraints on the innovativeness while other factors are relatively neglected. The results of empirical analysis in this paper reveal the importance of other constraints in affecting probability to abandon and delay innovation development in Croatian enterprises. This is especially relevant for constraints that are related to absorptive capacity. Lack of information on technology along with lack of qualified personnel are significant predictors of abandonments and delays in innovation development. That finding confirms the importance of firms' capabilities to acquire and implement new knowledge in order to be innovative.

For Croatian firm it is especially important to acknowledge this finding since the descriptive analysis shows that precisely lack of qualified personnel is perceived as very high. More than 60 per cent of all firms and 82 per cent of innovative firms reported the presence of this constraining factor. For firms aiming at improving innovation activities, this finding implies that significant effort should be made to strengthen absorptive capacity of firms primarily by training and education of existing employees as well as employing qualified personnel.

This problem should be treated very seriously, as the enterprise that lacks sufficient number of qualified employees might have problems with acquiring and implementing information on new technologies at the suitable pace.

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## PREPREKE INOVACIJSKOJ DJELATNOSTI U HRVATSKIM PODUZEĆIMA

### Sažetak

Hrvatska poduzeća bilježe relativno nisku razinu inovativnosti. Cilj je ovog rada identificirati čimbenike koji otežavaju inovacijske aktivnosti u hrvatskim poduzećima. Analiza je usmjerena na utjecaj otežavajućih čimbenika na odluku o napuštanju ili kašnjenju razvoja inovacije primjenom podataka istraživanja Community Innovation Survey (CIS) za Hrvatsku. Istraživanje čimbenika koji dovode do napuštanja i kašnjenja projekata oslanja se na podatke 1041 poduzeća koja su iskazala postojanje bilo kojeg oblika inovacijske aktivnosti. Rezultati analize upućuju na postojanje razlika u utjecaju različitih ograničavajućih čimbenika na odluku o napuštanju ili kašnjenju razvoja inovacija.

Ključne riječi: ograničavajući čimbenici, napušteni inovacijski projekti, kašnjenje inovacijskih projekata, inovacijske aktivnosti