

## IMPLEMENTATION OF DESIGN AND BUILD MODEL IN CROATIAN CONSTRUCTION INDUSTRY

Nino Kovačić<sup>1\*</sup>, Mladen Vukomanović<sup>1</sup>, Mladen Radujković<sup>1</sup>

<sup>1</sup>Faculty of Civil Engineering, University of Zagreb, Zagreb 10 000, Croatia

### Abstract

New market laws impose new project delivery methods in order of greater efficiency. Design and Build can certainly be regarded as one of most common in this context. Although worldwide proven, Design and Build has not yet taken hold on the slowly-changing construction market of The southern east Europe (SEE). The main aim of the this research was to collect data that will indicate the presence and previous experiences in applying Design and Build models of procurement in the construction Croatian market, or market awareness of alternative methods of project delivery as well as the possibility of implementation of this model in the Croatian construction industry. Among other things, the research was to examine the general opinion on the Design and Build procurement model by profession, specifically investors, design/supervision and contractors separately, to give a realistic insight into the perspective of different participants in the construction. We have found that neither half of respondents is familiar with Design and Build project delivery method, and only one third of subjects did participated in that kind of projects. Most important conclusion is that 89% percent of respondents who participated on Design and Build projects think that model is applicable in Croatian construction industry in comparison to only 37% of total sample who has shared the same opinion.

### Keywords

Design and Build, project delivery, time, cost, implementation, construction

To cite this paper: Kovačić, N., Vukomanović, M., Radujković, M., (2014). *Implementation of Design and Build model in Croatian construction industry, In conference proceedings of People, Buildings and Environment 2014, an international scientific conference, Kroměříž, Czech Republic, pp. 232-242, ISSN: 1805-6784.*

\*Corresponding author: Tel.: +385-91-4277-552  
E-mail address: nino.kovacic@exstructa.hr

## 1 INTRODUCTION

Croatian construction industry is facing with insufficient connectivity of different stages in project. Mostly applied method of delivering project is traditional design-bid-build method, which allows competitive bidding but disables involvement of constructor in stage of design. That results in underused potential of their expertise and experience, especially in the form of consulting in design. Regarding to those factors, poor integration of stakeholders occurs through all stages of project and can generate negative outcome of project delivery.

Research conducted in 1996 on 150 different project in Republic of Croatia shown that 66% of all construction projects exceeds it planned deadline, and 17% of projects bursts their initial cost. Further research conducted in 1998 did not shows any improvements. On basis of 333 construction projects, it is noticed that 78% of projects exceeds initial deadline by 60%, when 81% of project bursts initial costs by 32%, especially in phase of construction due to poor coordination and integration. If we consider the fact that most of those projects were delivered by traditional design-bid-build model, it is obvious that obtained data can be attributed to above mentioned project delivery method. [1]

As shown in the previous study conducted in 2012, even though the SEE construction has started practicing modern IT tools, it does not follow the project management practices of developed economies. This is important to acknowledge because while western philosophies rely on a wider range of project management processes and procedures, the SEE construction sector is still operating very differently towards developed countries [2] and still practices management mainly through financial procedures. This causes inability to assess true costs of their operations [3] and enhances risks of losses, caused by poor decision making [4]. Understanding these major issues should help construction companies in SEE in managing projects more successfully, increasing their learning capacities and influencing the degree to which new technologies are adopted and implemented effectively [5]. Unfortunately, SEE carries the legacy of the former socialistic regime, which represents one of the main adaption issues of implementing western PMS on to transitional economies. [6]

All of above mentioned indicates that Croatian construction industry lags behind in accordance of using and implementing modern, alternative project delivery methods which would help with better performance through phases of project as well as project as a unity [7]. In order to implement changes and improvements we have found design and build project delivery method as a possible solution to problems of Croatian construction industry. Design and build is globally proven model which can contribute if it's used properly. Research conducted in similar surroundings has shown that design and build can produce significant savings of time and money, and also improve overall satisfaction of the customer as well as the constructor in delivering projects. Despite the fact that design and build in Croatia is confronted with a series of legal obstacles, especially in sector of public procurement, in this study we will show representation of the same in Croatian construction market, as well as subjective opinion and experience of participants in the construction process who have dealt with the aforementioned.

The main aim of this paper was to analyse the use of Design & Build within the Croatian construction market and to give some introduction on the subject, regarding to its representation globally, benefits of using design and build project delivery method, associations of the same in the world and also show some of case studies conducted in other construction market. In following we will describe the methodology of research conducted in this study and present the result in order to structure sample and all of the specifics connected

with it. At last there will be discussion regarding on applicability of the same in Croatian construction market, as well as conclusion which will gave as clear perspective of implementation of design and build in Republic of Croatia.

## **2 LITERATURE REVIEW**

Design and Build is a method of project delivery in which one entity – the design-build team – works under a single contract with the project owner to provide design and construction services. One entity, one contract, one unified flow of work from initial concept through completion – thereby re-integrating the roles of designer and constructor. Design-build is an alternative to the traditional design-bid-build project delivery method. Across the country and around the world, design and build successfully delivers both horizontal and vertical construction projects with superior results – no matter what the project type.[8]

DBIA (Design-Build Institute of America) is organization that defines, teaches and promotes design-build best practices through conferences, education and certification globally. As DBIA is not stand-alone organisation, CDBI (Canadian Design-Build Institute) is also very active at promoting model itself, trying to spread positive practise and provide support to members or non-members who practice mentioned project delivery method.

Studying the literature we can come across many benefits of above mentioned project delivery method, therefore it is difficulty to downsize to a few of them. But as the most important of them we can surely consider: single point of liability for design and construction [9], accelerated project delivery through the simultaneous design and construction, better coordination and communication [10], previous completion and safety of charges, improvements in innovation and quality, less claims and disputes in project, increased possibility of change by investors after the project commencement [11], etc.

Results of previous research confirms the allegations of literature and so thus confirm the benefits of Design & Build in modern construction industry. Numerous studies have shown that usage of design and build project delivery model can save time and money [12]; and it was scientifically substantiated [13] by collecting and analysing data sample of 351 American project, made up of six types of objects. They used a multi-variant model to examine the unit cost, speed of construction, project delivery speed, cost growth, and schedule overrun. They concluded that the DBB projects have a greater tendency to exceeding the timetable in relation to DB projects. They also concluded that the design and build project delivery model provides cost advantages. Molenaar [14] came to similar conclusions, examining a sample of 104 projects were design and build a model in the public sector.

As an example we can show study conducted in 2011 [15] which was focused on a comparative analysis of the performance of traditional contracting and design-build procurements on client objectives in Nigeria. Thorough analysis of Nigerian construction market case study has shown the following facts:

- In comparison to DBB (Design-Bid-Build), DB (Design and Build) generated half as many cost overruns. On sample of total 88 projects (53 DBB and 15 DB), parameters had shown 42.6% budget exceeding in DBB projects in comparison to only 21.4% in DB projects. That can be attributed to better communication and coordination in project through integration of designing and constructing by one entity.
- This specific study result had shown that 78% DB customers were satisfied with project outcome, when only 51% of DBB customers were satisfied with aforementioned. That clearly indicates that DB is much more likeable for realisation of

investor's ideas. Quality measurement is always carried subjectively, taking into account the client's satisfaction with the works carried out in relation to the presumed object specifications.

Literature clearly speaks of undoubtable advantages of DB comparable to DBB. If we analyse and systematize the results of worldwide conducted studies and substantiate it with wide theoretical knowledge of project delivery methods, and try to consider it in the light of the Croatian construction market, we can observe wide range of possibilities by applying the DB project delivery method.

### **3 METHODOLOGY**

The study was carried out to provide a picture of the actual situation in the construction market of the Republic of Croatia, or need of changes that would facilitate the implementation of new integrated project delivery models, such as design and build. The research was conducted with main purpose of introducing such models in national construction, with the question of the applicability of this model in various segments of civil engineering. Therefore, the target of the research was on the professional opinion regarding the applicability to specific segments of the construction industry in the Republic of Croatia, as well as the subjective opinion as to whether the respondents (or their firms) able to independently implement successfully design and build project delivery model.

In order to address these research goals, survey entitled 'IMPLEMENTATION OF DESIGN AND BUILD MODEL IN CROATIAN CONSTRUCTION INDUSTRY' was carried out. The methodology selected in survey was in accordance with a relatively large sample size. Electronic type of survey was chosen because it faster and more efficient to access the respondents, and also easier to process the following results. As a pattern to create survey, 'google docs' (Google, Inc.) Internet forms were used, with which we have formulated questions and answers, and as such simultaneously sent to the electronic address of subjects. Using the above mentioned forms allowed the simultaneous monitoring and analysis of feedback.

The survey consisted of 22 structured questions about general characteristics of business of the surveyed business entities, information and experiences with FIDIC contract conditions, general information and application of design and build models in the their business operations and their subjective opinion on the implementation of this model in the Croatian construction market. Questions about the general characteristics of business were conducted solely for separating the views of individual stakeholders in the construction and classification of subjects according to the number of employees, size and the annual income. All questions that are the subject of such a classification, were structured according to the National Classification of Activities 2007 - 2007 NACE [16]. Questions were design with the option of single or multiple selection, with a choice of answers 'I'm not sure/familiar' (N/A). In matters where specifically required the evaluation of each parameter on the scale, a Likert scale was used as a measure of response.

Likert scale is a psychometric scale commonly involved in research using questionnaires / surveys. It is the most widely used approach to scaling responses in surveys, so it is often used interchangeably with rating scale, or more accurately Likert-type scale, although two are not synonymous. The scale is named after its inventor, psychologist Rensis Likert. Replying to a Likert scale questionnaire is made of the fact that respondents identify their level of agreement or disagreement on a symmetrical agree - disagree scale for a series of statements. Thus, the range captures the intensity of their feelings towards a particular point. In doing so,

Likert scale assumes that the distance for each item quantity equal. In our case, scale was designed to offer a value from 1 (lowest) to 6 (highest), as our survey revealed conflicting notions types: negative-very positive, never-almost always, slightly-very important, worst contribution to the project - best contribution to the project. [17]

The result of such complex structure in survey is a large number of mutually dependent and independent data that can be analyzed separately and in the connection with other data obtained from the survey. Such a complex data set, demanded not only the application of standard methods of research, but also more complex RII (Relative Importance Index) method. RII method (1) allows getting the results which are calculated by rating given to every question or choice ( $w$ ), the highest given assessment of the questions ( $A$ ) and the total number of subjects ( $N$ ). RII refers to the value in the interval [0-1]. With a higher value of the index RII element gets more important or better perception. Relative importance index is defined as follows:

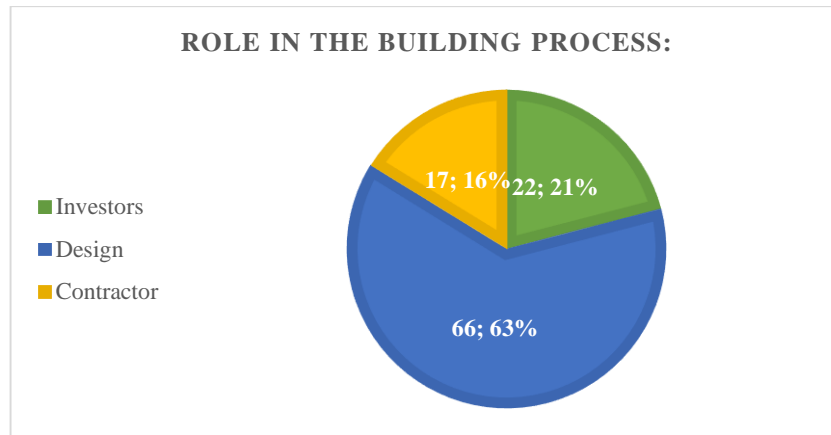
$$RII = \frac{\sum w}{A \times N} \quad (1)$$

The index of relative importance regarding some questions was calculated with respect to the structure of the survey sample, and the role of in the construction, company size, income and other characteristics of the respondents. The results are systematically processed and arranged in tables, and annotated with the aim of analyzing the significance of the results.[17]

#### **4 RESULTS**

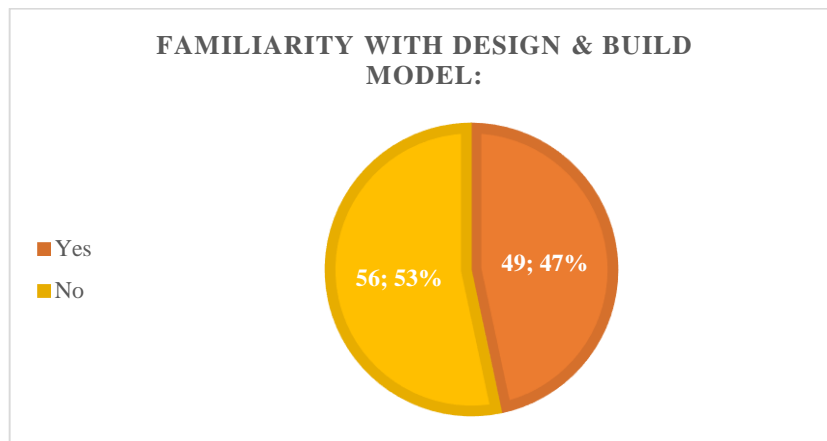
The survey was conducted among 105 bussines subjects whose characteristics matched study sample, and we can assume their awareness of the legislation as well as market conditions. Specified database of subjects was obtained from the Department of Construction Management and Economics, Faculty of Civil Engineering, University of Zagreb. Database of subjects was heterogeneous composition and the composition of subjects varies according to the roles of participants in the construction, the size of business entities/companies (classified according to the number of employees and annual revenue), and the domain in the which a business entity operates.

Sample analysis has shown that large amount of subjects were smaller companies/legal entities (Figure 1), with core bussines of designing of supevising in construction. We can also mention that two thirds of sample had annual revenue bellow 60 billions HRK (categorically a small company/entity). Construction domains were very veriated so for that reason we wont emphasize any of them regarding results of the research. Its important to mention that only 25% of survery respondents declare that they operate beyond the nationals borders, on foreign construction markets.



*Fig. 1: Analysis of sample structure*

The study consisted of 22 questions, as abovementioned, but this article will show only a part of the research focusing directly on Design and Build project delivery method. Below presented results will emphasize as the most interesting conclusions of the research.



*Fig. 2: Familiarity with Design and Build project delivery method*

As seen from the diagram in Figure 2., results show that almost half (47%) of the respondents are informed about the Design and Build project delivery method. Table 1. is showing the percentage correlation with the role of participants in the building process.

*Tab. 1: Awareness about Design and Build; breakdown by role in the building process*

AWARENESS ABOUT DESIGN AND BUILD MODEL:	YES	NO
<b>Breakdown by role in the building process:</b>		
<b>Investor</b>	32%	68%
<b>Design/Supervision</b>	45%	55%
<b>Contractor</b>	59%	41%
<b>TOTAL:</b>	<b>47%</b>	<b>53%</b>

Results of the analysis with regard to the composition of the sample according to the role of participants in the building process indicate that investors are least familiar to the model. The reason there's probably because investors are not technically educated and do not have the common opportunity to meet with new methods and models in the construction industry. Somewhat more awareness about the model can be discerned with designs/supervision, but the percentage of 45% clearly indicates the lack of 'up to date' knowledge in their profession. Contractors showed the highest percentage of awareness (59%), which is a positive fact and we can see that they are in step with modern and alternative methods of construction. Although, it should be taken into account the relatively small percentage of contractors in the overall sample of the research.

On the following question (Table 2.), respondents were offered a choice on Likert scale of 1-6, where they had to choose assessment opinions on Design and Build procurement model; where 1 meant negative, and 6 - very positive. The evaluation procedure is described in more detail in section 3. Methodology. Data analysis was performed using the method of relative importance index (RII), and the results are analyzed in Table 2. Note that the index ranges from 0 to 1, where 0 represents negative, and one very positive opinion about this model.

From the given table (Table 2.) we can conclude that there is generally a good opinion of Design and Build model among the respondents, regardless of the role in the building process, if we consider the overall sample of research. Total RII of 0.7191 indicates satisfaction with the Design and Build procurement model in general, and confirms our theoretical indications about the benefits and advantages of the model itself. However, if we analyze the sample filtered on basis of participating on Design and Build project, we can clearly note a positive bias in results. Filtered sample shows a significant improvement of opinion by 7.3% considering the sample as a single unit. Filtering even further, on the basis of role in building process, we can observe there is a pattern of highly positive experience with the given model among investor and contractors especially. RII of 0,8333 (investors) and 0,8667 (contractors) clearly indicate of that.

*Tab. 2: Overall opinion about the Design and Build model*

OVERALL OPINION ABOUT THE DESIGN AND BUILD MODEL:				
	<b>RII</b>	<b>RII – Investor</b>	<b>RII – Design/Supervision</b>	<b>RII - Contractor</b>
<b>Overall sample:</b>	<b>0,7191</b>	0,7222	0,7095	0,7500
<b>Respondents who participated in D&amp;B project:</b>	<b>0,7719</b>	0,8333	0,7592	0,8667

The next set of questions was designed to gain insight into the opinion of the assumed benefits of Design and Build, and their value on the actual projects. Sample was once again analysed with regard to role in the building process, as well as the actual participation of respondents on Design and Build projects.

*Tab. 3: Opinion of reducing time and cost by using Design and Build model*

REDUCING TIME AND COSTS BY USING DESIGN AND BUILD MODEL:				
	<b>RII</b>	<b>RII – Investor</b>	<b>RII – Design/Supervision</b>	<b>RII - Contractor</b>
<b>Overall sample:</b>	<b>0,6824</b>	0,7292	0,6712	0,6875
<b>Respondents who participated in D&amp;B project:</b>	<b>0,7417</b>	0,9333	0,7506	0,8000

Inspecting the results from the Table 3. it is clearly obvious that respondents who have participated in Design and Build project(s) have better views and greater appreciation of this model, triggered by the previous positive experiences of implementing the given project delivery model. However, pattern is appearing regarding the role of participants in construction process, where there is no evident increase in satisfaction of the design/supervision part of the analysed sample. It can be explained by the fact that that designers think that Design and Build model actually degrades the role of the designer in the entire project, that takes him certain specific powers that are taught in the traditional models of project delivery. The designer is actually losing the status of investor 'representative', and his opinion and is no longer so relevant, so it is understandable that they are not (and wont be) very prone to the application of this model in its entirety.

Regarding the question of improved communication and collaboration by using the abovementioned model we did not get astonishing results, only scoring 0,6384 RII of total sample.

*Tab. 4: Opinion of improved communication and collaboration by using Design and Build model*

IMPROVED COMMUNICATION AND COLLABORATION BY USING DESIGN AND BUILD MODEL:				
	<b>RII</b>	<b>RII – Investor</b>	<b>RII – Design/Supervision</b>	<b>RII - Contractor</b>
<b>Overall sample:</b>	<b>0,6384</b>	0,6042	0,6360	0,6905
<b>Respondents who participated in D&amp;B project:</b>	<b>0,7083</b>	0,8000	0,7143	0,8667

But taking into account the filtrated sample, we got enhancement of 10.9% (0.7083 compared to 0.6384). Once again, research has corroborated the facts of literature, on given benefits of Design and Build in practice.



*Tab. 5: Opinion of positive impact on greater autonomy of contractor by using Design and Build model*

POSITIVE IMPACT WITH GREATER AUTONOMY OF THE CONTRACTOR APPLYING DESIGN AND BUILD MODEL:				
	<b>RII</b>	<b>RII – Investor</b>	<b>RII – Design/Supervision</b>	<b>RII - Contractor</b>
<b>Overall sample:</b>	<b>0,6361</b>	0,7083	0,6143	0,8000
<b>Respondents who participated in D&amp;B project:</b>	<b>0,7417</b>	0,8667	0,7381	0,9333

There is a difference in the perception in positivity of greater autonomy of the contractor between participants in the construction process (Table 5.). Investors primarily consider it positive, especially given the fact allocating their own risk on the contractor, and less involvement in the technical part of the project which results in a lower possibility of mistakes by investors. Contractors also consider it very positive for obvious reasons, that give them the right to independently solve fewer problems that appear in the project without unnecessary complications and countless consultations for approval of the investor (or the designer). On the other hand, we see that the designers/supervision are the least index (0.6143) of all participants, probably because above explained reasons of degrading their role.

The most important question was possibility of implementing Design and Build in Croatian construction industry.

*Tab. 6: Opinion on possibility of implementation in Croatian construction industry*

POSSIBILITY OF IMPLEMENTING DESIGN & BUILD IN CROATIAN CONSTRUCTION INDUSTRY:	<b>YES</b>	<b>NO</b>	<b>N/A</b>
<b>Breakdown by role in the building process: (Respondents who participated in D&amp;B project)</b>			
<b>Investor</b>	32% (100%)	9% (0%)	59% (0%)
<b>Design/Supervision</b>	36% (92%)	5% (0%)	59% (8%)
<b>Contractor</b>	39% (75%)	6% (0%)	59% (25%)
<b>TOTAL:</b>	<b>37% (89%)</b>	<b>8% (0%)</b>	<b>55% (11%)</b>

As apparent from the Table 6., respondents who have not participate in those kind of projects are skeptical to given model, and on contrary, respondents who were part of project delivered on given model have very positive opinion on the subject and are openminded regarding its use and implementation on Croatian construction market.

## 5 DISCUSSION AND CONCLUSION

In this study we have found that a very small percentage of Croatian companies operate outside the Croatian borders, barely a quarter of businesses - where the market has a tendency for experimenting and implementing alternative methods and models in the construction industry in order to increase efficiency and effectiveness in the delivery of the project. Analogously devastating fact was found that neither half of respondents is familiar with Design and Build project delivery method, and only one third of subjects did participated in that kind of projects.

This pattern clearly indicates on problems of Croatian construction sector, obsolescence in organizational methods and models also as focus on domestic market. Although the exit to foreign markets was promoted as the salvation of the domestic construction sector, it is evident that it didn't happen, probably just for the reason given above. Such a negative trend in the construction industry should be discontinued as soon as possible and turn the adjustment of the national legislation to facilitate the implementation of various alternative models, as well as the modernization of the sector with the aim of conquering foreign markets.

Despite the results obtained in the total sample, which we mentioned above, the study still resulted in some positive conclusions. Deep analysis has shown that respondents who are familiar with the Design and Build procurement model are in general satisfied with given model, moreover, analysis of respondents sample who were engaged in the application of the model in practice indicates greater index of satisfaction with Design and Build a model. Last but not least it is important to highlight that 89% percent of respondents who participated on Design and Build projects think that model is applicable in Croatian construction industry. In comparison, only 37% of total sample has shared the same opinion.

However, forming the bigger picture about Design and Build in domestic market, we may say that Southern east Europe construction markets are still lagging behind from western construction markets, especially in application of new organizational models, processes and procedures, but there is clearly a slight move to modernization and will to achieve competitiveness on all field of market, including project delivery models.

On basis of this study, we may conclude that further research in terms of associated market factors are desirable, including inquiry of barriers for implementation of new processes and procedures such is Design and Build project delivery method.

## REFERENCES

- [1] Turina, N., Car – Pušić, D., Radujković, M. (2008.), "Design and build" in comparison with the traditional procurement method and the possibility of its application in the Croatian construction industry; *8th International Conference: Organization, Technology and Management in Construction*, Umag, Croatia, 17-20.09.2008.
- [2] Roztocky, N., Weistroffer, H.; Evaluating Information technology investments in emerging economies Information Technology for Development, *Tehcnical gazette*, **14**(1), pp. 1-10.
- [3] Ness, J., Cucuzza, T.; Tapping the full potential of ABC. Harvard Business Review, *Tehcnical gazette*, **73**(4), pp. 130-138.
- [4] Johnson, H., Kaplan, R., Relevance Lost: The Rise and Fall of Management Accounting. 1987: *Harvard Business School Press*.

- [5] Robey, D., Boudreau, M., Rose, M.; Information technology and organizational learning: a review and assessment of research. *Accounting, Management and Information Technologies, Technical gazette*, **10**, pp. 125-155.
- [6] Vukomanović, M., Radujković, M., Dolaček Alduk, Z., The use of Project management software in construction industry of Southeast Europe, *Technical gazette*, **19**(2), 2012.
- [7] Đondraš, N. (2013), „Analysis of organizational relationships in the implementation of projects under a system of 'design and build', master thesis, Faculty of Civil Engineering Zagreb, Zagreb
- [8] Design-Build Institute of America; *What is Design-Build?* Available at:  
<http://www.dbia.org/about/Pages/What-is-Design-Build.aspx> ; visited at 21.04.2014.
- [9] Beard, J.L., Wundram, E., Loulakis, M. (2001); *Design-Build: Planning Through Development*, McGraw-Hill publishing, New York.
- [10] Radosavljević, M., Bennet, J.,(2012), *Construction management strategies*, John Wiley & Sons, Ltd., West Sussex, UK.
- [11] Bennett, J., Potheary, E., Robinson, G. (1996.), *Designing and Building a World Class Industry*, Centre for Strategic Studies in Construction, Reading
- [12] Songer, A.D., Molenaar, K.R., and Robinson, G. (1996). Selection Factors and Success Criteria for Design-Build in the U. S. and U. K. *Journal of Construction Procurement*, **2**(2), pp. 69-82
- [13] Konchar, M., Sanvido, V. (1998); Comparison of U.S. Project delivery systems; *Journal of Civil Engineering and Management*, **124**(6), pp. 435-444.
- [14] Molenaar, K., Songer, A., Barash, M. (1999); Public-sector design/build evolution and performance; *Journal of Civil Engineering and Management*, **15**(2), pp. 54-62.
- [15] Ojo, S., Omotayo, A., Aderemi, Y. Adeyemi, (2011), A comparative analysis of the performance of traditional contracting and design-build procurements on client objectives in Nigeria, *Journal of Civil Engineering and Management*, **17**(2), pp. 227-233.
- [16] Government of Republic of Croatia; The National Classification of Activities 2007 - NKD 2007., available at: <http://narodne-novine.nn.hr/clanci/sluzbeni/298306.html> (Accessed 26 May 2014).
- [17] Radujković, M., Vukomanović, M., Burcar Dunović, I., (2012), Application of key performance indicators in southeastern european construction, *Journal of Civil Engineering and Management*, Vilnius, Litva, **16**(4).