World Applied Sciences Journal 29 (1): 20-25, 2014
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2014.29.01.13785

An Assessment of the Efficiency of the Information System of Design-and-survey Organizations Based on the Analysis of the Information Capacity of Projects Implemented

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Submitted: Nov 20, 2013; **Accepted:** Dec 23, 2013; **Published:** Jan 5, 2014

Abstract: The article features an analysis of the global and Russian construction markets and reflects the place of design-and-survey organizations in the development of this industry. Relying on the findings of a critical analysis of existing approaches to analyzing information costs, the authors bring forward a methodology for assessing the efficiency of the information system of a design-and-survey organization based on the analysis of the information capacity of projects implemented. The article introduces the term "information capacity". The authors have worked out a classification for information costs arising in developing a project. The testing of the methodology was conducted through the example of the activity of the design-and-survey organization JSC Institute "Kazan Promstroiproyekt" (The Republic of Tatarstan (the Russian Federation)). The authors have brought forward recommendations on boosting the efficiency of the organization's information system.

Key words: Information system · Information costs · Design-and-survey organizations · The construction sector

INTRODUCTION

The construction sector makes a substantial contribution towards boosting economic development indicators for many countries. A study by the McKinsey Global Institute [1] predicts that in the next decade, growth in the construction sector will outpace global GDP growth. As of the moment, the construction sector, which in 2008-2009 was affected the worst by the crisis, is returning to its pre-crisis performance levels in key indicators.

According to a forecast made in the Global Construction 2020 report prepared by analysts at Global Construction Perspectives and Oxford Economics [2], the world's largest global construction output will have been represented by 2020 by China (24%), the US (21%) and India (15%).

When it comes to Russia's construction market, there was a substantial decline in construction output over the global economic crisis period. However, compared with many other countries, the Russian construction sector made a rather swift recovery from the aftermath of the economic downturn. This is mainly due to the fact that over the last five years Russia has been engaged in large-scale construction work related to staging the 27th Summer Universiade-2013 in Kazan, the 22nd Olympic Games-2014 in Sochi, the 2015 World Aquatics Championships and the 2018 FIFA (soccer) World Cup. For the same reason, as of the 2011 year end, the top performers in the "volume of work performed in the "construction" type of activity" indicator were Krasnodar Krai (3993 969 rubles) and the Republic of Tatarstan (2207 776 rubles) [3].

The beginning of any construction works involves putting together the design documentation. The quality of construction-and-erecting works largely depends on that of design-and-survey work. Thus, for instance, according to the "rule of a tenfold increase in costs", costs of remediating errors in the construction-and-erecting works stage increase ten times compared with costs of identifying errors in the architectural design stage. Based on the above, we can conclude that the activity of design-and-survey organizations is a foundation for the activity of organizations within the

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construction sector. Therefore, we would like to devote this article to analyzing the activity of design-and-survey organizations and working out recommendations on boosting its efficiency.

Today, information is a strategic factor of success and useful knowledge makes up an organization's capital. This is especially topical for enterprises operating on the intellectual services market, to which design-and-survey organizations we are analyzing belong.

Thus, this article looks into a methodology for assessing the efficiency of the information system of design-and-survey organizations based on an analysis of the information capacity of projects implemented through the example of an enterprise based in the Republic of Tatarstan.

MATERIALS AND METHODS

The basis for an organization's competitiveness on the design services market is the high quality of projects and the ability to implement them within the shortest completion times and at optimal costs. Attaining these goals directly depends on building an efficient information system. The functioning efficiency of an organization's information system is associated with developing high-quality projects at minimum costs. In this regard, the issue of designing the information system and working out a methodology for assessing information costs can be treated as one of special topicality.

Information and information costs became the subject of economic theory only in the 20th century, which is associated with the informatization of economic systems. The impact of the activity of information systems on organizations' major business processes has been investigated in the works of a number of foreign researchers: H. Demsetz, J. Dyer, D. Norton, R. Kaplan, J. Zachman, J. Sowa, K. McGowan, D. Marca, etc. [4-9].

Having analyzed the above works, we have found that the efficiency of the activity of any organization depends on the functioning efficiency of the information system. The assessment of costs of production and information consumption helps gauge the efficiency of information streams. Consequently, the assessment of the functioning efficiency of an information system will rightfully depend on the assessment of costs associated with the acquisition, production and use of information.

At present, especially topical is the issue of the analysis of the information systems of enterprises within the services sector. Thus, for instance, A.Z. Novenkova, N.V. Kalenskaya and I.R. Gafurov in their "Educational Services Marketing: A Service Provider Satisfaction Study" dwell upon the issue of the significance of the data collection process for educational institutions [10], while O.V. Martynova in her "Innovation as a Factor in the Economic Growth of Retail Trade Chains" stresses the significance of innovation in the sphere of innovation technology for trade chains [11].

All the present methodologies for assessing information costs are characterized by that they help gauge the efficiency of the information support of an organization's activity using indicators that only indirectly reflect the contribution of information support towards getting the end-results of an organization's activity at large, which is their substantial drawback. Besides, their significant negative attribute is the application of indicators by which it is hard to get accurate quantitative assessments.

When it comes to the need to assess the efficiency of the information system of a design-and-survey organization, we find it expedient to analyze what information costs arise in developing a project and whether these costs are commensurate with gains the implementation of this project would result in. This approach was used in respect of the marketing information system of an organization and proved its efficacy [12].

Thus, we suggest using the term a project's "information capacity", which stands for an indicator that reflects the assessment of the total volume of information costs to be incurred in conjunction with the development of a particular project.

To provide a monetary assessment of a project's information capacity, we suggest introducing a classification of information costs (Table 1).

Information costs for a specific project can be determined using the following formula (1):

$$\mathbf{I_{so} = I_{wt} + I_{si} + I_{dd} + I_{ip}} \quad (1)$$

Cumulative information costs of general nature can be calculated using the following formula (2):

$$\mathbf{I_g = I_{pl} + I_{sig} + I_{ddg} + I_{ipg} + I_a + I_{te} + I_p + I_{int} + I_{wi} + I_s} \quad (2)$$

The information capacity of an n^{th} project (I_{cn}) implemented in the financial year can be calculated using the following formula (3):

$$\mathbf{I_{cn} = I_{so} + I_g * D_n} \quad (3)$$

Table 1: The classification of information costs of the information system of a design-and-survey organization

Information costs for a specific object (I_{so})	Information costs of general nature (I_g)
Monetary assessment of working time spent on work with information *(I_{wt})*	Cost of subscription to periodic literature *(I_{pl})*
Cost of scientific-and-technical information, specialized literature, sector reviews, etc., needed for development of the project *(I_{si})*	Cost of scientific-and-technical information, specialized literature, sector reviews, etc., the study of which is not associated with specific projects *(I_{sig})*
Cost of design documentation, model designs, etc., needed for development of the project *(I_{dd})*	Cost of design documentation, model designs, etc., the study of which is not associated with specific projects *(I_{ddg})*
Payment of information processing expenses associated with services provided by other market participants, which are needed for development of the project *(I_{ip})*	Payment of information processing expenses associated with services provided by other market participants, which are not associated with development of the project *(I_{ipg})*
	Payment of expenses associated with participation in specialized exhibitions, fairs, seminars, conferences and other similar activities *(I_a)*
	Payment of telephone expenses *(I_{to})* Payment of postal expenses *(I_p)* Payment of Internet access expenses *(I_{int})*
	Wages of managers and specialists whose activity is associated exclusively with work with information *(I_{wi})* Cost of specialized software *(I_s)*

where D_n is the share of cumulative information costs of general nature for an n^{th} project.

The calculation of the share of cumulative costs take up by each project is not possible. Therefore, we suggest that all of the organization's projects be classified based on the complexity of an object designed:

- Projects involving highly complex work with information (developing the working design of a plant, a warehouse facility, etc.);
- Projects involving intermediately complex work with information (developing the working design of a residential building, a cultural facility, etc.);
- Projects involving lowly complex work with information (developing the working design of a heat supply station, a parking garage, anything related to gas supply or power supply for the building, etc.);
- Engineering-and-geological surveying, engineering-and-geodetic surveying and structural steel inspection.

This decision was made after we surveyed, by way of interview, employees of 20 design and survey organizations in the Republic of Tatarstan. The survey revealed that the degree of complexity of working with information is directly dependent on the degree of complexity of an object designed, i.e. the more complex the object designed, the larger the share of information costs of general nature it may take up.

Furthermore, cumulative information costs of general nature as of a year-end can be distributed across four separate groups of projects, in accordance with a classic proportion based on the Pareto rule (50/30/15/5). Since there are several projects implemented within a year in each group, we must distribute general-nature information costs evenly within each of the groups described above. Thus, D_n can be calculated using the following formula (4):

$$D_n = P_k/T_k, \quad (4)$$

where P_k is a share assigned to a k^{th} group of projects, $P_k = 0.5$ for projects involving highly complex work with information, $P_k = 0.3$ for projects involving intermediately complex work with information, $P_k = 0.15$ for projects involving lowly complex work with information, $P_k = 0.05$ for engineering-and-geological surveying, engineering-and-geodetic surveying and steel structure inspection;

T_k is the number of projects assigned to a k^{th} group of projects as of the end of the financial year.

Our methodology for assessing information costs enables one to:

- Quantitatively assess information costs associated with the implementation of a specific project;
- Quantitatively assess costs of general nature;
- Classify all projects implemented by a design-and-survey organization, based on the degree of complexity of an object designed;
- Determine, based on the Pareto rule, the share of general-nature information costs taken up by each group of projects in the classification.

We can draw a conclusion on the efficiency of a project by juxtaposing data on the information capacity of each project with proceeds from the given project.

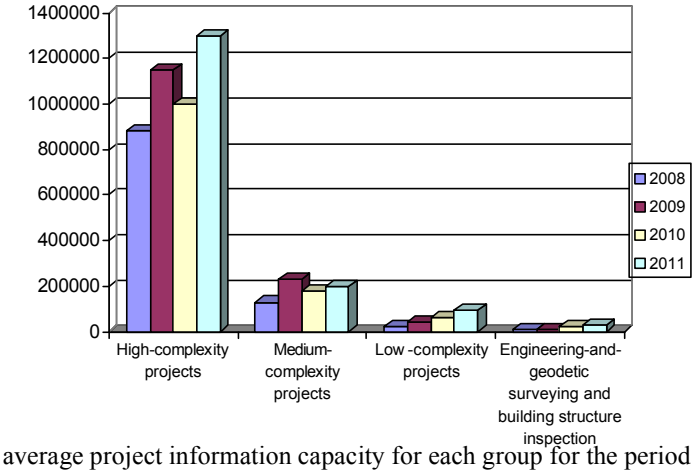

Fig. 1: The dynamic of the average project information capacity for each group for the period of 2008-2011, rubles.

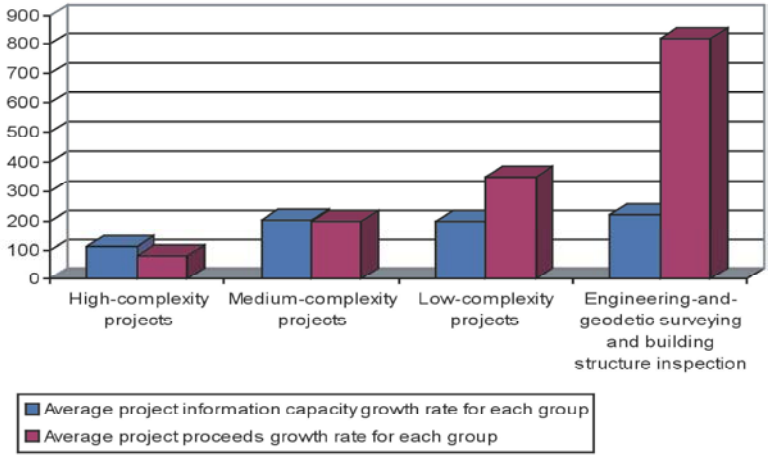

Fig. 2: The ratio of the average project information capacity growth rate to the average proceeds growth rate for a group of projects (data for 2011 in relation to data for 2008),%

Main Part: The testing of the methodology for assessing information costs arising in the functioning of the information system of a design-and-survey organization was conducted through the example of the activity of JSC Institut "Kazan Promstroiproyekt", which has been operating for over 40 years on the design and survey market in the Republic of Tatarstan and other regions of the Russian Federation.

We assessed the information capacity of 134 projects implemented at JSC Institute "Kazan Promstroiproyekt" over the period of 2008-2011. The results of our calculations are provided in Figure 1.

The diagram demonstrates that the highest information capacity is formed by high-complexity projects. We can also note that information capacity has a trend towards an increase for all the project groups. However, just a decrease or an increase in project information capacity does not as such characterize the efficiency of information support. To get more significant information, we need to juxtapose the information capacity growth rate with the proceeds growth rate for each project group. The results of the analysis are provided in Figure 2.

Figure 2 demonstrates that for the group of high-complexity projects the proceeds growth rate is lower than the information capacity growth rate. This is due to that projects that make up this group are normally one-off projects and in implementing them, we cannot use any previous information accomplishments; besides, implementing them involves enlisting the services of the most qualified and highly paid specialists. However, this group brings the enterprise over 50% of annual proceeds.

The assessment of high- and medium-complexity project information capacity revealed that the largest costs arise in the process of searching for and exploring scientific-and-technical information and exploring trends in the construction sector.

As a measure aimed at the reduction of information costs in the above areas, we suggest that JSC Institute "Kazan Promstroiproyekt" create a "Knowledge Database" that would become a receptacle for the organization's intellectual capital. Relying on the experience of similar organizations in terms of maintaining a "Knowledge Database", one can expect getting the following results: the reduction of time needed for searching for and exploring scientific-and-technical information and exploring trends in the construction sector in implementing high-complexity projects by 30%, medium-complexity projects by 22% and the rest of the project groups by 10%. Thus, in the first year we can expect the reduction of information costs by 1 035 762 rubles and 1 078 032 rubles the next year.

Also, we suggest that JSC Institute "Kazan Promstroiproyekt" adopt the "1S: Enterprise 8. The Management of a Design Organization" software package, which can be regarded as an ERP-class corporate information system. Let us take a look at the experience of adopting a similar software product in the activity of the design organization JSC "Giprosintez", which is described by A.F. Sokolov in his thesis-related study [13]. In his work, A.F. Sokolov came up with coefficients reflecting increases in the labor productivity (i.e., the reduction of costs of time spent on working with information) of employees of different structural units, which were attained as a result of adopting the "1S: The Management of a Design Organization" software package. Having adapted these coefficients to the activity of the enterprise at issue revealed that we can get a decrease in information costs in the amount of nearly 2 690 329 rubles in the first year and 3 240 329 rubles in the next year.

Thus, implementing these recommendations will help boost the efficiency of the information system of JSC Institute "Kazan Promstroiproyekt" by means of streamlining its make-up and structure as well as reducing the information capacity of projects implemented.

CONCLUSION

As part of this study, the authors conducted an analysis of the contribution of certain countries towards the formation of the global construction market. The analysis revealed that today Russia ranks among the 10 largest construction markets. The development of the construction sector in Russia has led to increased competition among its participants. The analysis of enterprises operating in the "construction" type of activity led us to conclude that the efficiency of the activity of construction-and-erecting enterprises in the sector depends on the efficiency of the activity of design-and-survey organizations. The efficiency of the activity of design-and-survey organizations, in turn, directly depends on building an efficient information system.

The article examined a methodology for assessing the efficiency of the information system of design-and-survey organizations based on the analysis of the information capacity of works performed. This methodology implies juxtaposing data on the information capacity of each project with proceeds received as a result of implementing the project. By this methodology, the information system of a design-and-survey organization is considered to be efficient if the proceeds growth rate for a project is higher than its information capacity growth rate.

The testing of the methodology was conducted through the example of one of the largest design-and-survey organizations in the Republic of Tatarstan, JSC Institute "Kazan Promstroiproyekt". The authors found that the enterprise's information system has been functioning inefficiently, for the information capacity growth rate for high- and medium-complexity projects is higher than the proceeds growth rate for the given project groups, whereas the share of proceeds formed by projects in this group exceeds the 50% threshold.

In this article, the authors brought forward recommendations on boosting the functioning efficiency of the information system of the organization at issue, the implementation of which will help reduce the information capacity of projects implemented by 3 726 092 rubles right in the first year.

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