Construction in the Republic of Yemen: Problems of Development and Solutions

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Abstract. Nowadays globalization, outsourcing and new technologies create the additional risks and uncertainties for organizations. An unclear and complicated reality establishes a new request for additional risk management tools for business. According to the conditions of the economic crisis, the construction industry, like most branches of the Russian economy, lacks financial resources for completing full elimination of inconsistency risks of real construction products with consumer expectations. First of all, this situation is usually for small companies which constantly have financial problems. In such a situation, classical models of nonconformance management, based on CAPA (Corrective and preventive action), become ineffective. There is a need for low-cost but acceptable approaches to management of non-conformities from the point of view of effectiveness. According to the author’s opinion, one of the ways of solving this problem can be the development of heuristic algorithms for the formation of an action plan aimed at reducing the risks of inconsistencies.

1. Introduction

The construction industry in Yemen, as in many developing countries, is going through a very difficult period. It is facing many constraints and obstacles to development. [1] These obstacles affect the efficiency of the construction process and create complex conditions for the development of construction in the country. History has shown that it has been very difficult for local construction companies to adapt to modern forms of construction that have emerged in recent decades [2]. The hindrances include: lack of funding, insufficient production of local building materials, failures in project design and management, and the small potential of local construction firms [3]. The construction industry in Yemen is experiencing great difficulties as in many developing countries, which require serious effort to improve construction technologies, methods of organizing and managing construction, and changes in legislation [4-6].

It's not a secret that the outcome of the decisions made depends to a large extent on how accurate the information is about the current state of affairs in the area under investigation. One of the effective ways to gather up-to-date information on the problem is to conduct expert surveys in the relevant field. This article presents the results of our study, reflecting primarily the main obstacles to the potential development of the construction industry in Yemen.
2. Methodology

Data for the study was collected by interviewing construction industry specialists and other stakeholders working in the largest cities of the country: Sanaa, Aden and Taiz.

The purpose of the survey was to study the opinions of specialists of the construction industry and stakeholders on the current state of the industry and the problems that impede the development of the country's construction industry. The questionnaire included questions concerning the main obstacles to the development of the construction industry in general and the production of local construction materials in particular.

Despite the fact that the poll was conducted mainly in the capital of Sanaa, where the main major participants of the construction business are concentrated, it was decided to include in the survey the respondents working in the capital, but coming from different parts of the country. This gives us the right to assume that the results of the survey reflect the peculiarities not only of the capital region, but also of other regions of Yemen. The questionnaires were sent to participants by e-mail, and also were given directly to representatives of construction organizations. A total of 59 responses were received, 5 of which were dropped, as not completely filled. Thus, 54 participants responded to the subsequent analysis.

Figure 1 shows an enlarged scheme of conducting a survey on the study of the construction industry in Yemen.

![Figure 1](image)

**Figure 1.** The enlarged scheme of carrying out of interrogation on research of building branch of Yemen

**Structure of the questionnaire**

The questionnaire consists of three parts. The first part is general information about the survey participant: the participant's name, age, education, scope of work, place of work, position, work experience etc. The second part contains questions concerning the main problems in the construction industry of the country, factors affecting the production of construction materials, the reasons for the high cost of housing and, finally, the causes of high losses in construction. The third part of the questionnaire is aimed at collecting data on the types of living quarters / buildings erected in Yemen and on their conformity to the interests of the population of the country. For each question of the
questionnaire, a set of answers was proposed that the survey participant should have ranked according to his views on the degree of influence of one or another response to the activities of the construction organization and / or the industry as a whole. These answers are described in the following parts of this report.

3. Results

3.1. Processing and analyzing of the answers of the survey participants

Respondents were asked to indicate their opinion on the factors for each point of the questionnaire. The distribution of answers was used to assess the significance of these factors. An analysis of the survey participants showed that a wide range of stakeholders participated in the survey as well as experienced engineers working privately in small and medium-sized consulting and contract construction firms or participating in implementation of state projects.

The results of the survey show that the main obstacles to the development of the construction industry in Yemen are organizational and administrative weakness, corruption, lack or underdevelopment of infrastructure, as well as inefficient legislation. In addition, it was found that the most significant reasons leading to high costs for the construction of facilities are the use of imported construction materials and equipment, inflation, economic instability and a high level of construction waste. Below are more detailed results from processing the results of the survey.

3.2. Barriers to the development of the construction industry

When answering the first question, participants were asked to assess the significance of the factors that, in their opinion, are the main obstacles to the development of the construction industry in Yemen. Among the significant obstacles (with an index of more than 60%) survey participants indicated 11 factors. The results of processing the responses are presented in Table 1.

| Factor                                      | Index, % |
|--------------------------------------------|----------|
| Administrative problems and bureaucracy (including corruption) | 86       |
| The state of the infrastructure            | 83       |
| Inadequate supply of available land for construction | 82       |
| Complex rules and ineffective legislation  | 82       |
| Underdeveloped financial system            | 82       |
| The lack of research and pilot projects    | 81       |
| The lack of standardization of local materials | 79       |
| The existence of specifications(Lack of specifications) | 66       |
| The availability of skilled labour(Lack of skilled labour) | 65       |
| Poor use of local building materials and technologies | 63       |
| The shortage of building materials         | 60       |

As can be seen, in the first place, the majority of respondents raised administrative and bureaucratic problems (including corruption). According to the majority of survey participants, excessive bureaucracy is the reason for delays in the construction project at all its stages. It is characterized by too many laws and regulations, excessive documentation, too many permits and duplication of powers of state bodies.

The second most important barrier was the undeveloped infrastructure (complex geography, lack of asphalt roads in some communities, inadequate or lack of electricity and water supply). To the
undev
developed infrastructure, the survey participants also attributed the poor access roads to the
construction sites and related vehicle damage, delays and difficulties in delivering resources. Here,
respondents attributed overestimated prices for land in the cities and increasing the burden on the
existing infrastructure as a result of the construction of new residential facilities.

The third position in the survey with an indication of relatively high importance of 82% was
divided into three factors: insufficient supply of available land for construction, inefficient
construction legislation and poorly developed system for financing the construction industry. The
survey participants noted that customers, investors and contractors are experiencing a large lack of
financial support from banking institutions or are encountering very difficult conditions when
obtaining a loan. Significant problems with the results of the survey can be attributed to serious
problems with the lack of research and experimental projects in construction.

3.3. Barriers to the development of the building materials industry

This section of the study is devoted to identifying problems that prevent the achievement of good
results in the production of local building materials. The factors proposed as barriers in this part of
the questionnaire have been carefully selected based on the analysis of the experience of practitioners, a
broad review of scientific and specialized literature and international reports of governmental and non-
governmental organizations in developing countries.

The result of processing the responses of survey participants is shown in Figure 2.

![Figure 2. Barriers to the development of building materials Industry](image)

As can be seen from the figure, the most significant factor is administrative problems, the second is
the factor of complexity of local conditions and underdeveloped infrastructure (lack of access roads,
problems with the supply of electricity and other services necessary to create economic activity).
Insufficient scientific research in the field of construction and, consequently, lack of information were
in third place. Among the barriers were problems in financing, difficulties in providing enterprises
with equipment and skilled labor, problems with obtaining land for plant or factory placement, market
problems, difficulties in obtaining raw materials.

3.4. Causes of high construction costs

In this section, participants were asked to rank factors that, in their opinion, make the greatest
contribution to construction costs. The majority of survey participants noted that inflation, price
fluctuations, the use of expensive imported materials and excessive waste are the most significant
factors causing an increase in the cost of construction projects. The factors that exerted less significant
influence were the costs of labor and the cost of local materials. The results of processing the
responses of this part of the questionnaire are presented in Figure 3.
According to the surveyed specialists, inflation and price fluctuations are the most important factors (92% significance index), which have a significant impact on construction costs. The increase in inflation is due to a number of reasons: the demand for inexpensive comfortable housing exceeds supply, there is a shortage of goods, economic instability, political instability and the associated protracted period of armed clashes. In addition, the price fluctuations are affected by the cost of raw materials, labor, and services.

The application in construction of expensive imported construction materials and equipment is the second-placed factor (91% in the significance index). Many respondents noted that when buying imported materials, cheap, but low-quality and less durable materials are often used. In addition, when using imported equipment, the cost of maintenance or replacement increases dramatically, if necessary during the life cycle of buildings or structures.

In the third place, the survey participants put 2 factors - the lack of cost-effective methods and excessive waste. The causes of excessive waste are the use of inefficient construction technologies, the lack of qualified personnel, errors in material procurement planning, the low level of accounting and control over the consumption of materials, the lack of a recycling mechanism for waste.

3.5. Causes of waste in construction

This section was used to determine the factors leading to the occurrence of construction waste. We define waste as "something different from the absolute minimum amount of resources of materials, equipment and labor required to increase the value of the product" Serpell & Alarcon (1998). In scientific literature, it has been repeatedly stressed that waste is not only associated with material waste in the construction process, but also with other activities that do not add value, for example, repairs, waiting time and delays. In general, all construction works that directly or indirectly increase the cost, but do not add value or progress to the product, can be called waste. Any efforts to improve the situation should focus on identifying waste generated during the construction process, an analysis of the causes that lead to the generation of this waste, and the development and implementation of measures aimed at reducing the impact of these causes or their elimination.

To rank the survey participants, the following factors were proposed: inefficient planning and management, inefficient use of resources, problems with the quality of resources, lack of work skills, lack of supervision and oversight, inefficient procurement.

The results of processing the answers to the part of the questionnaire are shown in Table 2. As can be seen from the figure, the values of the significance index for the proposed factors lie in the range from 60% to 80%. Although there is almost no significant difference between the first five ranked factors, the lack of early planning and poor contract management ultimately ranked first. Good project management implies planning, coordination and control of all aspects of the work and can lead to a significant increase in productivity without increasing investment.
Table 2. Causes of excessive cost of materials

| Factor                                      | Index, % |
|---------------------------------------------|----------|
| Inefficient planning and management         | 80       |
| Inefficient use of resources                | 79       |
| Problems with the quality of resources      | 78       |
| Lack of work skills                         | 77       |
| Lack of supervision and oversight           | 76       |
| Inefficient procurement                     | 60       |

Local official, and especially unofficial contractors and subcontractors do not have management skills that can improve productivity and prevent over-expenditure of time and costs. Inadequate economic analysis of the project or overestimation of the financial potential of the customer is also a symptom of poor planning. Adequate management of contracts is very important, since most other problems are related to failures in the management of the contract, either by the customer or by the contractor. Unfortunately, this is a very old problem: back in 1984, the World Bank noted a lack of management skills as a major drawback of local construction enterprises in developing countries.

In second place is the lack of control and weak supervision of activities at the construction site. According to some participants, this may be due to the fact that qualified engineers and technicians conducting supervision are often underpaid for it. A number of survey participants noted that poor management of contracts generates shortcomings in the organization of construction and work plans. Some experts explained these shortcomings as lack of relevant experience or lack of specialization.

The factor "Irrational use of resources", which took the third place, is caused by inefficient organization of work in the workplace, inappropriate storage of materials and damage during transportation.

In fourth position are the problems with the quality of resources, in particular the quality of cement, on which the quality of concrete largely depends. In developing countries, such as Yemen, the quality of building materials may not meet international standards due to poor quality control, transportation and storage problems, water quality and building materials components, due to lack of control and testing and restrictions on specifications.

Lack of skills to perform the work took the fifth place, and inefficient purchases took the sixth place. The latter may be due to the fact that the participants could not determine the importance of this factor.

4. Conclusions and recommendations

As the analysis of respondents' answers shows, the main barriers to the development of Yemen's construction are administrative problems and corruption, lack of infrastructure necessary for economic and economic activities and resettlement of people, shortcomings in construction legislation and other legal issues, problems of financing construction projects. The survey participants believe that sectorial technical problems are of less importance. They also noted that economic stability is important for the potential development of the construction industry, since it provides a lesser risk for investment.

One of the serious obstacles to the successful implementation of construction projects, in the opinion of survey participants, is the high cost of construction. The use of expensive imported materials, inflation and instability of the economy, excessive construction waste were identified as the most important causes of higher construction costs.

From the results of the analysis it follows that the country needs very serious reforms that must be implemented in both the public and private sectors.

There is a need for long-term and medium-term strategic planning for sustainable economic development aimed at reducing unemployment and foreign exchange consumption. To do this, it is important to develop and begin to implement a more thoughtful policy of employment, use of local building materials, minimization or control of imports. To solve this task, first of all, it will be necessary to coordinate the needs of the population of the country and plans for the development of
the state as a whole and its individual regions in particular. It is also necessary to improve the general and construction legislation. Building codes and regulations can influence the choice and quality of materials, allowing designers to have more confidence in the implementation of optimal projects. The principles of monetary policy and tax policy should be developed to promote economic activity, control market prices, limit inflation and expand the share of small businesses in construction. In addition, the development of the construction materials industry in Yemen should be adjusted and monitored with a new strategy that balances local industry protection policies and open markets. Yemen should strive to increase the level of labor resources in construction and adopt only those technologies that are relevant and adequate to local conditions and needs.

The implementation of the above tasks, in our opinion, is possible in the conditions of creating a mechanism for regional cluster policy [7], that is, by creating regional building clusters [8, 9]. The main directions of this mechanism include:

- in the economic sphere - development of small and medium-sized businesses, cooperation and integration, diversification of the region's economy in order to fill its budget and ensure employment of the population, development of the region's infrastructure;
- in the social sphere - stimulating demographic growth, raising incomes and providing the population of the region with basic social services (comfortable housing, education, medical care);
- in the institutional sphere - interaction of all authorities, monitoring of municipalities, increasing the investment attractiveness of the territory;
- in the environmental sphere - ensuring environmental safety and environmental protection, stimulating environmental protection [10, 11], etc.

The experience of creating and operating clusters in a number of developed and developing countries shows that the cluster model of regional economic development is the most effective from the point of view of increasing competitiveness, strengthening cooperation and increasing the innovation activity of economic entities that are members of the cluster [12-14].

In general, according to the definition of clusters given by M. Porter [15], the cluster members can be producers and suppliers, engineering research organizations and organizations that train engineers, credit organizations and banks, infrastructure, government, professional and community organizations. An analysis of the socioeconomic situation in the regions of the Republic of Yemen showed that the most promising of them from the point of view of the necessary conditions for the formation of a regional construction cluster is the region (governorate) of Sana. On the territory of the region there are 3 large industrial enterprises (Amran cement plant and two metallurgical plants) capable of fulfilling the role of the core of the cluster. Here is the largest university in the country - the National Research University of Sana, and a number of other scientific and educational institutions. In the region there are 14 general contract construction organizations and a number of medium and small enterprises specializing in performing certain types of construction, installation and commissioning works. Sana is one of the regions with a relatively high population density, which guarantees the availability of the necessary number of labor resources. The infrastructure of the region is well developed and is capable of providing cluster members with access to energy sources and various communication and transportation channels.

Summing up, it can be confidently asserted that the regional construction cluster of Sana in case of its formation will be able to ensure sustainable development of the region by improving the investment climate and increasing competitiveness through the development of social, economic, information and integration subsystems, which in turn will attract investment and further economic growth.

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