Overcoming information asymmetry in the construction industry based on open and closed contractor activity data

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Abstract. The purpose of the research is to find measures to reduce information asymmetry which significantly affects the relationship between customer and contractor, leading to higher prices for construction work and enhanced opportunism. Information asymmetry can make contractor and customer move away from direct contractual relations to more and more costly ways of interaction: legal, law enforcement and ethical. In the long run, the most effective level of interaction is ethical, as it significantly reduces information asymmetry as well as attendant costs. The article proposes two approaches to analyse asymmetry of contractor’s information: in the situation of limited access to internal information of a construction company and in the situation of maximum access to information of the activities of construction company’s individual departments. In the first approach, an assessment of price discrimination and changes in the cost of construction due to a deliberate deterioration in its quality is used. In the second approach, a set of indicators is considered, grouped by the functional levels of the contractor: physical, procurement, economic, technological and design.

1. Introduction

Key players of the construction industry are construction company (contractor) and investor (customer) who are interested in bilateral relations [1]. The building owner bears significant costs for the construction of industrial, residential and infrastructure facilities, as well as their maintenance over the life of the product. Therefore, it is very important for him to evaluate the reliability of a construction company in the long run. To assess reliability, the customer has to overcome information asymmetry in his relations with the developer. Such information asymmetry (hereinafter - IA) is naturally overcome in the course of long-term cooperation. From this point of view, a long-term construction contract not only brings the contractor cash income, but also maintains its reputation and trust among customers. As a result, IA and associated risks are reduced.

If the contractor and the customer lack experience in interacting with each other, information asymmetry and attendant risks are at their maximum. It forces the contractor to use market signals to overcome it:
- ratings and returning client testimonials
- construction objects guarantees
- quality system standardization (for example, standards ISO 9000 series);
- guarantee of third parties (professional construction organizations, government agencies, etc.);
- disclosure of construction technology and materials used
- video recording of the construction process
testing by the customer (including individual stages of construction);
- phased delivery of construction projects to the customer.

Nevertheless, in the construction industry, information asymmetry and risks still remain even in the relations with long-term partners. It was clearly demonstrated by the crisis of 2007, which caused a wave of bankruptcies in the world, including bankruptcies of construction companies. Thus, additional mechanisms are needed to reduce IA and attendant risks.

2. Features of information asymmetry in construction transactions

In any construction transaction, the relationship between customer and contractor take place not only in the form of a contract, final occupancy and its payment. If either party behaved opportunistically (i.e. has not fully complied with the terms of the contract), cooperation could move to other levels (Figure 1).

![Figure 1. The levels of interaction between contractor and customer](image_url)

If for some reason the construction contract has not been fulfilled, the parties move to the next legal level. As a result of this, the parties will incur additional costs for resolving legal issues, and the transaction itself will become more costly and less profitable for both parties.

If, at the legal level, it was not possible to reach a settlement that works for both parties, they proceed to the next power level, which involves coercion to fulfill the terms of the contract in various forms: providing unflattering media coverage, putting pressure on banks and suppliers, informing other contractor's customers about the situation, initiating state inspections, filing an appeal to the parent company, etc. It further increases the costs of each of the parties [2].

If a compromise has not been reached at the power level, then the parties could try to settle it at the ethical level, which is a system of rules and values of society that aims to overcome the limitations of society, to achieve inter-individual harmonization and personal growth through increased awareness. This level is most high-maintenance because it requires investing time and energy over a prolonged period. At the same time, this level is the most effective because it automatically harmonizes all the levels below. Thus, it is to the benefit of all conscientious participants in the construction industry to establish a unified ethical standard in the industry, which will help them reduce long-term costs. If such a single ethical standard is not available, customers can use indirect indicators that can reduce IA in relation to the contractor.

3. Indirect evaluation of information asymmetry

Information asymmetry allows the contractor to raise prices for construction work \((+\Delta P)\) and / or to lower the cost of construction work \((-\Delta C)\) with the help of a conscious deterioration of the quality of these works. It is relatively easy to identify such facts if the contractor builds standard objects for different customers. In this case, if prices of such objects at fixed costs differ, then there is price discrimination caused by information asymmetry (Figure 2).
If, at a fixed price for identical construction projects, their cost is significantly different due to deliberate quality deterioration, this phenomenon can be called discrimination of customers on the quality of construction work (quality discrimination) (Figure 3).

Based on this, a change in information asymmetry ($\Delta AI$) can be expressed through the equation:

$$\Delta AI = \sum_{i=1}^{n} (\Delta P_i + |\Delta C_i|)$$  \hspace{1cm} (1)

where

- $n$ - the number of customers
- $i$ - a specific customer of construction products.

The above formula allows us to represent information asymmetry in monetary value. Practical application of this formula is complicated by the problem of separating information asymmetry factor from other factors that may affect price and cost.

If the contractor performs non-standard construction orders or the customer has access to the contractor’s internal information environment, the customer can conduct a comprehensive analysis of contractor's activities to reduce information asymmetry.

4. Comprehensive analysis of the contractor activities to reduce information asymmetry

Comprehensive analysis performs a set of following functions:

1. Physical function – creation of construction projects.
2. Supply function – organization of interaction between the individual construction sites of the contractor, logistic operations, storage facilities, energy supply, provision of labor resources (including a training system), etc.

3. Economic function – support for construction work using cash flow (income generation, payment for construction materials, wages for workers, taxes, etc.).

4. Technological function – development and implementation of construction, administrative, human resources and other technologies.

5. Project function – identification of strategy, relationships with external actors, relations with state agencies, work with key customers, etc.

For each of these levels we can apply their own indicators to reduce information asymmetry regarding a specific aspect of the contractor's activities. Consider them below.

**Physical level**

The following indicators can be applied at this level:

- increase of the number of participants in the construction process (suppliers and subcontractors). It indicates an increase in specialization and a subsequent increase in construction efficiency
- share of work for long-established customers out of the total volume of construction work. It indicates stability of the construction quality and confidence in the contractor;
- steady increase in the average load of the main equipment
- reduction of the share of manual labor and construction labor.

**Supply level**

At the supply level, the quality of construction work should be evaluated first. It is the most difficult aspect of external analysis, because it is not always possible to evaluate it in a professional manner. However, if the contractor is interested in getting a correct evaluation of his activities, he will provide all the evidence of quality stability of construction, including acts of expert examination from specialized organizations.

The risks of deterioration in construction quality are strategic. If the contractor consciously takes this step, then, firstly, he is not able to maintain his position by other means, i.e. its competitive performance is questionable. Secondly, he destroys his long-term competitive performance by deliberately deceiving customers and compromising his reputation as a credible partner. Of course, all of the above does not apply to cases where the cost reduction is caused by positive effects of the economy of scale, new technologies implementation or reduction of prices for any of the resources.

To analyze the supply level of the contractor, the following indicators can be applied:

1. Changes in a number of reclamations and consumer complaints about the construction quality. Such information is fairly easy to collect if you consult former and installed base customers. In this case, you should take into account not only changes in a number of complaints, but also changes in the volume of construction. Therefore, a more reliable indicator would be a number of reclamations and consumer complaints about product quality per unit of construction products.

2. The share in the total volume of construction work, which quality is beyond dispute. Declining quality of construction can not always be recorded even by users of fully commissioned construction objects. Therefore, a more objective evidence of products quality could be quality certificates (ISO, etc.), certificates of expert examination, etc. A positive development could be the availability of voluntary Quality Conformance Certificates.

3. Industry awards for quality, ranking among contractors, overall reputation. Such indirect indicators are created by independent parties and therefore objectively reflect a change in the construction quality, although sometimes with some delay.

4. Duration of contracts with key customers. In this case, what is measured is how successful the contractor has been in maintaining relationships with key customers, whether the work of the contractor is in demand, and whether the clients order work regularly and in sufficient quantity.

5. The share of expenses for the payment of the accounts of the main sub-suppliers, sub-contractors, etc. in the construction cost. This indicator reflects the relations between the enterprise and external partners who provide the contractor with productive resources, work and services. It helps to determine
manufacturing reliance of the enterprise and direction of its outgoing financial flows. It also allows to identify a whole set of other risks such as regional, political, risk of currency depreciation, transport and others.

**Economic level**

At the economic level, changes in prices, profit margins, market volumes, and terms of credit are thoroughly examined. In addition, an analysis of price discrimination is necessary. Such analysis aims to increase transparency of methodology of setting individual prices for identical or the same construction project at fixed costs. It means that all information about price structure (including the percentage of profit) should be considered. In fact, this aspect of assessing information asymmetry reveals the degree of monopoly market power of the contractor, which allows him to determine the price of his work and group customers according to the degree of their elasticity of demand. In addition, it allows one to find out whether the contractor is inclined to outsource some of the construction activities to third-party contractors and appropriate a brand name.

The most obvious indicators that allow us to identify the implicit risks of the contractor in terms of price policy analysis are the following:

1. Seasonal and business cycle price fluctuations at fixed production costs. The difference in the construction price during the period of decline in demand and during the period of its maximum value allows us to indirectly identify threshold limit value of the price and surplus the contractor receives in case of speculative demand \[3, 4\]. An important condition for correct evaluation is rigidity of production costs, which allows us to exclude from the analysis cases that are not the subject of evaluation (for example, cases of purchase cost decline of raw materials and consumables).

2. Difference in price of an identical or similar construction object for different consumers at fixed production costs. The higher the value of this indicator is, the greater the difference in the elasticity of customer demand. Here, we study cases in which a unit of construction work is sold at a bid price, i.e. at the highest possible price that the customer is willing to pay. This policy is called price discrimination based on the income of the buyer.

3. Price discrimination based on market segmentation. In this case, customers are divided into separate groups according to the elasticity of their demand in terms of price and other qualitative parameters: industry affiliation, form of ownership, geographical location, etc. Different price levels for these customer groups allow us to estimate the stability of the contractor's position and the possibility of sales diversification.

4. Assessment of middlemen's profit.

In this case, we evaluate the role of the contractor as an intermediary between customers and a third-party subcontractor. In the real world, it is not rare that the construction is indeed carried out by third-party contractors, and the contractor under evaluation only resells the project to its customers. This type of situation should be evaluated as highly risky because both the actual producer and end-use consumer are objectively interested in eliminating unnecessary intermediaries with corresponding financial losses. In this regard, sales revenue should be adjusted to the difference between purchase price and sales price. To do this, the difference between product price received from customers and product price paid to third-party contractors is summed up.

Economic level assessment should also include an analysis of the contractor’s main activities in the context of their profitability. This aspect of analysis is focused on increasing the transparency of sources of income and profits. As a result, we should have clear and complete understanding of what types of contractor’s activities are most likely to affect overall profits.

Indicators to identify the risks of the contractor’s income and profits may include:

1. Cost effectiveness and profit-making capacity of contractor’s activities. Due to the availability of financial statements of most companies, it is possible to establish facts of changes in the economic efficiency of the main production profile of the contractor, as well as identify new, financially interesting segments of the market.

2. Cost effectiveness and profit-making capacity of the contractor in his relations with the clients. In most cases, each company has both key customers and less important customers. While key customers
do not always deliver the highest profitability, their impact on revenue is generally high. If we know the difference between cost effectiveness and profit-making capacity of these two customer groups, we can estimate the degree of reliance of the enterprise on specific customers, as well as the risks that may arise from the loss of these customers.

3. Share of income from non-basic activities in revenue from sales of products. The concept of “core business” for a particular enterprise can transform as it develops, captures adjacent markets and acquires non-core assets. An increase in the share of income from non-core activities may signal qualitative shifts in the competitiveness of the enterprise in the "home" market and in the "new” market. Such facts should be recorded by an external analyst and evaluated in terms of new risks and opportunities for the enterprise.

Technological level
At the technological level, the following aspects should be evaluated:
– compliance of construction methods with market requirements;
– achievement of target indicators of cost effectiveness and profit-making capacity;
– flexibility to change production capabilities of the enterprise according to business activity in the economy;
– setup costs and staff retraining.
– compliance of construction technology with quality standards and environmental requirements

Design level
At the design level, the following aspects should be evaluated:
- compliance of the enterprise with community demand in the long term;
- information openness of a contractor;
- participation of the contractor in environmental and humanitarian projects aimed at harmonization of social relations;
- promotion of long-term survival and development of society.

As a result of the conducted analysis, a set of indicators will be created to comprehensively evaluate long-term sustainability and predictability of the contractor, which substantially reduces information asymmetry in relations with a contractor. This, in turn, reduces the cost of monitoring the progress of construction and the fulfillment of the terms of the contract. As a result, the price level for construction work can be significantly reduced in the interests of all participants in the construction industry.

5. Interdependence between functional levels
There is interdependence between different functional levels. So, for one phase of the construction activity cycle at the physical level (construction phase of the facility) there are at least two phases of the supply cycle (at least transportation of workers and materials to the construction site, as well as preparation of the territory for construction and cleaning of the construction site after construction is completed) [5, 6]. In turn, for each phase of supply there are at least two phases of the economic cycle (at least execution of a contract with suppliers and subcontractors, payment for materials, work and services, monitoring the implementation of the contract by suppliers and receiving payment from the construction customer). Similarly, for each phase of the economic cycle there are at least two phases of the technological cycle (at least the development of project documentation, control over the activities of units, adjustment of internal technological processes and commissioning of the facility). Similarly, the design level cycle is more intense than the technological one. The project cycle includes continuous monitoring of demand for construction work, development of business processes for each type of work and services, coordination of construction activities with authorities, trade unions and other external entities).

The intensity of transactions at each of the levels can be calculated using the formula:

\[ Int = \frac{Q_{\text{trans}}}{T} \]

where

\( Int \) – transaction intensity at functional level.
$Q_{\text{trans}}$ – the number of transactions of units of a separate functional level of the contractor with other construction entities (internal and external).

$T$ – time period.

If the contractor is in the growth stage, then the intensity of the processes at the project level is much greater than at other levels, because at this level, the company operates with many external entities in a constantly changing external environment, which requires immediate and constant adjustment of construction technology at all other functional levels [7]. In this case, we can observe the following ratio of transaction intensities of functional levels:

$$I_{\text{project}} > I_{\text{technological}} > I_{\text{economic}} > I_{\text{supply}} > I_{\text{physical}}$$

Between the indicated levels, quantitative relationships can also be observed. For example, if we know the planned volume of construction (physical level) it is quite easy to calculate the complexity of the work, the number of workers, the required amount of materials, storage space, transport units, special equipment, etc. It determines the quantitative relationship between the physical and supply levels.

Based on the data of the supply level, you can determine the main indicators of the economic level: payroll, transportation and storage costs, taxes, profits, payment to suppliers, etc.

The parameters of the physical, supply and economic levels are directly related to the parameters of the technological level, primarily with the volume of development of construction technology and construction documentation.

Thus, if we know the quantitative parameters of one of the levels, it is possible to determine the intensity of processes at all other levels. To accomplish this, it is also necessary to know the features of the construction industry (road, housing, industrial, etc.).

Any change in the phase of the contractor’s cycle first becomes apparent in a change of the intensity of transactions at the project level, which activates all the levels below correspondingly (Figure 4).

![Figure 4. The relationship of the phases of the cycle at different functional levels of the contractor](image)

The size of the interval $t_1 t_2$ shows the degree of flexibility of the contractor’s organizational structure to change in the market demand for construction work. It largely determines its competitiveness in the long run.

The exact quantitative relationships of different functional levels for a particular contractor can only be determined empirically. It will allow the customer to predict in advance the change in the state of the contractor and thereby significantly reduce the information asymmetry.

6. Conclusion
Thus, according to the study, we can conclude that the customer can significantly reduce the information asymmetry in their relations with the contractor. Moreover, the more detailed internal information about the contractor you can get, the more reliably you can predict his behavior in the long term. The proposed methods to reduce information asymmetry can also reduce the risks of all construction participants and facilitate long-term cooperation.

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