Optimization of trading and purchasing policies in the market of the construction material

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Abstract. In the present research, the authors’ attention is concentrated on the methodological fundamentals of surveying the situation on the construction material market using mathematical analysis methods, the model of “Profitability – Risk” in particular. The significance of the paper under consideration is conditioned by a great value share of construction materials in the integrated capital of an investment construction project and by the necessity to make the dependence on imported construction materials lower. The construction material market regulation and its conditioning oriented at its more effective functioning are to affect the construction field favourably. The information received in the process of analysis with regard to a retrospective information is to become a reference basis in managerial decision making. The objectives to be achieved on managerial decisions making depend on the quality of the reference information. A mathematical algorithm for studying a retrospective information on constructive material value is offered in the paper under consideration along with the analysis of other factors. The algorithm has been worked out basing on the portfolio theory concepts. While gestating the offered algorithm practically, construction materials were ranged to form groups, and following that, several types of materials were defined for each group. In the process of the analysis, a number of items were calculated: yearly price changes, expected average price changes and root-square deviations as risk level indicators and an average values ratio in a price movement to the corresponding risks. Besides, some groups of materials were identified as having considerable value fluctuations. The reasons of their fluctuations having been revealed, the most cost-effective and mostly exposed to risk groups of construction materials were indicated as being mostly on demand in the home markets. The offered recommendations are the result of the investigation and are meant for main participants of the construction material market, such as the government, construction material producers and developers engaged in organizing and planning their activities in the sphere of investment-construction project realization.

1. Introduction
Construction is an integral part of a country existence. Housing, enterprise, infrastructure construction provides working places for the people, takes important socio-economic decisions and improves living
standards. The subjects of the investment-construction process are represented by a considerable number of enterprises orientation: ordering parties, project owners, construction material distributors, dealers, design engineers, etc.

A high capital capacity is characteristic for an investment-construction sphere, this fact determining the orientation of construction production management efforts to reduce the expenditures with regard to realization of the projects. Depending on the type of an investment-construction project, the region of its realization and a number of other factors the material expenses in the total project expenditures fluctuate within 40% to 60%. Therefore, the control of material resources value will make it possible to solve a number of problems that are essential for the branch under consideration.

The construction material market had naturally been formed as a result of an economic intercourse developed in the process of production followed by purchase and sale of materials. The price of a certain material depends on a great number of factors including a demand for the material, its accessibility, the availability of deterrent factors such as sanctions, production conditions, facilities of access for a raw material resource, etc. The crisis that the Russian Federation has met with lately has affected all the spheres of social life and has certainly had an impact on the construction material market. The analysis of changing prices on the market makes it possible for the construction enterprise management and the contacting officer-suppliers to realize different solutions connected with their main activities and in particular allows:

1) to follow promising trends on the construction material market;
2) to optimize the realization strategies that are common for investment-construction companies with regard to the companies engaged in construction;
3) to estimate the future profits and losses of companies producing construction materials and to diversify the production basing on the results obtained;
4) to adapt the lines of activities concerning the trading and purchasing companies choosing more profitable ones with regard to the analysis data;
5) to model the government policy regarding one or another aspect of the market under consideration and to develop a subsidization strategy to support the construction field.

The given paper is aimed at an algorithm development oriented at an increased force of price attraction with regard to different kinds of construction materials on the part of all the market members in addition to its practical approbation.

To achieve the purposes some objectives have been set:
1) using the initial data and the mathematical analysis methods it is necessary to follow the parameters of price changes calculating the mean values of price changes and the risk (a standard deviation), followed by a scatterogram in correspondence with the axes of risk and an average mean value change and to drop out the duplicates which are the materials that have close values of risk and profitability parameters, their conditions being inferior, and to separate groups characterized by some dependence that can be followed;
2) to study the causes of changing different construction material prices and price dependence in separate groups. To analyze the data obtained from the point of view of a producer, supplier, stock object acquirer and organs of power (that have the ability to make decisions at the federal and regional level);
3) to work out the recommendations concerning the force of investment attractiveness with regard to this or that kind of materials, to determine the most commercial kinds of construction materials and enterprises that do not need any implementation of special instruments as well as to identify the kinds of materials that are least commercial but are necessary as the ones to be used in the building process.

2. The algorithm used to analyze construction material price changes.
In practical work, the analysis results obtained facilitate developing effective action strategies meant for each of the market members that in their turn contribute to an affluence growing.

A financial analysis is performed basing on the portfolio analysis, developed by G. Markowitz (1952), U. Sharp (1970). A model designed with regard to an investment risk and expected returns is meant by the methodology. These two notions are interconnected in the model. The objective is to
compile a bundle of assets contributing either to a minimum risk achieved at the target level of profitability or to a maximum income at a target risk level. [9].

The process of a model designing anticipates:

1) A risk calculation meant as an average square deviation of returns and the calculation of total returns meant to be a simple average of returns for equal periods of time [10].

2) A diagram plotting with the horizontal axis being marked with risk measurements while its vertical one being marked with returns and the subsequent dropping out. Among the pairs of double points under consideration, there is a point which is in a worse position in the diagram. This point is to be excluded from the further examination. Two points are considered to be double points, their risk or returns being correspondingly different from each other by no more than 0.1 %. In such a pair, the point positioned to the right is not taken into consideration if dropping out takes place in correspondence with a risk index, it being even lower if dropping out happens in correspondence with the index of returns.

3) On having been dropped out, the points are removed and the trend line is added followed by its equation.

4) Selecting groups with regard to some common characteristic [9].

The assets you see in the right lower corner are most unprofitable ones because they combine the greatest risk and the lowest returns. The assets in the left lower corner are most reliable, though not the most profitable ones and they are used to save the funds, whereas the assets in the right upper corner are most risk-related and suitable for the ones seeking for a quick profit, whereas the most attractive assets are located in the upper left corner and combine a high profitability and a low risk relation [4].

To approbate a price changing analysis algorithm with regard to construction materials, the data on the value of 18 kinds of construction materials were subjected to the analysis, the materials being divided into several groups. The paper covers the period of 2010 – 2016 [7]. Value changes on an annual basis, expected average price changes and mean square deviations as the measure of risk relation were calculated in the process in addition to the mean values of price changes in the relation with the corresponding risks (table 1).

| Construction material | Average (%) | Standard deviation (%) | relation of profitability to risk |
|-----------------------|-------------|------------------------|----------------------------------|
| Concrete which is ready for filling (custom concrete), m3 | 2,9 | 5,8 | 0,5 |
| Construction mortars, m3 | 3,9 | 6,9 | 0,6 |
| Ceramic refractory building brick, thousand relative units | 6,2 | 8,2 | 0,8 |
| Brick of silicate, thousand relative units | 5,6 | 4,8 | 1,2 (min) |
| Insulating building fiberboards, sheeting, panel boards, paving tile, and similar products made of gypsum or compounds on its basis that are not covered or reinforced with paper or cardboard with the exception of ornamented products or the ones agglomerated with gypsum, m2 | -5,1 (max) | 21,3 | -0,2 (min) |
| Broken natural stone, m3 | 5,7 | 12,5 | 0,5 |
| Sundry natural sands, m3 | 8,3 | 24,3 | 0,3 |
| Sundry expanded mineral materials (gravel ceramsite), m3 | 6,3 | 8,5 | 0,7 |
| Sundry pre-fabricated construction elements of steel, tons | 10,3 | 16,5 | 0,6 |
| Material Description                                                                 | Price 7.0 | Price 9.2 | Price 0.8 |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|
| Hot-rolled and shaped rolled products, hot drawn, extruded and forged from unalloyed steel, tons | 7.0       | 9.2       | 0.8       |
| Converted timber common that does not belong to any other groups, and some other products, m³ | 5.8       | 5.2 (min) | 1.1       |
| Wood chipboards of continuous pressing, m²                                            | 10.9 (max)| 22.0      | 0.5       |
| Compounds and products from heat insulating materials that are not covered by any classification, m³ | 6.8       | 24.4      | 0.3       |
| Ceramic glazed tiles for the inside wall cladding, m²                                  | 7.3       | 16.3      | 0.4       |
| Cast and profiled rolling glass sheets, m²                                             | 2.2       | 9.5       | 0.2       |
| Cement, tons                                                                          | 6.0       | 12.2      | 0.5       |
| Dry oil, tons                                                                         | 9.3       | 30.8 (макс)| 0.3       |
| Ready-mix paint, t                                                                     | 2.6       | 9.8       | 0.3       |

The materials classified as stable one and belong to the group of “Wooden materials and products” have been marked for the greatest price growth. Purpose-made materials (molding) are the most unstable ones and some kinds belonging to this group, on the contrary, would reduce in price. “Sand-lime brick” is particularly marked for its returns to risk relationship indicator -1.2 which means that in fact returns grow more quickly than risks. This is quite contrary to “insulating building fiberboards, sheeting, panel boards, paving tile, and similar products made of gypsum or compounds on its basis that are not covered or reinforced with paper or cardboard with the exception of ornamented products or the ones agglomerated with gypsum” with the value of -0.2.

To make the reasons for a price leap regarding a number of materials well founded, the legislation and competitive environment were studied. Some other factors were revealed that could have led to construction material price changing. For example, since January 1, 2015 the general state standard of 32389 – 2013 Drying oils. General technical conditions. has come into force. This general state standard was introduced on the territory of RF and the neighboring countries and considerably tightened the regulations of the drying oils, the process of their production and its control. A price leap is a natural market reaction resulting from tightened standards followed by expenses. The countries that have accumulated state standards have got the markets that are closely interconnected. Therefore, the growing prices cannot be compensated by an import trade for cheaper products from neighboring countries. A similar situation has taken place with the item of “Compounds and products from heat insulating materials that are not covered by any classification”.

On the other hand, unlike the above materials, fiberboards, sheeting, panel boards, paving tiles and similar products made of gypsum or its compounds but neither covered nor reinforced with paper or cardboard became considerably cheaper in 2013, ornamented products or gypsum sintered ones being the exception. This was facilitated by:

1) The establishment of works to produce partition blocks of gypsum on the territory of “Samara Gypsum Center” in 2013. This caused the appearance of a new market member and an increased volume of products, conditioned the competitive struggle for the consumer and lower prices (www.samaragips.ru).

2) The growth of inner production resulted in the growth of a monthly export volume by 30 %: 682 thousand dollars in January 2013 as compared with 904 thousand dollars in December 2013 [3,4] along
with a decreased import volume of expensive products from Europe by 20% monthly: 2.1 million dollars in January 2013 as compared with 1.7 million dollars in December 2013 [3,4].

For the further analysis to be performed, it is reasonable to plot the data on a diagram with the axes of risk-returns and leave the outsiders with no further consideration (Fig. 1). All the construction materials included into the group of leaders can be divided into several groups, though conventionally to some degree. The materials that are used in a rough-edged construction of the most objects in the RF are to be marked first. They are “concrete which is ready for filling (custom concrete)” which is a basic compound of any building foundation, “converted timber common that does not belong to any other groups, and some other products” such as sawn timber and other materials which are popular with private construction along with “brick of silicate” which is the basic material for the walls in rental apartments as well as “pre-fabricated construction elements of steel” that are used in the frames of great buildings,” the expanded mineral materials (such as gravel ceramsite”) should also be mentioned as the ones used to facilitate the thermoinsulation of the foundation, floor, roof, utility systems, they being added to concrete. All the materials that belong to this group with the exception of concrete are positioned above the trend line (Figure 1) and consequently possess the best indices of returns-risk relation.

![Figure 1. The diagram of dispersal with regard to construction materials possessing the best indices.](image)

A correlation analysis has been made basing on the materials forming the group of leaders. It resulted in revealing that there is no correlation between average price changes developed by leading materials.

**Conclusion**

There are some recommendations for the management of companies engaged in the production of materials or planning to start their production in the near future:

1) The production of materials for rough-edged construction is preferable, i.e. for walls, the foundation and the roof. Artificial materials of stone and wooden demonstrating a steady price growth for a long period are the most profitable ones.

2) The production of materials for interior finish is an extremely risk-related business and calls for detailed studies of quickly changing trends on the market of home decoration construction materials, a more narrow segmentation and an assessment of a potential market volume.

At the federal level:
1) The examples dealing with drying oils and heat insulating compounds prove of the great influence that the state regulation exerts on the market. The introduction of many standards for one occasion only results in a price leap. Besides, the goods bought before new standard introduction become unsaleable, so a customer has to buy the product he needs once again which is sure to cause higher prices resulting from a higher demand conditioned by a limited stock-in-trade.

2) The analysis performed allows to identify the regions that need a state support for their development. The situation with trowel firms has been unsteady and their assets are at risk. At the same time, this portion of the construction market is as important as the “rough” one. It is in this market segment that a high dependence on import is registered in creating additional threats for economic stability.

For a building owner:

1) For a building owner, whether we speak of a physical or a legal entity, it is important to understand that there are materials with a value growing steadily, and these are the materials that are used for a foundation, load-bearing wall panels and a roof erection and that a delay with the rough work orders results in a greater value of a “case” construction. A forecastable rise in price should have been made provisions for in the capital expenditures of an investment project.

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