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Investment strategy for ensuring quality of finishing works on residential buildings

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Preliminary report

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Investment strategy for ensuring quality of finishing works on residential buildings

The relationship between the quality of finishing works, costs, market value, and profit, is presented and explained for residential buildings. The results show that the higher quality of finishing works increases profit for investors. As the maximum market price is limited, there is a limit when the investment in finishing work is no longer cost-effective as, after increase in costs, the market value decreases and the profit reduces. The research methodology presented in the paper can be applied to any residential real estate market.

Key words:
quality, price, finishing works, cost significant items, survey, residential building

Prethodno priopćenje

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Investicijska strategija za osiguravanje kvalitete završnih radova na stambenim zgradama

U radu je prikazan i objašnjen odnos između kvalitete završnih radova, troškova, tržišne vrijednosti i dobiti za stambene zgrade. Rezultati istraživanja su pokazali da veća kvaliteta završnih radova osigurava i veću dobit investitorima. S obzirom na to da je maksimalna tržišna cijena ograničena, postoji granica ekonomske isplativosti ulaganja u završne radove jer nakon povećanja troškova tržišna vrijednost opada i dobit se smanjuje. Prikazana metodologija istraživanja se može primijeniti na bilo koje tržište stambenih nekretnina.

Ključne riječi:
kvaliteta, cijena, završni radovi, troškovno značajne stavke, anketa, stambena zgrada

Vorherige Mitteilung

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Investitionsstrategie zur Qualitätssicherung bei Endarbeiten im Wohnungsbau

In dieser Arbeit ist Verhältnis der Qualität von Endarbeiten zu Kosten, Marktwerten und Gewinnen im Wohnungsbau dargestellt und erläutert. Forschungsresultate zeigen, dass eine höhere Qualität der Endarbeiten, den Investoren größere Gewinne einbringt. Da maximale Marktpreise begrenzt sind, besteht eine Grenze der Investitionsrentabilität für Endarbeiten, da nach dem Kostenanstieg der Marktpreis sinkt und der Gewinn abnimmt. Die dargestellte Forschungsmethodologie kann für jeden Wohnungsmarkt angewandt werden.

Schlüsselwörter:
Qualität, Kosten, Endarbeiten, rechnungswichtige Arbeiten, Umfrage, Wohngebäude

1. Introduction

Investors can expect a long-term success on the real estate market only if an appropriate quality of construction work is maintained [1, 2]. The traditional approach to quality means successful control of the construction process quality with the aim of eliminating unsatisfactory work results. The modern approach implies quality management, which includes recognizing market demand (quality planning), ensuring high quality workmanship (quality assurance), testing procedures (quality control) and improving overall performance over time (quality improvement). In general terms, quality management means sustainable development and management of the entire construction process [3].

In terms of the level of investment, the construction phase of residential projects is actually the most important one because over fifty percent of total project costs are in fact generated in this phase. It can be argued that the superstructure and rough construction works have been studied in detail, and that technological processes have been fully developed in this segment. On the other hand, finishing works are not clearly defined in terms of technological dependencies, which often leads to a longer duration of projects. While importance of the quality of finishing works is recognized, there is not enough guidance in terms of the profit and investment ratio [4]. Furthermore, the quality of finishing works is the only observable and measurable quality of residential buildings from the user's point of view [5].

The goal of this research is to prove that a higher quality of finishing works increases investor profit on residential projects. However, the main goal is to prove that there is a turning point when it comes to investing in the quality of finishing works, after which it is no longer economically justified to make quality improvements. If so, this research should provide a methodology for determining the required level of quality that ensures the maximum profit for investors.

In addition to the main goals, the secondary objective of the research is to develop and improve the concept of residential projects management by enabling a rapid cost/profit estimation in relation to different levels of quality of finishing works, and by establishing the basis for cost control.

Besides the quality, the location of the building also has an important impact on the market value of residential buildings. In every city, there are city zones with distinct market prices. The research of quality/profit relations must therefore be organized in a way to fit different location/market value scenarios.

The research is organized as follows:

- Section 2 explains the algorithm for establishing a relationship between quality and profit on residential projects through a sequence of estimation and calculation steps, in such a way that the procedure can be applied to any residential market.
- Sections 3 to 7 concentrate on the application of the proposed methodology to the Belgrade real estate market, and on the project database that was available for detailed analysis.
- Section 8 explains the research achievements with regard to the stated goals of the paper.

2. Methodology

The proposed methodology consists of two separate parts:

1. Establishing a relationship between the level of quality and cost.
2. Establishing a relationship between the level of quality and profit.

The prerequisite for the proposed methodology is a project database with the detailed cost and quality data. The first step is to group buildings according to city zones, in order to accommodate different quality/profit relationships. The complete procedure is then conducted separately for each group of buildings. Also, two surveys need to be conducted: one to explore the desired quality features of a residential building from the users' point of view, and the other to determine market value of residential buildings in relation to their location (city zone) and quality.

PART 1: Establishing relationship between quality and cost

The C Set is a set of cost significant items for a residential building. The cost significant items theory (C.S.I.) is based on the fact that a small number of items from the bill of quantities define a large part of total costs. Specifically, approximately 20 % of cost significant items determine about 80 % of total costs. Cost significant items are those whose costs exceed the mean value of costs of all items from the bill of quantities, while the cost significance factor represents the ratio of the value of cost significant items to the total value of the project [6, 7]. The C Set is formed by applying the cost significant items theory to the project database.

The Q Set is a set of quality significant items (from the bill of quantities) that define quality of a residential building from the users' point of view. The formation of Q Set is based on the real estate market survey results (buyers of apartments). The survey is a set of questions with answers which serves as a guide to potential buyers, aiming to determine sets of similar elements with characteristics that can be quantified and measured [8].

The QC set is the cross section between the Q Set and the C Set. It helps to establish the relationship between quality and cost of residential buildings based on data from the project database. The QC Set is formed by comparing the Q Set and the C Set, and selecting the items that belong to both sets. The QC Set is made of items that have a significant impact on both quality and cost.

PART 2: Establishing a relationship between quality and profit

The second part of the algorithm consists of calculations and estimations that are conducted using the project database and the previously determined QC Set.

The Quality measurement is done by introducing the concept of the quality code (qc), which represents the assessment of quality

of the materials and/or technology of each of the items from the QC Set. Lower quality indicates a lower quality code value. Each element of the QC Set has five quality variants, each of which carries a rating ranging from 1 to 5. The sum of quality codes determines the aggregate quality code (AQC), which is a measure of the quality of the building from the buyer's point of view, and ranges from n to 5n, where n represents the number of elements of the QC set. For all buildings from the project database, the quality is measured by evaluating qc and calculating aqc. The most frequent values of AQC are used for further analysis.

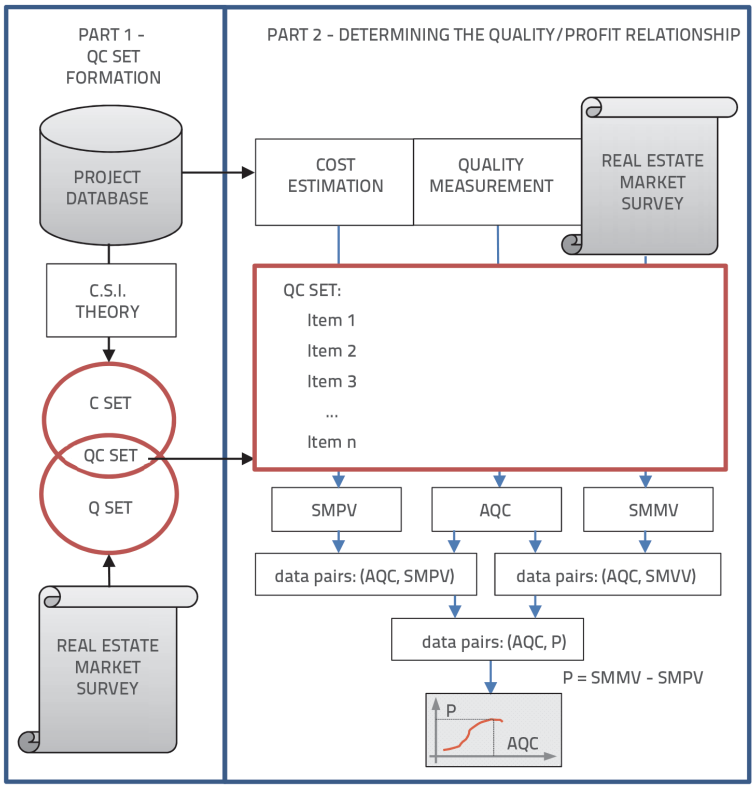

Figure 1. Algorithm for proposed methodology.

The Square Meter Production Value (SMPV) represents the total cost of a finished residential building distributed over the net sales area (€/m^2) [9]. The SMPV consists of all the construction costs, and also includes other dependent costs, such as the design, engineering, supervision, technical acceptance, fees (for connections to utility infrastructure, and for licenses and permits issued by relevant state and local government authorities), taxes, insurances, and the like. The SMPV is divided into two parts: the cost of QC Set items (variable part of the project costs, the cost related to quality - SMPVq) and all other costs (fixed part of the project costs - SMPVf). The SMPV is calculated in several steps. First, the total project value (PV) is obtained from the project database for every building, as well as the value for project related costs (PVq). The fixed cost is calculated as the difference (PVf=PV-PVq). Then the SMPVf value is calculated as PVf distributed over the net sales area (SMPVf=PVf/Pnet). The net sales area consists of the residential area (apartments), commercial areas, and parking areas. Using the data from the project database, average values of SMPVq are calculated for every value of the previously chosen AQC values. After that, the SMPV can be calculated (SMPV=SMPVf+SMPVq). Finally, data pairs (AQC, SMPV) are formed for every building.

The Square Meter Market Value (SMMV) is the total market value of a residential building distributed over the net sales area Pnet (€/m^2). The market value of a real estate building is estimated as an average sales value for a particular city zone. The current market value of a building is the price that can be obtained at the moment of assessment [9]. A survey must be conducted to estimate SMMV for database projects. The real estate agencies survey, conducted by renowned real estate agencies for each database building, should return the following result: the minimum and maximum sales value of the residential premises, commercial premises and garage parking places, and the minimum and maximum recommended quality levels for respective locations. The survey results determine two extreme data pairs: (min AQC, min SMMV) and (max AQC, max SMMV). The third data pair is the actual data (actual AQC, actual SMMV), which is obtained from the database. Once the statistical analysis is performed, the remaining data pairs (AQC, SMMV) are calculated for other values of AQC, for every building. Since three data pairs are available, the proposed method for calculating SMMV values is to form a quadratic relationship ($SMMV=a \cdot AQC^2+b \cdot AQC+c$).

The Profit (P) is the difference between the market value and production value of the building (P=SMMV-SMPV) [9]. The relationship between the quality and profit is established by forming data pairs (AQC, P)=(AQC, SMMV-SMPV). Based on these data pairs, a quality/profit chart can be plotted [10]. A reasonable assumption is that a limit exists for the maximum market value. Therefore, the chart should show a maximum which defines the level of quality for the highest possible profit, and determines the limit of economic justifiability for investing in quality. Determination of the AQC value that enables reaching the maximum profit is the main goal of this research. The corresponding algorithm is shown in Figure 1. A detailed description of the algorithm elements is provided in the following sections.

3. Defining quality and costs relationship – QC set formation

The proposed methodology has been applied to the real estate market in Belgrade, Serbia. The project database consists of 54 buildings grouped into three categories according to the city zone they belong to: 17 buildings belong to zone 1 (central city zone), 23 belong to zone 2 (wider city centre) and 14 belong to zone 3 (suburbs). The project database used in this example is

typical for the residential construction market in Belgrade, Serbia, for the period between 2005 and 2012. The number of floors varies from 4 to 7, the gross areas vary from 700 to 8000 m^2, and the number of underground floors is 1 or 2. The superstructure of all buildings is a skeletal system with earthquake-resistant reinforced concrete walls, and with reinforced concrete walls in the stairwells and elevator cores. The buildings from the database represent quite well the Belgrade real estate market, since almost all recent residential projects can be classified into one of the categories. The only exception are individual housing projects that could be a separate category, or even a separate research with its own categories. It should be noted that the research was conducted before introduction of energy efficiency measures and sustainability issues to the residential market, which could slightly alter the survey results.

3.1. Determination of Q Set

To enable investors to determine their investment strategy with regard to the quality level of finishing works, it is also necessary to define quality from the buyer's point of view. The systematization of the potential buyers' wishes in terms of determining the quality level of residential buildings was carried out by conducting a survey, being one of appropriate market research methods. The survey involved 84 owners of apartments. The goal of the survey was to determine which work items are important to potential buyers. The survey results are presented in Table 1.

Table 1. Survey results

Construction works	Number of choices	Percent of choice	Average grade
1. Earthwork	3	3.57	
2. Masonry	17	20.24	
3. Concrete works	25	29.76	
4. Reinforcing works	17	20.24	
5. Carpentry	9	10.71	
6. Insulation works	41	48.81	
7. Doors & windows	**49**	**58.33**	**3.23**
8. Roof cladding	9	10.71	
9. Metal works	4	4.76	
10. Ceramic works	**53**	**63.1**	**3.81**
11. Flooring works	**57**	**67.86**	**3.36**
12. Painting works	**52**	**61.9**	**3.93**

The respondents were asked to select 4 most important items and to rate them at the 1-5 scale. Based on a sample of 84 respondents, work items where the percentage of choice exceeded 50 % were selected. In this way, the Q Set was formed: interior doors, front security doors, windows, ceramic tiles, parquets, and painting works. These items define the quality from the aspect of the final user. The elements of the Q Set are shown in Figure 2.

3.2. Determination of C Set

The C.S.I. method was applied to the project database. The initial step was to select the cost significant items from the bills of quantities (BOQ) of the project database. Once the price limit that determines cost significance was set, it was established that 27 out of the total of 118 items were cost significant. Viewed as a percentage, 22.88 % items carry 84.07 % of costs, which is in compliance with the C.S.I. theory. The next step was to plot the diagram showing the percentage of cost significant items in price, and the number of such items. The shape of the curve and its values are very close to the theoretical curve which, in addition to the initial (0 %-0 %) and end point (100 %-100 %), also has three pairs of values (10 %-60 %; 20 %-80 %; and 30 %-90 %). The C Set definition is the final outcome of applying the C.S.I. theory to the project database. The C Set elements are shown in Figure 2.

3.3. Determination of QC Set

The QC Set is the cross section between the Q Set and C Set as shown in Figure 2. Given that all elements of the Q set are contained in the C set, the QC Set equals the Q set.

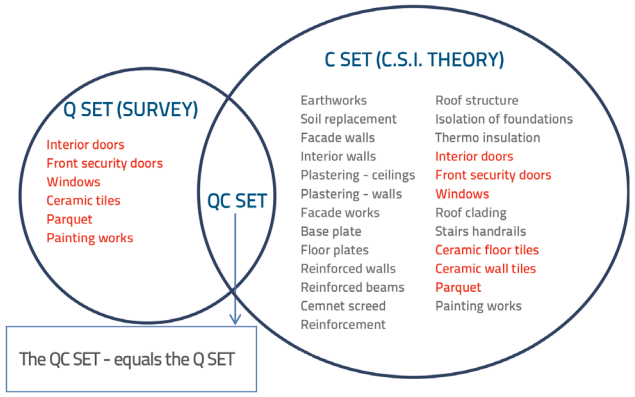

Figure 2. Establishing the relation between quality and cost

4. Quality measurement

The quality is measured by introducing the concepts of quality code (QC) and aggregate quality code (AQC). In this research, the QC set consists of six work items. For each item, there are five quality variants, each of them carrying a quality code that ranges from 1 to 5. For each element of the QC Set, the quality codes represent a certain level of quality and the matching cost. For instance, ceramic tiles QC = 1 denotes 2nd class domestic tiles (e.g. Kanjiza factory), QC = 4 denotes imported tiles (e.g. Tau Ceramica Spanish factory), and QC = 5 denotes the 1st class large size imported tiles (e.g. Casa Dolce Casa Italian factory). In case of windows, qc = 1 means PVC windows without blinds, QC = 3 means aluminium frame windows with blinds, and QC=5 means wood-coated aluminium frame windows with blinds. An aggregate quality code is obtained by summing up the individual quality codes for all six QC Set elements. Depending

Table 2. Real estate market value survey results

City zones	Net sales area						AQC	
	Apartments [euro/m²]		Commercial area [euro/m²]		Garage place [euro/pcs]			
	Ca min.	Ca maks.	Cc min.	Cc maks.	Cg min.	Cg maks.	min.	maks.
Category 1	1.800	3.000	2.200	3.200	9.000	12.000	17	30
Category 2	1.200	1.800	1.700	2.200	5.000	9.000	14	26
Category 3	750	1.200	1.000	1.600	4.000	6.000	6	17

Ca - kategorija stambni prostor (eng. *Category apartments*); Cc - kategorija poslovni prostor (eng. *Category commercial*); Cg - kategorija garažni prostor (eng. *Category garage*)

on the quality of individual QC Set items, the AQC varies from 6 to 30. The quality varies considerably by city zone: the quality of Category 1 buildings is very high (AQC: 16-34), while it is significantly lower for Category 3 (AQC: 10-21).

The quality was measured for all buildings contained in the database. Nine different quality-code combinations were recognized as being the most frequent in the project database. These nine values determine the AQC set (AQC: 6, 8, 11, 14, 17, 20, 23, 26, 30) which is used in all other calculations.

5. Profit measurement

The production and market value of residential building must be determined before the relationship between the quality and cost can be established.

5.1 Market value estimation

Ten renowned real estate agencies were surveyed in the scope of the market value assessment, in order to obtain the following data: price range of apartments, commercial areas, and garages, and the range of quality levels for the city zones in question. The survey showed the following results:

The net sales area (Pnet) is defined as the sum of net areas of apartments, business premises and garages for sale:

$$Pnet = Pa + Pc + Pg \quad (1)$$

Where:

Pnet - total area of the building intended for sale
Pa - apartments area
Pc - commercial premises area
Pg - garage parking space area.

The market value of buildings (MV) is calculated as:

$$MV = Pa \cdot Ca + Pc \cdot Cc + Pg \cdot Cg \quad (2)$$

The SMMV value is calculated as:

$$SMMV = \frac{MV}{Pnet} \quad (3)$$

The minimum and maximum prices and quality levels from the survey were applied to every building from the database. Two data pairs were thus formed for every building: (min AQC, min SMMV) and (max AQC, max SMMV). The third data pair for every building was obtained from the database as the actual project data (AQC, SMMV). Finally, the SMMV values for the remaining 6 AQC values were calculated using the formulas (4).

$$SMMV = \begin{cases} \min SMMV, AQC \le \min AQC \\ a \cdot AQC^2 + b \cdot AQC + c, \min AQC \le AQC \le \max AQC \\ \max SMMV, AQC \ge \max AQC \end{cases} \quad (4)$$

Table 3. SMMV calculation example for one building

Database data	
Apartments area	869,44
Comercial area	72,65
Parking spaces	13
Net sale area	1.129,14

⇒ tržišna vrijednost

Survey min.	Actual	Survey max.
1.570	1.850	1.980
1.900	2.300	2.500
6.700	7.600	8.600
1.590.156	1.874.359	2.014.916

a	-1,7669
b	102,0246
c	326,26

⇐

	3 available data pairs		
AQC	14	20	26
SMMV	1.408	1.660	1.784

Data source	survey: AQC ≤ min AQC			survey	formula	database	formula	survey	anketa
AQC	6	8	11	14	17	20	23	26	30
SMMV	1.408	1.408	1.408	1.408	1.550	1.660	1.738	1.784	1.784

A parabola was chosen for SMMV calculation because it fits the quality/market value relationship better than a straight line. Since three data pairs are available, the system of three quadratic equations can be solved by substitution. The example of the calculation is presented in Table 3 for one of the category 2 buildings.

The same calculation procedure was conducted for all 54 buildings from the project database.

5.2 Production value estimation

The database contains detailed cost data for all the buildings. The total cost (production value PV) is the sum of all project costs. The quality-related cost (production value for quality related items PVq) is the sum of costs of the elements belonging to the QC Set. The difference resembles the fixed cost (PVf = PV - PVq). The fixed cost distributed over the net sales area (SMPVf) is calculated for every building using the formula:

$$SMPVf = \frac{PVf}{Pnet} = \frac{PV - PVq}{Pnet} \quad (5)$$

For example, Table 4 shows the calculated SMPVf value for the same building. The next step is to estimate the average values for quality related cost distributed over the net sales area (SMPVq) for all 9 AQC values. The formula is:

$$SMPVq = \frac{\sum_{i=1}^{m} SMPVq_i}{m} \quad (6)$$

where m is the number of buildings with the same AQC value. The SMPVq value for each of nine recognized AQC values is determined and shown in Table 5.

Table 4. Calculation of SMPVf value for one building

Pre-construction costs		
1	City land tax	130.695,77
2	Loaction purchase	236.086,52
3	Taxes - electricity	21.525,00
4	Taxes - heating	36.299,76
5	Taxes - water & sewage	5.788,04
6	Taxes - shelter	11.620,35
7	Infrastructure	2.888,49
8	Design	27.700,00
9	Financing cost	23.050,00
Σ	**Total** [EUR]**:**	**495.653,93**
Troškovi gradnje		
1	Electricitya	64.755,37
2	Water & sewage	49.162,47
3	Heating & elevators	120.094,42
4	Construction works	607.091,72
Σ	**Total** [EUR]:	**841.123,98**
Total project cost - PV:		**1.336.777,91**

Quality related costs - PVg		
1	Inetrior doors	21.699,03
2	Security doors	5.891,04
3	Windows	55.259,75
4	Ceramic works	20.569,49
5	Painting works	16.654,24
6	Parquet works	22.284,23
Σ	**Total - PVq** [EUR]**:**	**142.357,78**

PVf = PV - PVq	**1.194.420,13**
Net sales area - P [m²]	**1.129,14**
SMPVf = PVf/Pnet [EUR/m²]	**1.057,81**
SMPV = PV/Pnet [EUR/m²]	**1.183,89**
SMPVq = PVq/Pnet [EUR/m²]	**126,08**

Table 5. SMPVq values for various AQC values

AQC	**6**	**8**	**11**	**14**	**17**	**20**	**23**	**26**	**30**
SMPVq	68.28	68.96	78.38	97.89	113.79	126.08	138.99	156.73	187.89

Table 6. SMPV values for various AQC values

AQC	**6**	**8**	**11**	**14**	**17**	**20**	**23**	**26**	**30**
SMPVq	68.96	68.96	78.38	78.38	113.79	126.08	138.99	156.73	156.73
SMPVf	1,057.81								
SMPV	1,126.77	1,126.77	1,136.19	1,136.19	1,171.60	1,183.89	1,196.80	1,214.54	1,214.54

Table 7. Profit measurement for one building

Kategorija 2 - Zgrada 1									
AQC	**6**	**8**	**11**	**14**	**17**	**20**	**23**	**26**	**30**
SMPV [EUR/m²]	1,126.10	1,126.77	1,136.20	1,155.71	1,171.61	1,183.89	1,196.80	1,214.54	1,245.71
SMMV [EUR/m²]	1,408.29	1,408.29	1,408.29	1,408.29	1,550.04	1,659.99	1,738.13	1,784.47	1,784.47
P - Profit [EUR/m²]	282.19	281.52	272.09	252.58	378.44	476.10	541.33	569.93	538.76

Finally, 9 data pairs (AQC, SMPV) can be formed for every building. The SMPV value is calculated by adding quality related costs to fixed cost (SMPV=SMPVq+SMPVf) for every AQC value. For example, calculated SMPV values for the same building are shown in Table 6.

The same calculation procedure was conducted for all 54 buildings from the project database. In relation to city zones and quality of finishing works, the SMPV costs vary as follows:

- Category 1 buildings: 1.400 - 2.100 €/m²,
- Category 2 buildings: 900 - 1.300 €/m²,
- Category 3 buildings: 700 - 1.100 €/m².

5.3 Determination of profit

Profit distributed over the net sales area (P) is calculated as the difference between the market value and production value:

$$P = SMMV - SMPV \quad (7)$$

Previous steps enabled determination of SMMV and SMPV values for all 54 database buildings for 9 different AQC values. For example, for the same building, profit values in relation to quality are shown in Table 7 as follows: The same calculation procedure was conducted for all 54 buildings from the project database.

		AQC								
		6	**8**	**11**	**14**	**17**	**20**	**23**	**26**	**30**
Average profit value [EUR/m²]	Category 1	453,37	419,49	391,00	390,61	393,68	530,38	635,87	831,87	771,07
	Category 2	267,54	253,81	249,49	308,36	403,63	562,03	558,89	552,89	470,63
	Category 3	70,29	200,77	226,18	291,04	278,60	268,17	247,94	237,26	129,18

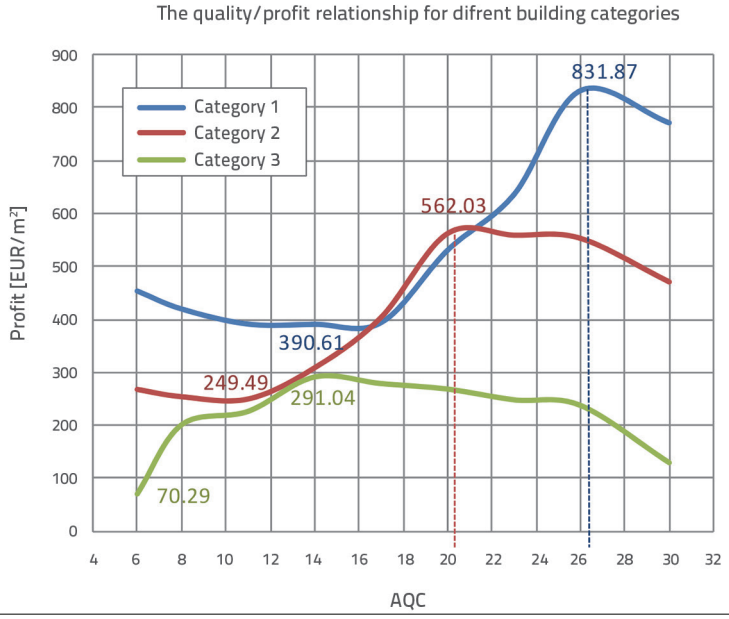

Figure 3. Profit/quality relationship for different categories of buildings

6. The ratio of quality and profit according to building categories

There are 9 x 54 combinations of quality/profit data pairs. They are grouped into categories according to city zones. Average profit values, calculated within each category, are shown in Figure 3. The chart in Figure 3 shows the quality/profit relationship for each category.

The minimum and maximum values for profit and corresponding AQC are shown in Table 8.

The Figure 3 chart is the main result of this research. It shows the quality/profit relations as follows:

- Category 1 buildings are located in the elite part of the city and they are designed for wealthier clients. A high level of

Table 8. SL and QIL according to categories of buildings

	CATEGORY 1		CATEGORY 2		CATEGORY 3	
	minimum	**maximum**	**minimum**	**maximum**	**minimum**	**maximum**
Profit [EUR/m²]	390,61	831,87	249,49	562,03	70,29	291,04
AQC	14	26	11	20	6	14

quality with greater profit is envisaged. Figure 3 shows that the maximum average profit of 831,87 €/m^2 is achieved for AQC = 26, while the minimum average profit of 390,61 €/m^2 is achieved for AQC = 14. For AQC = 26, the average quality of QC Set items is 4,33 (out of 5). This indicates what investors should place in buildings in order to maximize profit: above standard dimension doors and windows, 1st class imported large size tiles, wood coated aluminium framed windows, and the first class imported parquet.

- Category 2 buildings are located in the wider city centre and they are designed for diverse clients. The envisaged quality level is diverse, whereby the profit can vary in a wider range. Figure 3 shows that the maximum average profit of 562,03 €/m^2 is achieved for AQC = 20, while the minimum average profit of 249,49 €/m^2 is achieved for AQC = 11. For AQC = 20, the average quality of QC Set items is 3,33. As expected, investors should plan slightly above the average quality for category 2 buildings. This implies aluminium frame windows, mediapan doors, first class parquet, and 2nd class imported tiles. Lower quality can reduce profit and very high quality would not pay off because of limited market prices.
- Category 3 buildings are located at the periphery of the city, in less attractive locations, and they are designed to be as cheap as possible. The envisaged quality level is low, and so is the profit. Figure 3 shows that the maximum average profit of 291,04 €/m^2 is achieved for AQC = 14, while the minimum average profit of 70,29 €/m^2 is achieved for AQC = 6. For AQC = 14, the average quality of QC Set items is 2,33. Thus investors should increase quality to appropriate levels (AQC = 14) even for the least attractive locations. That implies standard PVC windows with blinds, second class beech parquet, standard doors and first class domestic tiles. It is particularly interesting that profit decreases almost evenly if investors choose to invest too little or too much in quality. The most important conclusion that can be made by analyzing Figure 3 is that profit can dramatically increase or be reduced if a wrong investment strategy is chosen. For categories 1 and 2, the difference in profit can be more than double (390.61-831.87 €/m^2; 249.49-562.03 €/m^2). For category 3 the difference is even greater (70.29-291.04 €/m^2). Therefore, it appears that investment strategy for finishing works is one the most important decisions on residential projects. There is probably no other single decision that can affect profit to such an extent. That means that investors should pay extra attention to determine the most appropriate level of quality. The research results can also be useful for potential buyers, because it may help them to discern which levels of quality can be expected in different city zones.

It should be noted that in this research the profit is calculated as a value distributed over the net sales area (€/m^2). It may therefore appear that it is not recommended to invest in category 3 buildings because profits are lower than in other categories. This is however not the case as these buildings are usually larger than other buildings in the area, and are easier and quicker to build. The overall profit is sometimes even bigger in this category. This research is intended to point out the quality levels within a category in order to maximize profit, once the investment decision is made.

7. Summarized research results

Determining the level of investment in the quality of finishing works is one of key decisions on residential projects. It is important that the investor knows the effects of additional investments in finishing works with respect to the market value of buildings, i.e. he should be well advised about the investment to profit ratio. This research shows that investment in the quality of finishing works increases profit for investors. There are however some additional conclusions that can be made after analysis of the diagrams presented in Figure 3:

1. There is always a turning point for investment in the quality of finishing works, regardless of the location. The 3 maximums (category 1 for AQC = 26; category 2 for AQC = 20; category 3 for AQC = 14) show the maximum profit values and the corresponding quality level for each category. The higher the market value of buildings, the higher the maximum profit and level of quality. The turning point is called the quality investment level (QIL). Increasing the investment in quality to the level higher than QIL will result in lower profit because there is always a top limit in the real estate market value for residential buildings.
2. For two city zones there is also a bottom limit for investing in quality. That level of quality is called the speculation limit (SL). The diagram shows that decreasing the quality of finishing works to the level lower than SL increases profit to a certain level. It is important to point out that this situation happens when investors intentionally decrease quality and hope to sell for standard market prices. In this way, buyers are actually deceived and deprived of anticipated quality. That is why it is called speculation, and it should not be happening in mature real estate markets, because such investors will lose business in the long run. The speculation limit does not exist in the least attractive parts of the city (green line), because lowest levels of quality are anticipated by buyers.

Regardless of the differences between diagrams, they have common characteristic points as shown in Figure 4. Figure 4 presents an idealized view of the diagram in Figure 3.

There are 3 different zones in the diagram. The green zone represents the steady quality/profit relationship (higher quality – higher profit). The blue zone represents the situation in which the market value can not follow the rise of investment in quality, and so the profit decreases. The red zone is a speculation zone where buildings are sold at the minimum market value even though the quality is below expectations. These three zones are separated by the quality investment limit (maximum profit) and the speculation limit (minimum profit).

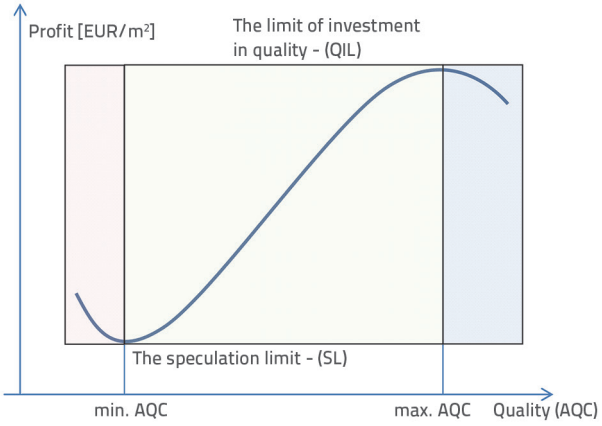

Figure 4. Idealized quality/profit diagram

The additional benefit of the research is the possibility to make rapid estimations, i.e. the rapid cost/profit estimation in relation to different quality levels of finishing works, and to establish the basis for cost control. Many established parametric systems can be used for the purposes of rapid cost estimation. However, the proposed methodology can also be used for this purpose. The input data for the rapid cost estimation are: location of the building, net sales area, and the envisaged level of quality. The location of the building determines its category (1, 2, or 3). The net sales area can be easily estimated using urban planning parameters that are available for building lots. The SMMV and SMPV estimation is conducted in exactly the same way as in the examples for one building (Tables 4, 5, and 6). Then the profit can be calculated as shown in Table 7 for 9 different AQC values.

As for cost control, it can be performed for finishing works in the design phase of the project. When a certain AQC value is adopted, then the elements of the QC Set are defined in terms of technical description. The technical description is a part of a design brief, and it provides guidance to designers and sets limits when it comes to describing bill of quantities items. Cost control can further be carried out in the procurement phases, when actual materials are checked against QC Set database elements. It is not a cost control system, but the data from the project database can serve as a basis for cost control for finishing works.

8. Conclusion

With regard to main goals defined in initial part of the paper, the following main conclusions can be made:

- The increase in quality of finishing works on residential projects also increases profit for investors. It can be said that this statement is common knowledge. However, this research effectively contributes to the body of knowledge by establishing a methodology for an accurate quantification of this relationship. The methodology is fully explained through an appropriate mathematical model that can be applied to any residential market.
- The quality/profit relationship is quantified for three distinct zones forming part of the Belgrade real estate market, and for a representative project database. A diagram is plotted for each zone. It defines the recommended level of quality that returns maximum profit. This level of quality is quantified through the value of AQC, which in turn precisely defines the technical description of quality related items, which define the QC Set. The benefit for investors is that they can precisely plan an optimum quality level for future projects, in terms of the types of doors, windows, tiles, painting works, and parquetry.
- Another contribution of this research is the determination and proving of a turning point for quality investment after which it is no longer economically justified to increase quality because profit starts to decrease. This turning point is called "quality investment level - QIL" and it is different for each category of buildings. The QIL is defined by the value of AQC (26, 20, and 14 for categories 1, 2, and 3).
- This research also shows that for some building categories (city zones) there is an opposite quality wise turning point (speculation level – SL) that determines the level of quality with minimum profit. It should be noted that this situation is a deliberate reduction of quality by investors in order to gain an extra profit and that this should not be happening on mature real estate markets.
- Another major contribution of this research is that it shows the significance of determining an optimum investment strategy for finishing works, because profit dramatically depends on that decision. For the database in question, the profit can be reduced or increased by at least two times, depending on the investment strategy.

It is clear from the stated conclusions that all major research goals have been achieved.

The secondary goals have also been fulfilled, because the proposed methodology can be used for rapid cost/profit estimation in relation to different quality levels of finishing works by using the same mathematical model and proposed formulas.

In addition, determination of accurate quality levels for finishing works can serve as a basis for cost control at the design and procurement phases of a project.

The methodology is applicable to any residential market. There are no limitations concerning the size of a city or the type of buildings. In every city, buildings can be grouped into certain categories and by location, and can be analysed separately using the same methodical approach. The prerequisite is a database with accurate quality/cost data and reliable surveys. However, the data from a different project database and different survey results may lead to a different categorization of buildings and different conclusions regarding levels of quality. Also, different investment strategies can be expected on different markets. But the shape of the curves and basic conclusions should be the same everywhere - only the specific levels of quality may differ from one market to another.

Future research should include: regular updates and extensions of the project database, and improvements of the mathematical model when determining the quality/profit data pairs.

REFERENCES

[1] Dolaček-Alduk, Z., Mikulić, D., Radujković, M.: Quality cost management model for construction projects", Gradjevinar 61 (2009) 2, 147-159, 2009.

[2] Samiaah, M., Al-Tmeemya, H., Abdul- Rahmanb, H., Haruna, Z.: The level of the site staff's knowledge is important as that of the management", Elsevier International Journal of Project Management, 827-838, 2012.

[3] Dolaček-Alduk, Z., Mikulić D., Radujković M.: Quality management in project-oriented construction processes", Gradjevinar 59 (2007) 3, 209-2018, 2007.

[4] Ivković, B., Popović, Ž.: Upravljanje projektima u građevinarstvu, IP Građevinska knjiga, Beograd, 2005.

[5] Ćirović, G., Luković, O.: Finansijsko poslovanje i investicije u građevinarstvu, Viša građevinsko-geodetska škola, Beograd, 2004.

[6] Ivković, B., Popović, Ž., Božić, I.: Mogućnost primene modela troškovno značajnih stavki za procenu troškova u građevinarstvu, Izgradnja, Beograd, 1994.

[7] Asif, M., Horner, R.M.W.: Economical Construction Design Using Simple Cost Models, University of Dundee, 1989.

[8] Kovačević, D.: Menadžment – preduzeće, investicioni projekti preduzeća Energoprojekt, 1998.

[9] Pavlović, Z.: Uticaj kvaliteta izvedenih zanatskih radova na vrijednost stambenog objekta, magistarski rad, Građevinski fakultet, Beograd, 2005.

[10] Dimitrijević, B.: Analiza ekonomske opravdanosti ulaganja u kvalitet završnih radova na stambenim objektima, magistarski rad, Građevinski fakultet, Beograd, 2013.