OPTIMIZATION METHOD FOR THE DECISION TO INVEST IN HOUSING CONSTRUCTION

Ovidiu Gavris Pascu[1], Sorina Anamaria Ciplea[2], Horea Stelian Dan[3]
[1] Technical University of Cluj Napoca, ovidiugavrilg@yahoo.com
[2] Technical University of Cluj Napoca, sorina.ciplea@ccm.utcluj.ro
[3] Technical University of Cluj Napoca , horea.s.dan@gmail.com

ABSTRACT: This paper presents a method of analysis for investment efficiency at the early start of an investment in housing construction, method that is based on multi-criteria analysis. The method proposed in the paper takes into account a number of factors that can help a buyer in taking the decision when buying a residential space or real estate investors if they make the decision to invest in housing construction. The criteria considered for making the calculations are the investment cost, the distance from the city-center, the attractivness of the investment for potential users (renters, tenant) and the degree of comfort in terms of the environment.

KEYWORDS: costs, constructions, distance, environmental impact, multi-criteria analysis.

1. INTRODUCTION

A number of Romanian authors consider in their work that „managing companies consists in studying the processes and the management relations within them, in order to discover legalities and principles that govern them, the design of new systems, methods, techniques of management, that ensure the obtaining and increase of competitiveness "[1].

Management plays an important role in any firm, with any field of activity, but especially within the construction companies. The manager using his past practical experience and help of knowledge management that he/she has acquired, can lead and manage a unit to be profitable, with a well planned and organized activity, using adequate methods and management techniques based on a reliable software information system and taking the relevant decisions.

Organization of construction companies is generally performed by the top company managers, but since the organization function is an integral part of the management process, its achievement is made possible also by the help of experts in this field. Therefore through the organization it is actually sought to achieve the company's objectives [2].

This paper aims to study the return of investment not only from the managers' perspective and the companies they run, but also from the beneficiaries' perspective. However the method proposed and studied in the paper is not at hand for everybody, but the results are beneficial for both sides.

Buying a home is a dream for many families right now. But the price of apartments and houses determines the most buyers to make their calculations and put a series of questions about whether the investment is worthwhile if it is cheaper to buy a house in the center of the city or at the periphery, what are the true/full costs of acquisition (credit, cost of credit, etc.) , which will be further implications: travel expenses at work, children's schools, shopping centers, administrative units etc.

Investors have the same problems and the question is: how to find the location for the construction such the sale of apartments to be quick and with maximum profit. Construction of an apartment building in a central area involves higher costs than one from a peripheral area, not only for the building itself, but strictly speaking for the on-site organization, heavy construction equipment access, access to building materials, protection of the neighbourhood

buildings (buildings being possible of historical heritage), the existence of utility networks on the site to be diverted and/or modernized to accommodate the new building. In peripheral areas of a city, the construction site is easy to be organized, issues like access to resources (materials and equipment) are easier to solve, but may occur additional expenses related to land development bringing the utilities (power, gas, water etc) in the zone of the roads.

The actuality of this article and methods of this proposal is given by the report of Cluj-Napoca City Hall from September 2014 which shows [3] as:

- the city's population growth during 1977- 1992 was over 25 %;
- in the period 1992 - 2011 the population was reduced by approximately 6% (in 2011 compared to 1992) leading to a stable population of 309 000 people;
- the university population adds a number of 80,000-100,000 students yearly who have a major influence on housing.

The graph of population evolution in Cluj-Napoca is presented in figure 1 as submitted by the town hall (source www.primariaclujnapoca.ro)

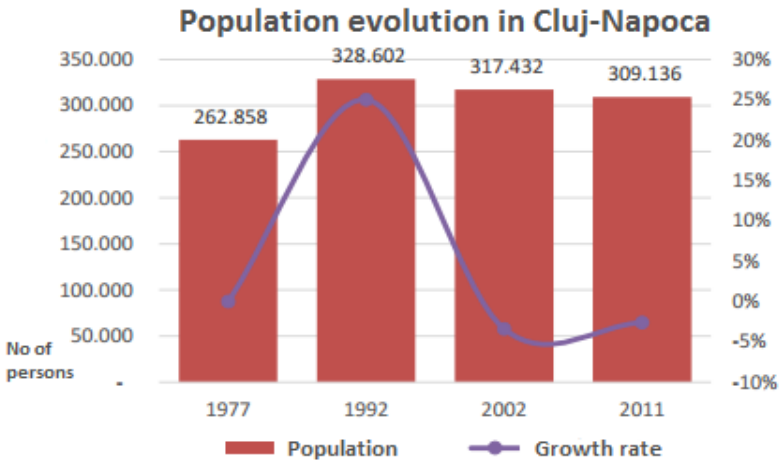

Figure 1. Evolution of fixed population per year in Cluj-Napoca, Romania [3]

Housing stock increases during 1977 - 1992 by 74 %, driven by population growth stable over 65,000 people. In the period 1992-2011, although the population has diminished due to migration and a declining birthrate, the housing stock increased by 2.8 milion m^2, recording a growth rate of 72%. Consequently, the living area of Cluj-Napoca municipality has grown to 2.25 milions m^2 in 1977 to nearly 6.8 millions m^2 in 2011.

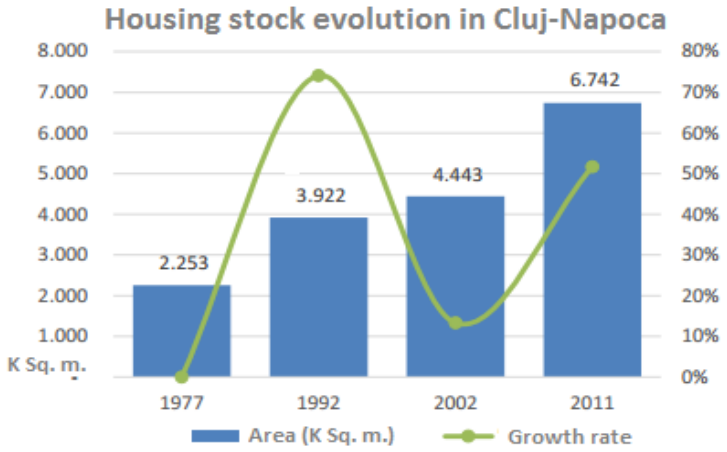

Figure 2. Evolution of housing fund per year in the city of Cluj-Napoca, Romania [3]

Average living area related to a person in the Cluj-Napoca municipality reached 21.8 m^2 per person in 2011, while the same indicator record level of 8.6 m^2 per person in 1977, respectively 11.9 m^2 per person in 1992 .

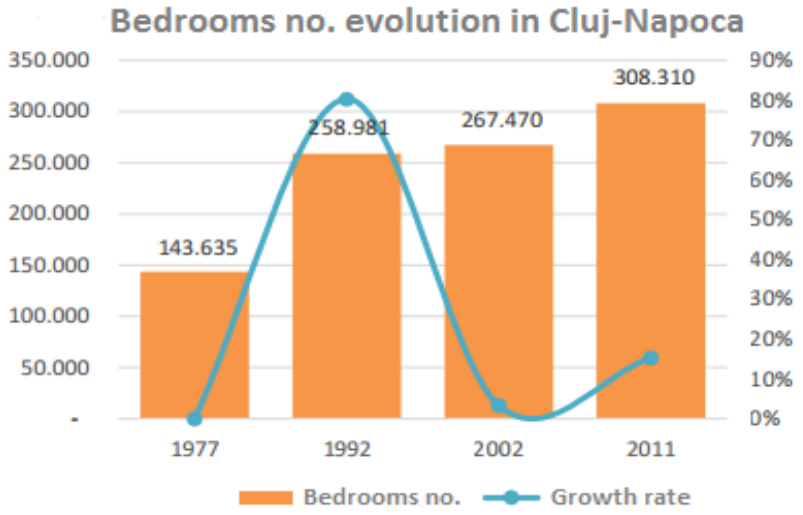

Figure 3. Evolution of housing bedrooms per year in the city of Cluj-Napoca [3]

From the statistics above it results the importance of finding a methodology for quantifying the advantages and disadvantages of easing the decision of starting such an investment in construction.

2. WORKING METHODOLOGY

At the basis of the calculations of the costs stands a series of functions that require a pre-set level and structure of the costs, of recording in each period of current production expenses, establishing the required indicators and control, monitor with analysis of the level and cost structure.

Costs appear everywhere in the management of an enterprise, this proves the importance of the cost calculation, which is the only one who can give the answers about the effectiveness of the economic activity of that company and the information it provides is used by management for all its cost centres. Responsibility of costs levels is shared among the different hierarchical management lines, each department manager is responsible for the costs of the department he/she leads.

In periods of high inflation it is difficult to calculate the real cost. Some of the companies have employed contractors for specific construction activities. R.F. Fellows, a professor at the University of Bath, UK, has analyzed the implications of the inflation phenomenon in construction projects. Fellows conducted its study from a Lewis Parry's allegation claiming that in 1965 the key of construction were the population, loans and inflation. Until 1965 the execution of construction contracts were subject of fixed price projects. Later studies have concluded that construction companies are subject of continuously changing of materials prices, fuel, transportation costs, etc. In 1964 it was considered that a construction contract with fixed price should not be exceeding two years[4].

In the 70s it was found that a fixed price cost of construction may generate a loss of over 25% due to increased fuel prices and also due to increasing bank interests with direct influence on the cost of materials used. Although in the 80s inflation was stabilized at 5% per year, there

were many construction companies that were bankrupt due to losses and impossibility of payment obligations[4].

Studies in the field have revealed that associations of entrepreneurs have attempted to realise mathematical models to assist them in calculating the cost influenced by these inflation elements. These models give results in a relatively stable economy.

However, to participate in the auctions or to biddings, construction companies need to determine the estimated costs of the construction works where they have to add a reasonable share, to cover the risk of inflation. A price reduction could be a reduction of the profit to the minimum, following that during the execution of work they will try to correct the variable expenditures [5],[6].

As a result of the importance of a company's costs in the activity of company, the criteria considered in this methodology are: the investment cost, the distance from the city-centre, the degree of comfort in terms of the environment [7].

The criteria are not limited to this and any potential users can take into account any other external influences that could influence the decision. As some of the criteria, for some investors, may be more important than others we can enter weighting coefficients. Each location will be reviewed and scored by the proposed criteria.

Each criterion will be scored from 0 to 100 points and will correct weighting coefficients depending on its importance.

The locations will be analysed and marked through the proposed criteria, after that the final score will be ranked and then the first position will be the chosen one.

2.1 The cost

This criterion was proposed because it reflects the investment effort for each solution chosen [8]. The cost can be expressed in EURO per square meter or RON per square meter. In the case when buying an apartment is discussed then is the price asked by the seller. In the case of building the apartments, then the price is calculated by dividing the total cost of execution (given by general work estimate) plus profit margin to the usable area. Score for this criterion is obtained by the formula:

$$\frac{Cost_{\min}}{Cost_{option_i}} \times 100 \tag{1}$$

Where we consider the minimum cost and the cost for the chosen option.

2.2 The distance to the city center

The distance to the city centre can be an important criterion in the decision making since travelling down-town where the main public institutions (schools, hospitals, city hall, work) involves also the day-to-day costs and discomfort caused by unnecessary use of time wasted in the traffic. The reason why institutions open their branches in the districts of the city is to reduce this discomfort. In this article the distance to the city centre is an adverse effect.

The score is calculated using the relation:

$$\frac{D_{\min}}{D_{option_i}} \times 100 \tag{2}$$

Where we consider the minimum distance and the distance for the chosen option.

2.3. The environmental impact

The environment includes several subsystems, such as the economic, technical, political, sociological and ecological one. The importance of specific subsystems differs from one activity to another. The relationships that construction companies have with the environment are diverse, but mainly they are exchanges of goods and services. Lack of this exchange of products reflects that the company can not adapt to the environment, which requires urgent action [7], [8].

Economic factors are the ones that include all elements of the economic environment, with direct action on microeconomic activity. An important starting point is to study the market, providing information on the level and structure of demand, the price competition. On this basis the management of the company can make decisions related to sourcing/supply, production and sales. Knowing these details involves conducting comprehensive marketing studies that can provide all the information necessary to adapt the unit to the market demands.

Natural factors - affecting more agricultural companies but also constructions, in that sense that these companies have to adapt to the natural environment. In construction companies case, these factors influence is felt in every general object of the production process, since most of the activity takes place outdoors.

Most of the works performed, regardless of the domain of activity, have an impact on the environment.

Quality of the air

The criterion takes into account dust emissions depending on the technology of execution. The factor has to be considered because some road sections are crossing urban areas. Some other pollution sources are the hazards of hot asphalt. However their effect on the quality of air is a minor because the emission are of short duration.

Noise Level

This item quantifies noise pollution of execution technologies. Besides the noise of the machinery this point should also include the vibrations that are produced during the road rehabilitation and their effect on surrounding buildings.

Accessibility (street structure modernized)

Refers to the existence of a modernized access (streets, side-walks), rainwater retrieval systems, safety systems possibly access etc.

The quantification of the environmental impact was made using a notation scale, from "-3" to "+3", for each criterion as follows:

- "-3" - important negative impact which requires redesigning or giving up the project;
- "-2" - important negative impact which can be minimized by taking adequate measures;
- "-1" - less important negative impact;
- "0" - no impact whatsoever;
- "+1" - reduced positive impact;
- "+2" - important positive impact;
- "+3" - very important positive impact.

In the end, the marks for all criteria will be counted and the option's mark will be obtained. The score for each option will be calculated as follows:

- 0 when the sum of the marks is less than "-10", (the sum of the marks +10) x5 when the sum of the marks is between "-10" and "10" and 100 for the marks summing more or equal to 10.

3. RESULTS

As a case study and numerical example the following comparative analysis is proposed for the execution of two apartment buildings, one located 0.5 km from the city centre and the second at 5.0 km from the centre.

The scores calculated and awarded for each criterion are presented in the accompanying tables. The score for the first criterion, which is the cost, is presented in Table 1 [7], [8].

Table 1. Score for cost

	Score			Percentage %			
Criterion	Option A	Option B		%	Option A	Option B	
Cost	460	320		33.33	23,18	33.33	

The score for the second criteria, which is the distance from the center, is presented in Table 2.

Table 2. Score for the distance from the center

	Score			Percentage %			
Criterion	Option A	Option B		%	Option A	Option B	
Distance from the center	0.5	5		33.34	16,67	3.34	

The score for the third criteria, which is the environmental impact quantification, is presented in Table 3

Table 3. Score for the environment impact

Criterion	Option A	Option B
1. quality of the air	-1	2
2. noise level	-3	1
3. accessibility	3	-1
TOTAL	**-1**	**2**
TOTAL SCORE	**45**	**60**

And the final score for the two situations taken into account is comparatively presented in the Table 4.

Table 4. Final score

	Score			Percentage %		
Criterion	Option A	Option B		%	Option A	Option B
Cost	460	320		33.33	23.18	33.33
Environmental impact	45	60		33.33	15.03	19.98
Distance from the center	0.5	50		33.34	16,67	3.34
Total	**152.7**	**185.98**		**100**	**54.88**	**56.65**

Data presented in this last table proves that Option B despite the fact that the area is a little more distant from the city-center, still wins by environmental factors and by the cost, which is slightly lower because access within the city-centre with construction materials is severely taxed by the municipality which raises the cost of construction in case of Option A. This shortcoming may be overcome by the profit earned from the sale of apartments given the fact that the amounts charged (according to data from real estate websites) are 1550 EUR/m^2 in case A and 1250 EUR/m^2 in case B.

4. CONCLUSIONS

Decision making in the investment process, proves to be very difficult, especially when an important sum of money is in the middle. Having a methodology of analysis that takes into account as many factors that influence the outcome of the investment is necessary and beneficial.

This method proposes an algorithm based on multi-criteria analysis and the authors consider that it can help investors both for private and public investment cases.

Careful analysis of the criteria and the estabilishment of the weightening for those criteria in order to evaluate the advantages and disadvantages of the investment, leads to the right decision in promoting or not promoting it.

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