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Izbor optimalne metode investicionog odlučivanja u funkciji upravljanja poslovnim procesom

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Apstrakt: Rad se bavi izborom optimalne metode investicionog odlučivanja u funkciji upravljanja poslovnim procesom. Nastao je kao rezultat analize neophodnih aktivnosti koje treba preduzeti u cilju povećanja energetske efikasnosti stambene zgrade. Mere preduzete na energetske sanaciji zgrade analizirane su sledećim metodama: neto sadašnja vrednost, interna stopa rentabilnosti i metoda povraćaja. Komparativna analiza urađena je na konkretnom projektu energetske sanacije četiri zgrade. Rezultati su pokazali da su primenjene metode kompatibilne, a razlikuju se u načinu prikazivanja rezultata. Metod neto sadašnje vrednosti iskazuje rezultat kao novčanu vrednost u sadašnjem trenutku, odnosno, pokazuje koliko novca će zaraditi ocenjivani projekat. Metod interne stope rentabilnosti pokazuje profitabilnost projekta izraženu procentima, a metod perioda povraćaja kao rezultat primene pokazuje vreme (broj godina) za koji će se uložena sredstva u projekat vratiti. Zbog specifičnosti problema predlaže se stavljanje modifikovane metode perioda povraćaja u prvi plan.

Ključne reči: poslovni proces, vremenska vrednost novca, interna stopa rentabilnosti, period povraćaja

Selection of Optimal Methods of Investment Decision-Making in Management of Business Processes

Abstract: This paper identifies the selection of optimal methods of investment decision-making in function of management with business processes. It was created as a result of the analysis of necessary actions to be taken in order to increase energy efficiency of residential buildings. Measures taken in the energy rehabilitation of buildings were analyzed by the following methods: net present value, internal rate of return and payback period method. A comparative analysis was performed on a real projects of energy rehabilitation for four buildings. The results showed that the applied methods are compatible and differ in the mode of displaying the results. The net present value expressed the result as a monetary value in the present moment, that shows how much money you will earn evaluated project. Methods of internal rate of return indicate the profitability of the project, expressed in percentages, a payback period method possesses time dimension, because it indicates how long it takes (number of years) to payback the investment outlays. Due to the specifics of the problem the placing payback period method is to the fore.

Keywords: business process, the time value of money, internal rate of return, payback period

1. Introduction

By coming of the Industrial Revolution on the world scene, human progress is linked with economic growth and material goods, so there come up drastic increases of production, consumption and wealth in general (Jacobus, 2006). The period stable growth in the world economy, which was performed after the Second World War, supported the belief in the unlimited possibilities of scientific and technical progress, but from the seventies of the 20th century, the oil crisis and other disorders, showed the depth of these misconceptions. The growing concern over the depletion of natural resources and increasingly present a discussion on possible limits to growth.

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Intensive growth of industrial production, growth of human population and its needs lead to a significant increase in energy consumption. The consequence of the increase in energy consumption is the intense emission of harmful substances into the atmosphere (Wilkinson S., 2006). The increased concentration of harmful substances, it is believed, causes the greenhouse effect, destruction of the ozone layer and other negative impacts on human health. The largest part of emissions (over 90%) comes from the combustion of fossil fuels (Ekologija sagorevanja).

The problem of preservation material resources is basically a problem of conservation of energy (Ralić, 2016). Matter can be used in a closed cycle, recycling many chemical compounds that were previously accounted as ballast (e.g. plastic.). Buildings are the largest single consumers of energy in Serbia, as they account for over 50% of final energy consumption. The efforts of the EU and other countries, are aimed at increasing energy efficiency in buildings in order to save energy. The common characteristic of much of the housing stock in Serbia is irrationally high consumption of all forms of energy so that the energy rehabilitation of buildings are imperative. The problem arises due to the fact that every step taken in this direction involves minor or major investment costs.

According to its basic characteristics of the investment decisions are strategic decisions, which means that they are difficult and associated with a significant risk regarding the final result. The situation is further complicated by the ownership structure of the housing stock. Similar to other countries in transition in Serbia are 98% of privately-owned flats (Republic Statistical Office Of Serbia, 2011). The adoption of any investment decision in buildings with multiple dwellings implies the consent of all owners. It must be very circumspect approach managing energy rehabilitation process taking into account the economic power of the population and the educational structure of decision-makers. The present selection criteria must be tangible and comprehensible to everyone.

Business processes are subject to permanent changes caused by various disorders of the Interior within the system up to influencing the external environment. They are structured by a number of activities initiated by a specific event (or more), and aimed at achieving a certain goal. Most of the problems in the company or in a company is a consequence of inadequate organization and management of processes. In order to achieve the desired objectives, the process should be managed in an effective and efficient manner. Decision-making in the energy rehabilitation is complicated due to the aforementioned reasons.

A number of methods are used to estimate engineering of investment projects. However, all methods are mutually compatible but what differentiates them is how they show the result (Milanovic D.Lj, 2012). So, for example, the net present value is expressed as a result of the monetary value at the present time, i.e. shows how much money you will earn during the evaluated project. The methods of internal rate of return show the earnings of the project, expressed in percentages, and the payback period methods as a result of the application has the dimension of time, because it shows the time (in years) for which the funds invested in the project give back.

This paper concerns with the engineering-economic analysis of the activities undertaken for the purpose of energy efficiency of residential buildings. We have analyzed four residential buildings which differ in their macro and micro location, shape, size, number of floors, shape factor, the structural characteristics, etc. Common to them is that they were built, as well as from 20.1% of the housing stock in Serbia in the period from 1961 to 1970 (Europe, 2006). The first regulations related to the thermal protection of buildings were adopted later.

2.0 Problem Formulation

This paper on concrete examples that were the subject of the research is to determine whether there are significant differences in the results obtained using the above methods. Four buildings were analyzed where the comparison of the current situation with an alternative solution, included the appropriate technical procedures on energy rehabilitation in order to increase their energy efficiency. Buildings were insulated with thermal insulation thickness of 20 cm, and new windows were installed with multiple chamber PVC frame and low emission glass $U = 1,1 \text{ W/(m}^2\text{K)}$.

A comparative analysis was made on the basis of the following elements of cash flow:

1. The cost of energy rehabilitation of buildings
2. Savings in the amount of funds needed for equipment for heating buildings
3. Decrease in prices of connection to the public utility company „BEOGRADSKE ELEKTRANE“
4. Increasing the energy efficiency of buildings, thanks to energy rehabilitation, reduces the height of monthly bills for central heating.

The first three elements of the cash flow are present at the beginning of the lifetime of engineering investment project. The fourth element is present throughout the lifetime of the project. The discount rate, for investors, is the opportunity cost of committing the funds. For the purposes of this study used the rate of 12%. Lifecycle of the project is 20 years. Figure 1 graphically shows the cash flow in the observed period.

Figure 1. Graphical representation of cash flow

3.0 Net Present Value

The net present value is the most important dynamic method for estimation efficiency of investment projects. It is a classic discount method to perform the reduction of all income and expenses that arise during the lifetime of the project in the same time period (Newnan D, 1998). In this way, it becomes comparable with the amount of capital investment in the investment project, which is also expressed in the present value of money.

The function of the net present value depends on the influential parameters, and can be written as an equation that has the following form (Dubonjic R, 2005):

- I – investment,
- R_{pp} – annual income after tax,
- C_{pp} – annual operating costs (and other expenses) after taxation
- D_{ap} – amortization amounts after tax
- L – liquidation value of investments
- W – investment in working capital
- WR – residual value of working capital
- k – interest rate (discount rate),
- n – number of years of the project.

$$S = -I - W + (R_{pp} - C_{pp} + D_{ap}) \cdot \frac{(1+k)^n - 1}{k(1+k)^n} + (L + WR) \cdot \frac{1}{(1+k)^n} \quad (1)$$

where is: S – net present value of the project.

Table 1. Elements of cash flow at the beginning of the project

Building	1	2	3	4
The cost of energy rehabilitation	-109.107	-67.046	-35.902	-84.821
Savings for equipment	19.041	8.795	5.704	11.185
Savings for connection	41.329	18.656	11.113	24.430
In total	-48.736	-39.596	-19.085	-49.206

Source: (Ralic, 2012)

Table 2. The net present value for the buildings

Building	The lifespan of the project	Investment	Savings in exploitation	Amortization	Liquidation value	Discount rate	Net present value
	(n)	(I)	(R _{pp})	(D _{pp})	(L)	%	(S)
	years	EUR	EUR	EUR	EUR		EUR
1	20	-48.736	13.555	1.796	765	12	53.934
2	20	-39.596	7.953	912	563	12	20.548
3	20	-19.085	4.947	544	337	12	18.307
4	20	-49.206	11.506	1.119	642	12	37.642

Source: (Ralic, 2012)

All these methods have their advantages and disadvantages. In net present value method is necessary to determine the discount rate by which all values seen for the initial (zero) year, which is not always easy. Applying the criterion NPV all independent projects are acceptable whose net present value greater than zero. This method is an absolute indicator that clearly shows how much they will earn money from the contemplated project. In the case of four building can be seen that it is profitable to invest in the energy rehabilitation.

4.0 Method of Internal Rate of Return

The previous method has shown that investing in energy rehabilitation brings money. The method of internal rate of return gives the discount rate for which the net present value of the project is equal to zero (Chan, 2014). For the owner of the apartment is useful to know which is the minimum acceptable rate of interest to compared it with interest that would be obtained if the funds deposited at the bank.

The formula for calculating the internal rate of return has the following form (Dubonjic R, 2005):

I_0 – investments
 NP_t – net cash flow of the project
 k^* – internal rate of return (yield)
 n – number of years of the project.

$$\sum_{t=1}^n \frac{NP_t}{(1+k^*)^t} = I_0 \quad (2)$$

Internal rate of return is a condition, however, which cannot be directly calculated based on the formula. In calculating this investment criteria established by the systematic process of trial and error in order to find the discount rate which reduces the NPV cash flow to a value that is close to zero. Results of calculating the internal rate of return are shown in Table 3.

Table 3. Internal rate of return for the buildings

Building	The lifespan of the project	Investment	Savings in exploitation	Amortization	Liquidation value	Internal rate of return	Net present value
	n	I	R _{pp}	D _{pp}	L	%	S
	years	EUR	EUR	EUR	EUR		EUR
1	20	-48.736	13.555	1.796	765	27,98	4
2	20	-39.596	7.953	912	563	19,77	6
3	20	-19.085	4.947	544	337	25,95	0
4	20	-49.206	11.506	1.119	642	23,25	11

Source: (Ralic, 2012)

The value of internal rate of return for the buildings shows that investing in energy rehabilitation of building is a profitable investment because the calculated value is greater than the current interest rates on the capital market.

1.0 Payback Period Method with the Time Factor

The method of payback period was commonly used in investment decision-making by the late 1950s. This method indicates how long it takes (number of years) for the investment outlays to return. The advantage of this method is its simplicity. Checking the engineering investment projects focuses on the time in which there are expected returns on the initial investment. This method is also suitable for comparing several alternatives, at issue the more favorable project has a shorter period of return on investment than other.

Two major drawbacks of the payback method are:

1. The impossibility of measuring the profitability of the project. Simply getting time period of return on initial investment costs little to estimating cash inflow from the realization of this project.
2. The analysis of payback period does not respect the time value of money concept, i.e., it cannot identify the distinction between present and future value of money.

Between the moment of investment in engineering investment project and the moment of achieving income (effect) on the basis of the project there is always a time lag. In this regard, it is logical that money has a greater value at the time of issue of those values that has at the moment of payment (the concept of time value of money). Therefore, a modified payback period method of the return which includes a time factor are applied. Thus, the main disadvantage of the payback period method of return, disregard of the time value of money concept, is successfully eliminated.

Applying the payback period method with the time factor included, the number of years required for the return on investment outlays is obtained by cumulative calculations of net present value of money per year of project duration (from zero year and onwards), i.e., the number of years it takes for the return on investment outlays is obtained by summing up all years with a negative present value. The year of a present value transition from a negative into a positive value is the year of investment outlays payback. Payback period method of the return which includes a time factor is calculated using the following formula (Dubonjić R, 2005):

$$NSV_t(k) = -I + (R_1 - C_1) \cdot (f_{SB})_k^1 + (R_2 - C_2) \cdot (f_{SB})_k^2 + \dots \\ \dots + (R_t - C_t) \cdot (f_{SB})_k^t \geq 0 \quad (3)$$

R – total income per annum,

C – total expenditure per annum,

I – total investment project outlays,

t – number of years required for the investment outlays to return

$(f_{SB})_k^t$ - present value factor for the year t.

The results of calculation of payback period, along with elements of the cash flow for each building are shown in Table 4.

Table 4. The results of calculation of payback period with the time factor for the buildings

Building	1	2	3	4
	EUR	EUR	EUR	EUR
The cost of energy rehabilitation	-109.107	-67.046	-35.902	-84.821
Savings for equipment	19.041	8.795	5.704	11.185
Savings for connection	41.329	18.656	11.113	24.430
In total Σ	-48.736	-39.596	-19.085	-49.206
Savings in exploitation	13.555	7.953	4.947	11.506
years	Net present value, NPV (12%)			
0	-48.736	-39.596	-19.085	-49.206
1	-36.633	-32.495	-14.668	-38.932
2	-25.827	-26.154	-10.724	-29.759
3	-16.178	-20.494	-7.203	-21.569
4	-7.564	-15.439	-4.059	-14.257
5	127	-10.927	-1.252	-7.728
6		-6.898	1.254	-1.899
7		-3.301		3.305
8		-89		
9		2.779		

The calculation results show how each building is specific. The period of return ranging from fifth to ninth year. The worst case is a building 2, in this case the payback period is shorter to by more than 50% of the life of the project (20 years).

6.0 Conclusion

The applied methods in this paper are compatible with each other and have shown that it is acceptable to invest in the energy rehabilitation of buildings to increase their energy efficiency and from an economic point of view. The results are differ in the way they are presented. Due to the specific ownership structure managing of the process of energy rehabilitation, and hence investment decisions must be based on indicators that are clear and understandable.

Method NPV is an absolute indicator that clearly shows how much they will earn money by investing in energy rehabilitation of each of the analyzed buildings, but it says nothing about the profitability of the proposed project. Method of internal rate of return eliminates this lack, and on the basis of its application leads to information that is more cost-effective to invest in the energy rehabilitation rather than deposit them in one of the commercial banks.

Applying the payback period method with the time factor gives more accurate results than classical methods, which ignored the time value of money. Size of error that occurs due to neglect of the time value of money depends on several factors, but primarily on the size of the discount rate and the difference between the money invested and earnings achieved by the project during its service life. The application of this method is precise information about the time when they will be returned invested funds. In most cases it can be a turning factor to invest in the energy rehabilitation.

Investment decisions are associated with the risk in terms of the final outcome, so they must be approached cautiously and judiciously. The ownership structure of the housing stock, underdevelopment of the market, lack of confidence in financial institutions further complicates decision-making. Similar to other countries in transition in Serbia is trying to find a model of rational management of housing stock. Making any investment decision in buildings with multiple dwellings should be approached cautiously, taking into account the economic

power of the population and the educational structure of decision-makers. The present selection criteria must be understandable to everyone, so it is recommended highlighting the results of payback period method with time factor to the fore. Other methods are compatible and should be used as a support for a comprehensive explanation of the economic justification of the proposed investment.

Increasing the energy efficiency of buildings, thermal insulation of buildings, the savings of all types of energy, renewable energy and environmental protection, have now become a basis for sustainable development. Sustainable development imposed itself as an essential prerequisite and as the ultimate goal of efficient organization of numerous human activities on Earth. Considered projects must be preferred with favorable prices, subsidies, education society and other measures that will allow their wide application.

Literature

1. (n.d.). Retrieved 9 10, 2016 from Ekologija sagorevanja:
<http://www.rgf.bg.ac.rs/predmet/RO/VII%20semestar/Sagorevanje/Predavanja/12Ekologija%20sagorevanja.pdf>
2. *Republic Statistical Office Of Serbia*. (2011). Retrieved 10 26, 2016 from
<http://webzrs.stat.gov.rs/WebSite/Public/ReportResultView.aspx?rptKey=indId%3d05080104IND01%26102%3dRS%26136%3d1%2c2%26137%3d0%26sAreaId%3d05080104%26dType%3dName%26IType%3dSerbianCyrillic%26isAdvanced%3dtrue>
3. Chan, S. P. (2014). *Contemporary engineering economics*. Harlow : Pearson education limited.
4. Dubonjic R, M. D. (2005). *Engineering economy*. Krusevac in Serbian: ICIM.
5. Europe, U. N. (2006). *Country Profiles on the Housing Sector Serbia and Mintenegro*. Retrieved 9 12, 2016 from
<https://www.unece.org/fileadmin/DAM/hlm/prgm/cph/countries/serbia%20and%20montenegro/CP%20Serbia%20&MontenegroPub.pdf>
6. Jacobus, A. (2006). Sustainable development – historical roots of the concept. *Environmental Sciences*, 3:2 , 83-96.
7. Milanovic D.Lj, R. Z. (2012). Analysis of applying payback period method in engineering economy. *SIE* (pp. 261-264). Belgrade: Faculty of Mechanical Engineering in Belgrade.
8. Newnan D, L. J. (1998). *Engineering Economic Analysis*. Austin, Texas: Engineering Press.
9. Ralic, Z. (2012). COMPARATIVE ANALYSIS MODEL OF INVESTMENT ALTERNATIVES AS A FUNCTION OF INCREASING ENERGY EFFICIENCY IN RESIDENTIAL BUILDINGS. *PhD thesis* . Faculty Of Mechanical Engineering, Belgrade .
10. Ralić, Ž. (2016). Energetika i životna sredina. *The Serbian Journal of Engineering Management* .
11. Wilkinson S., R. R. (2006). Office building characteristics and the links with carbon emissions. *Journal: Structural Survey* , Vol. 24, Issue 3, pp 240-25