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# Decision Model on Financing a Project Using Knowledge about Risk Areas

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*The research presents an alternative to the classical method of measuring financial risk in funding a project. The goal of the model described in the paper implies identifying "risky areas" within the financial balance of the project. The model analysis the financial risk behavior studied along four scenarios by varying only the cost of financing source used according to the specific type of funding. The model introduces the time factor into the analysis of financial risk due to the specific type of financing source used because of the influence on financial balance of project' budget due to the distribution in time of the receipts and costs incurred in the life cycle of a project. Model presented help identifying the “risk areas” within the financials flows of a project offering a warning signal to the decision-maker to select the most suited risk management strategy.*

**Keywords:** *risk management, financial disequilibrium, decision-making*

## Introduction

Where did the money go? This is the question that managers of collapsed financial institutions have been facing during the actual global crisis. Is it the risky behavior of the agents on the market to be blamed? Financial institutions faced a period of concentration in staff, sites and company structure. Employees were dismissed; banks were bought by others as a whole or even closed. But the amount of money to be administrated was at least the same as before. Through bad news of the stock markets the amount of money remaining in the banks was even higher than before, because people didn´t invest or buy stocks. These funds needed projects in which to invest to.

This paper presents a decision model on selecting the financing alternatives that may be used to finance a particular project. The concept of project involves a number of defining elements that distinguish it from any other activity. Firstly, a project involves tracking a series of objectives to achieve a specific purpose (Gareis, 2006). Secondly, it also implies the process to go through several activities ordered in time and space. The notion of project differs from that of a process in the sense, that the objectives pursued by the project involve achieving a result, which means the ending of the project, while in a process each output is a new entry for another stage without implying the existence of a limit point. All in all, the project is a defined objective–oriented activity with a start and end point in time, following a determined objective.

The research presents a different method to analyze the financial risk in funding a project. In terms of project management, the required project resources, human, material and money are accounted separately at project level and quantified in monetary project budget. In this context, there will be analyzed the generated cash flows within the project. The classical methods used to measuring risk are statistical probabilities of occurrence for a risky event (Kolmogorov & Fomin, 1970). The economic model described in this paper brings an innovative element. This refers to a systematic vision of risk, studying the cumulative effect of factors that lead to specific risks in the building of the project (Scarlat & Marries, 2010).

The model introduces the time factor in the analysis because of its influence to the financial balance between revenue and expenditure in the budget of the project, which is due to timing of receipts and payments over time. Time factor entered into the equation leads to indicators such as the velocity of cost and revenue whose temporal evolution can generate the emergency of systematic imbalances in the financial equilibrium of the project, generating risk. The Figure 1 shows how velocity of cost and revenue leads to risk represented by the bounded area between the two velocity curves.

The model provides decision support needed by any financial manager in selecting the most appropriate financial sources to run a certain investment made through a project. Model analysis implies identifying "risky areas" within the financial balance of the project. These are the places where risk can occur due to higher levels of cost velocity greater than those of revenue generated by the financing sources used. The model analysis implies studying the behavior of risk into four scenarios. Varying the type of funding source and thus the velocity of cost of financing but keeping the revenue generated from investment the same throughout the scenarios implies studying the variation of risk levels due to the type of financing source used.

## A short description of the algorithm of the indicators used in the model

The purpose of the model is to study the risk of financial imbalances in a project by analyzing the factors that lead to the emergence of risk due to the lack of synchronization levels of velocity of cost compared to that of revenue. The model is defined by following algorithm. The first step in building the analysis of the model refers to defining the notions of velocity of revenue and cost. Figure 1 shows how the velocity rate of cost ($v_c$) exceeds that of revenue ($v_v$) and leads to an „area” bounded between the two velocities, which is a warning sign about the risk of imbalances in the budget of the project when the speed rate of cost is higher than the speed rate of revenue. Derivation of cost (C) versus time leads to the velocity rate of cost ($v_c$). Similarly, the velocity rate of revenue in the project is the derivation of revenue (V) over time (W. Gellert et al., 1980).

The budget balance equation is as follows:

$$C = V \qquad (1)$$

The derivation of equation (1) versus time leads to the following formula:

$$\frac{\Delta C}{\Delta t} = \frac{\Delta V}{\Delta t} \Leftrightarrow v_C = v_V \qquad (2)$$

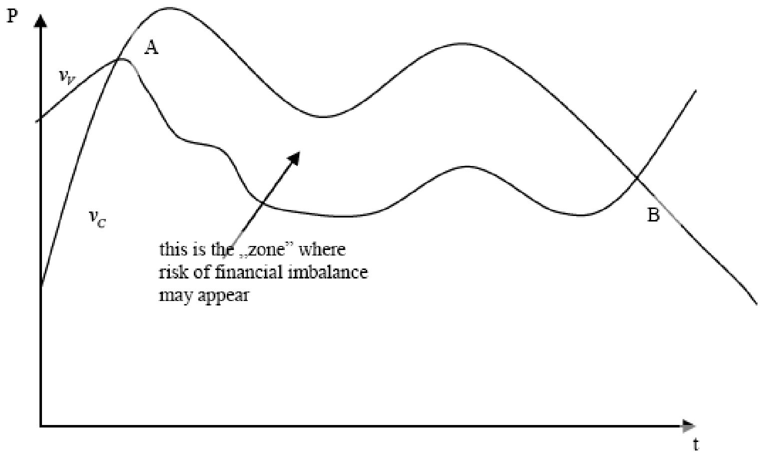


**Figure 1**: Representation of the variation of velocities of cost and revenue

Thus as revenue speed rate is higher than speed of cost reflects a favorable situation that can lead to the achievement of net profits in the operating phase of the investment. Instead, when speed of cost exceeds that of revenue generated by the investment this reflects a negative situation where the yield from the project is eroded by higher costs. The analysis of the model indicators targets a diagnosis of risk of financial imbalances in the equilibrium level of revenues and expenditure of a project. Risk criterion is important when the decision-maker must choose between various forms of financing for a project. Risk analysis follows a series of steps that describes the phenomenon from a quantitative and qualitative view.

The second step in the model refers to building function ϕ (t), as the difference between the velocity of cost and that of revenue during the project life. First of all, the notions of velocity of cost and revenue need further definition according to the projects' life cycle. The project implies an initial period of investment spending done from different kinds of financing sources as described in Table 1. After investment is done and becomes operational current expenses are incurred and revenue is generated from the exploitation of investment. The notions of velocity of cost and revenue are defined as follows:

$$v_v = \frac{\Delta V}{\Delta t}, v_C = \frac{\Delta C}{\Delta t} \tag{3}$$

Where $v_c$ is the velocity of revenue provided from financing sources used to finance investment during the first step in the project life, while during the exploitation of investment period this indicator is reflected from the value of revenue generated from operating investment realized.

$v_c$ is the velocity of cost from accessing the financing sources in the investment stage of the project, which are assimilated to the cost of investment, while during the exploitation of investment this indicator is based on the running costs of the investment during exploitation period summed up with the cost of financing accessed for building the investment.

Δt = is the period of time considered to be of 1 year.

We introduce the function ϕ (t) defined as the difference between velocity of revenue and project cost, as follows:

$$\varphi(t) = v_V(t) - v_C(t) \tag{4}$$

This function can be defined at each point in time t chosen to coincide with the time of each installment repayment of the funding accessed.

There are three possible values that the function ϕ (t) is able to take:

$\varphi(t) > 0 \Rightarrow v_V(t) - v_C(t) > 0$, in this case, we have a full "covering" of the cost from the revenues generated by the project, at time t, chosen as a reference.

$\varphi(t) = 0 \Rightarrow v_V(t) - v_C(t) = 0$, in this case, we have a balance between the revenue and cost at the budget of the project, when the project is at the break-even point.

$\varphi(t) < 0 \Rightarrow v_V(t) - v_C(t) < 0$, in this case, the project revenues are not high enough to cover the cost required for the project. This situation should be temporary as the project financial balance depends on the period of time, that this situation prevails, in order to prevent a financial collapse of the project.

The next step in the model analysis refers to the defining of the 'area of risk' A(t) as the graphical area between the curves generated by velocity of cost and revenue generated by the project. The meaning of the Area of risk function A(t) refers to the dimension of risk be-longing to a certain project of not being able to cover the its cost form the revenues generated. We are able to formulate the Area of risk function, A(t) depending on the factor of time:

$$A(t) = \int_0^t [v_v\ (t) - v_C\ (t)]dt = \int_0^t \varphi(t)dt \qquad (5)$$

$$\Delta t^* = t_1 - t_0 = 1 \qquad (6)$$

where the indicators have been described beforehand.

The mechanism of decision on the form of financing used to finance a project implies the selection of the type of funding (see Table 1.) that is used to finance a certain project. This refers to the selection of the funding source according to the decision function described be-low.

**The decision function is defined as follows:**

$$F(x) = \begin{Bmatrix} 1\ if\ \max A(t) \geq 0 \\ 0\ if\ A(t) < 0 \end{Bmatrix} \qquad (7)$$

Where: F (x) = 1, the subject will select the type of funding having according to level of indicator max A(t) >= 0 (see Table 2. for detailed presentation of results of the values of function A(t) according to each of the four scenarios),

F (x) = 0, the subject will not choose the funding because of the high risk of disequilibrium in the projects' budget (because A(t)>0).

## Empirical testing of the model

Model testing will be done by going through four scenarios for scientific validation. The analysis of the model described above implies using four combinations of project financing to realize an investment. The types of funding sources used in the model are described in Table 1.

**Table 1:** Funding sources used in the model

| TYPE OF FINANCING | DEFINITION |
|---|---|
| **Investment funds (equity)** | Investors are individuals who own private money. These are called HNI (High Networth Individual). They want to invest in companies with a high risk profile through the purchase of stocks or shares in a company with the purpose of exercising control over it and to sell their shares after a strong increase of company value. |
| **Bank loan** | Bank loans are repayable sources of financing to companies in exchange for the payment of an interest (cost). |
| **Grant** | Grants are offered to enterprises by public or private institutions on a project basis or a business plan in order to achieve socio-economic devel-opment. |
| **Public-Private Partnership** | A form of partnership between public institutions and private companies to finance public utility projects. |
| **Self-financing** | Using revenues generated by the project to cover the necessary operating and financial costs (Tulai, 2007). |

Source: own approach

Throughout the scenarios used to test the model, the revenue generating capacity of a given project will be considered to be the same along the scenarios. The variable elements of the analysis will be the funding available to finance a project.

The analysis of the model implies the following aspects:

- the revenue generated by the investment made through the project financed stays the same through the scenarios,
- the cost of operating investment made is held constant throughout the analysis,
- these elements are possible due to the fact that the analysis purpose refers to compare the possible financing sources for the project in order to select the financial structure based on the criteria of risk, as tackled by this paper.

The first scenario implies the use of credit financing for realizing the investment of a project that runs over 18 years. The cost of financing refers to the annual installments of loan repayment and interest payments from the third year of the operation of investment. The cost of accessing the credit is assimilated to cost of investment. Running cost appears in the third year of the project along with revenue generated by the exploitation of the investment.

The second scenario implies using credit financing in combination with a loan from a private investor used to financing the investment in the project that runs over 18 years. Investor's loan will be repaid together with the rate of return required by investor (Fabozzi, 2003) in two different installments, in the 7th and 9th year respectively. Cost of financing refers to repayment of the credit, in annual installments from the 7th year, used to refinance the loan coming from private investor.

Third scenario refers to public-private partnerships used to finance investment projects that are conducted in partnership with public entities over a period of 18 years. In the first 2 years of the project, there is a bank loan accessed to finance the investment. The bank loan will be repaid from the 3rd year of the project. Cost of financing refers to the annual installments of loan principal and interest rate repayments summed up with paying the annual fee (Damodaran, 2008) to the public entity for the provision of public services since 3rd year.

Fourth scenario refers to grant funding that is used for financing the investment in the project that runs over 18 periods (years). The investment is primarily financed by bank credit to be repaid from the 3rd year, which is refinanced under reimbursing principle from the grant accessed for the investment that will reimburse by 80% of the total value of the investment. Cost of financing refers to paying the annual installments of loan repayment and interest rate, since the 3rd year of the project and also the cost of the credit guarantee used to finance initial investment.

The decision over which type of financing to be used in financing an investment is ac-cording to risk criteria, as estimated in the model presented by the current research. The area of risk function A(t) is the indicator of which value guides the decision of which financing source to be used in the project. The risk of financing is minimized by the fact that value of function A(t) reaches maximum level, as described in Table 2.

**Table 2:** Values of area of risk according to the types of financing used in the four scenarios

| **Scenario No.** | **Values of function “Area of risk”)** *(At)* |
|---|---|
| 1 | 8,700,222 m.u. |
| 2 | 26,276,187 m.u. |
| 3 | 86,782,563 m.u. |
| 4 | 50,656,212 m.u. |

Source: Own approach

The role of the model is to provide an informational tool for making decisions regarding the financing sources of an investment project. The agent’s decision regarding which source of financing has lowest level of risk is the one that shows maximum level of the function A(t), according to Table 2.

The scenario analysis shows that there are parts of the graph where revenue is above the curve of cost and the type of financing reflects a favorable situation for a minimum risk being represented by highest level of the function A(t). There are areas on the graphs of risk where the velocity of cost is higher than the velocity of revenue indicating a higher level of risk and this represented by lower levels or even negative ones of the values of the function A(t). Depending on the length of time that this situation is maintained the risk of not being able to cover the cost in the project by the revenue generated by using a certain type of financing scheme is represented by the level of function A(t) which can take even negative values signaling a possibility of a financial collapse in the state of financial balance of the project.

The subject can react to minimizing this risk by selecting another financing source for the project according to preferred levels of A(t) estimated in the scenarios.

## Conclusions

The model examines the risk of the not being able to cover the cost of investment realized through a project from the revenue generated by the investment. Starting from the premises, that a higher level of velocity of cost and revenue can lead to the occurrence of risk and depending on the duration of exposure to this risk, the project can approach financial collapse.

Apart of the model scenarios of financing projects, the mixtures of different financial sources are either system-immanent, as with bank loans or grants, where equity is a must to fulfill requirements or they are logic-immanent, when for example private investors should just cover the necessary part of the needed equity and the rest could be financed from loans or grants with much better conditions for the project.

Even though the velocity of the operating cost of the investment is held the same through the model scenarios and the velocity of revenue generated from the investment is also the same along the model, the “risky areas” appear due to the specific conditions of each type of financing because of the different periods of time between the installments in various types of financing and different cost coming along. These are the financial risk gaps in projects that any agent’s decision regarding financing should take into account. All these findings should lead to a financial gap risk capital, which decision-maker should calculate extra to the calculated project cost in order to give notice to the existence of risk and to avoid collapses, when deciding which financing source to use. One problem is that companies, banks and other financial institutions do not pay a special percentage of risk capital in the projects' budget when building or analyzing a business plan. There is a golden role between the practitioners in the financing field: "Ask the bank for more money that you need, when starting the project, because you will never got any additional cent afterwards!" The main findings of the present research can also refer to the importance of including such additional risk calculation into business plans in order to avoid lots of failed projects or bankrupts. The value of additional risk calculation is represented by the function A(t) representing the "area of risk".

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