End-user's role in the implementation of information technology in financial modelling of the company

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Abstract: The implementation of new IC Technologies in everyday business application in general is far from optimal. The main reason is the lack of end user knowledge and understanding of possibilities that are already at hand. The paper is an overview of some examples that are very useful, easy to apply and still underused. With permanent growth and changing of both the business environment and new ICT the weakest link seems to be the human factor.

Key Words: Financial functions, Human factor, End user, Financial modelling, Optimisation

1. Introduction

Today's business environment is rapidly changing, the economy acquires completely new dimensions. In such dynamical environment the only thing that remains the same is the exploitation of the resources in business activities. One of the important factors of the efficient business is the forecast of the future movements of the financial indicators in which financial modelling plays the significant role.

In this paper the subject of the research is the evaluation of possibilities of the information technology implementation in financial modelling. Financial modelling encompasses the wide spectrum of problems and for their solving work of economists and information technology experts is essential. In this paper the authors will present the analysis of the significance and the effects of using of computer applications in the terms of developing the simple and more complex financial models. Some of the more complex problems that financial managers encounter are: a) the problem of evaluating the quality of future financial investments and b) problem of optimization by using the Microsoft Excel. The main reason is not the inadequacy of the tool, more likely it is the users' ignorance of it.

By the application the scientific knowledge on using the mathematical and statistical methods in the solving of financial problems by using Excel it is possible, by the use of automated procedures, to implement financial analysis. Those analyses will be tested on the example of evaluating the quality of the possible investments with an aim to choose the most profitable ones. What is more such analyses can be used for the problem of allocating the limited resources with an aim to achieve the best results.

2. Financial modelling

Financial modelling represents the research on the relationship between the connections between the variables of the specific financial problem. In the process of creating the financial models it is necessary to involve as much relationships between the variables in the model as possible. In this process the change of independent input or output variables it is observed how they affect the key dependent variables. Beside that, it is necessary to recognize that some of the relationships are easy to configure, some are

estimated as the approximate and some even remain unidentified. Those can be reached by using the financial theory, statistical methods, analysis of the data etc. The discovering of such data is one of the biggest challenges of the financial modelling due to the fact that the more relationships are known and involved in the model, the model is more valuable.

Financial models are almost always created with an aim to observe the way in which the values of the output variables are changing according to the change of the value of one or more independent variables. Dependent variables are those whose values people want to project or determine in the process of financial modelling. It is possible to determine the auxiliary dependent variables and output dependent variables. Auxiliary dependent variables can be used in the further calculations while output dependent variables cannot be used[1].

Financial modelling is based on the systematic approach that includes the prospective planning and it consists of the several steps[2].

- the defining and the structuring of the problems is the first step of financial modelling in which the reasons because of which the model is needful, which decisions will be made on its results and which questions will be answered by the solving of the model are discussed and defined

- by the defining of the input and output model's variables the list of all input variables is being made as well as the way to more calculate them more accurately and the lit of table, graphical and other outputs that model needs to present as the result.
 - the defining of the user and the frequency of model's use prevents users from entering unnecessary data, damaging the certain parts

of the model and enables the required output variables to be calculated automatically

- the understanding of models' financial and mathematical aspects presumes the good understanding of the financial and mathematical problems of the model that is about to be created because it is better not to start the creation of the model unless we are sure of the way in which we will solve it

- the designing of the model consists of the steps that the computer application has to follow in the solving of the problems or the planning of way in which the odel will be created by using the computer application

- the creating of the model represents the most important step that depends on the model that we want to solve by creating the model itself

- the testing of the model presumes the fining of the mistakes because there is hardly any complex model that works flawlessly and without mistakes on the first use

- the protection of the model is particularly important if the model is intended for the large number of users or the certain parts of the model are being hidden in order not to be seen by particular users

- the documenting of the model presents the providing of the written information needed for understanding the functioning of the model, its structure and the assumptions that are built into it in order to change the model if needed

- the renewing of the model is not the part of the initial model's creation, but almost all models (sooner or later) need the renewal because of the change of variables or because the model itself will be adjusted for solving of other similar problem

In the process of defining the above mentioned steps it is worth having in mind that in practice it is not obligatory to follow

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[1] Sengupta,C.: Financial Modeling Using Excel and VBA, www.amazon.com
[2] Ibidem

the steps according to the given order or the finishing of the particular step before the starting of the other. In the first place it depends on the nature of the particular situation. Besides, with time, it would be advisable to create the personal variations of the basic model approach and learn how to adjust it according to the specific situations. Excel is the flexible tool and accordingly the models can be changed in almost every moment without great difficulties.

3. The evaluation of the investment projects by using the financial functions

The basis for evaluating the investment projects is the future cash flow. Cash flow of the investment project is formed by the expected revenues and expenditures in the economic life of the project. Economic life of the project can be observed trough the phase of the investing and the phase of the exploitation of the project. The phase of exploitation is bounded with technological and market conditions that are specific for every project.

Trough the time of investing on the revenues side the positions of personal assets and the assets from the loans appear, while in the phase of exploitation positions of realization on domestic and foreign markets appear. In the last year of project of the revenues side, beside realization, the residual value of the project appears. The other positions on the revenues side depend on the project's type.

On the expenditures side in the time of investing there are positions of investing in fixed and liquid company's assets, while in the time of project's exploitation the majority of expenditures are considering operative costs and profit tax.

The financial flow of the project is used for the evaluation of project's accounting liquidity and as a background for creating the economic flow of the project. Economic flow is derived from financial flow by the

exclusion of the sources of financing and the sources of financing's liabilities which makes the financial flows free from financial transactions. In the economic flow net incomes in the first years of the economic course of the project are negative, while in the course of its exploitation they become larger than the net incomes in the financial course of the project.

The evaluation of the investment project is preformed on the previously mentioned basis of formed economic course of the project and on the quantitative methods of evaluation[3] that include Internal Rate of Return (IRR) method and Net Present Value of an investment method (NPV).

Internal rate of Return (IRR) of the certain investment is the discount rate that equalizes the present (discounted) value of the business cash flow and the amount of the expenditures for the investments. The advantages of this method are:
- recognizable value of money in time
- taking into the consideration the whole lifetime of the project
- the result of this method is presented as the percentage and therefore represents excellent base for the immediate reactions[4].

Between several projects that are in relation of mutual exclusion the best choice is the one with the highest internal rate of return.

Net Present Value of an investment method (NPV) is the method in which the business cash flow is discounted by the lowest target rate of return. The number that we calculated that way is then subtracted with the amount of the initial investment. If the discounted cash flow is larger than the amount of investment, or in the other words, if the net present value is positive the project is profitable and acceptable.

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[3] Polimeni,R.S.,Handy,S.A.,Cashin,J.A.: Troškovno računovodstvo, Faber&Zgombić Plus, Zagreb, 1999, p.194.
[4] Ibidem

The main advantage of the NPV method is the latent possibility to calculate the net present value, while the IRR method requires the value of money in time for the whole lifetime of the project[5].

The most convenient way to present this problem is by the use of table:

Table 1: The defining of the evaluation of the investment project problem

	A	B	C	D	E	F	G	H
1	Real flow of the project							
2	Net Income							
3								
4	2006 g.	2007.g	2008.g.	2009.g	2010.g.	2011.g	2012.g	2013.g.
5	-100.000	10.000	15.000	19.000	24.000	30.000	34.000	36.000
6								
7	Rate of capital return	6%						
8								
9	Internal Rate of Return	?						
10								
11	Net present value	?						

In the fifth row the Net Income has been presented. It is calculated as the residual when the total of income is subtracted by total expenditure of the economic flow of the investment project. The investment of 100.000 kunas is the first year of the economic course of the project (A5) will deliver in the next few years total income that is larger than the total expenditure (B5:H5).

The rate of capital return is presented in the A7 and it is very important for the evaluation of the every project, it is the referent indictor and it can be presented by:

- the best realized rate of return up-to-now
- opportune rate of return
- the price of involved capital

Previously mentioned data is necessary even for the working with the spreadsheets when we are calculating the Internal Rate of Return and as the discount factor it is used in the

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[5] Ibidem

calculation of the project's Net Present Value. With an aim to calculate those two measures for the project evaluation it is necessary to enter required formulas in B9 and B11. The easies way to do it is by using the built-in functions IRR and NPV.

Instantly after the entering of the functions the value of Internal Rate of Return is calculated in B9 and the value of Net Present Value is calculated in B11 as it is shown in Table 2.

Table 2: The solution of the evaluation of the investment project problem

	A	B	C	D	E	F	G	H
1	Real flow of the project							
2	Net Income (kn)							
3								
4	2006 g.	2007.g.	2008.g.	2009.g.	2010.g.	2011.g.	2012.g.	2013.g.
5	-100.000	10.000	15.000	19.000	24.000	30.000	34.000	36.000
6								
7	Rate of capital return	6%						
8								
9	Internal Rate of Return	22,94%	IRR(A5:H5,A7)					
10								
11	Net present value	133.480,66	NPV(A7,B5:H5)+A5					

It is obvious that the analyzed investment project is satisfactory profitable. The internal rate of capital return is 22,94% and it significantly exceeds the presumed rate of return, or in the other words the price of the capital, opportune rate of return or the profit rate of the personal best project whose rate is 6%. Throughout the economic course of the project, in the period of 8 years the profit of 133.480 kunas in the terms of present value will be realized.

Beside the Internal Rate of Return in practice we can also encounter the Modified Internal Rate of Return (MIRR). The main ideas of this method are:
- income should be discounted to the end of the last period and the Expenditure should be discounted to the beginning of the first period
- to determine the average interest rate by which the sum of the present value of the net

expenditures is realized in the sum of the future values of the net income trough the whole course of the investment

4. Solving of the optimization problems by using the Microsoft Excel

One of the problems in decision making that is often encountered in the production is how to allocate the limited resources that organization possesses. In the same way, organizations have to pay great attention to the costs and to the price of its goods. The relationship between the production and the costs is fairly simple: for the each level of production the organization must choose the most affordable combination of investment. The organization that is profit-oriented is always striving to choose the aggregate investments that provide the production with the lowest costs possible[6].

The optimal solution of the production problem can be found by the use of the tool Solver that is incorporated in the Microsoft Excel. Before the description of the model developing it is necessary to describe the problem of optimization by using the linear programming. In the models of linear programming we calculate the variables for decision making (adjustable cells) $x_1......x_n$, by changing which the optimal value of the target function is achieved, while at the same time the system of equations with which the constraints has to be satisfied. The problem of the linear programming optimizing can be described as above[7]:

MAX (or MIN):

$$f_0 \ (\ x_1, x_2 ... x_n \ ) = c_1 x_1 + c_2 x_2 + \ ... \ + c_n x_n$$

[6] Samuelson,P.A., Nordhaus,W.D.: Ekonomija, MATE d.o.o., Zagreb, 1992. p.119-124.
[7] Čerić.V.,Varga,M.: Informacijska tehnologija u poslovanju, Element, Zagreb, 2004.,p.155

Conditions:

$$f_1 \ (x_1, x_2 ... x_n \ )= a_{11} x_1 + a_{12} x_2 +...+ a_{1n} x_n \leq b_1$$

$$f_k \ (\ x_1, x_2 ...x_n \ ) = a_{k1} x_1 + a_{k2} x_2 +...+ a_{kn} x_{n \, =} b_k$$

$$f_m(x_1, x_2 ...x_n \ )= a_{m1} x_1 + a_{m2} x_2 +...+ a_{mn} x_n \geq b_m$$

$x_1, x_2 ... x_n$ are named the variables of decision making and the function f that needs to be maximised or minimised is named the target function. Functions $f_1 ... f_k ... f_m$ are defining the constraints, $c_1 ... c_n$ that represent the coefficients of the target function, while a_{ij} are the coefficients of conditions[8].

The setting and the solving of the production problems by using the linear programming in Microsoft Excel is shown by the following example.

Certain organization is producing four kinds of products and they are all made from the single raw material that is beside the sales price of the certain products and the average profit of the certain products shown in the Table 3.

Table 3:

Product	Quantity of the raw material	Average profit
Product A	45 g	7,00 kn
Product B	33 g	4.40 kn
Product C	20 g	3,20 kn
Product D	12 g	1,80 kn

The goal of the planned production is to maximize the profit by keeping in mind the given constraints. The basic constraint that appears is the availability of the raw material. Monthly, there is 2.500 grams of the raw material available.
Because the market needs the above mentioned products the constraints considering the minimal and the maximal quantity are presented. That way it is defined that in the overall production there should not

[8] Ibidem

be less than 10% of the certain product or more than 50% of the same.

For the determination of the model the variables of decision-making should be declared as well as independent and adjustable ones. The variable of decision making x_1 represents the quantity of product A, variable of decision making x_2 represents the quantity of product B, variable of decision making x_3 represents the quantity of product C and the independent variable x_4 represents the quantity of product D that is to be produced.

The target function in this example should be maximized or in the other words determine the desired quantity of production at which the total profit will be maximal. Maximal profit that can be realized by the production of four mentioned products can be defined as:

$$MAX: 7,00\, x_1 + 4,40\, x_2 + 3,20\, x_3 + 1,80\, x_4$$

The first constraint that should be taken into the consideration is the constraint of the available raw material needed to produce the anticipated product range:

$$45\, x_1 + 33\, x_2 + 20\, x_3 + 12\, x_4 \leq 2.500\ g$$

The second constraint considers the limitation of the minimal and the maximal quantity of the products:

$$x_1, x_2, x_3, x_4 \geq 10\% \,(x_1 + x_2 + x_3 + x_4)$$

$$x_1, x_2, x_3, x_4 \leq 50\% \,(x_1 + x_2 + x_3 + x_4)$$

Variables x_1, x_2, x_3 and x_4 must not be negative in value and therefore we must prevent results to come out as the negative numbers. The following constraint can be defined as:
$$x_1, x_2, x_3, x_4 \geq 0$$

The set model is represented by the Table 4.

Table 4: Set model

	A	B	C	D	E	F
1	Product	Raw material	Price	Profit	Pieces	Total profit
2	A	45	35	7		0
3	B	33	24	4,4		
4	C	21	18	3,2		
5	D	12	10	1,8		
6	Raw material spent		Total pieces		0	
7	➔	0	Total raw material		2500	

Variables of the decision-making are shown in the cells E2:E5. It can be easily seen that those cells are empty, but in this case it is the same as if the zeroes (0) were entered in all of them.

If we would like to paste the above-mentioned expressions in the Microsoft Excel's worksheet the target function would be:

$$F5 = E2*B2 + E3*B3 + E4*B4 + E5*B5$$

And it should be typed that way. But, if there were more decision making variables in the particular problem it would be very hard to write such expressions. The similar situation is also with the expressions that represent the constraints.

To avoid this we use the following incorporated function:

SUMPRODUCT (array1, array 2,.....).

If array1 consists of the following data

$$x_1, x_2 \dots\dots x_n\,,$$

and the array2 consists of this data

$$y_1, y_2 \dots\dots y_n\,,$$

the solution calculated by the function SUMPRODUCT is

$$x_1\, y_1 + x_2\, y_2 + \dots + x_n\, y_n$$

In other words, this function provides the sum of the all arguments' products and therefore the formula

SUMPRODUCT(E2:E5;B2)

that is entered in the cell F2 is the equivalent to the expression

E2*B2+E3*B3+E4*B4+E5*B5

but it is far more convenient for the spreadsheet calculations. The same goes for the cell B7 that is used for the calculation of the raw material constraints. In the cell E6 the sum of cells E2:E4 is calculated.

After all of the needed elements are entered in the worksheet we start the optimizing process with the help of tool Solver. The tool can be found and run from the Toolbar Tools in which we activate the option Solver and by doing so the window Solver Parameters opens.

After we enter all the required data such window should look like in the Figure 1.

Figure 1. Solver Parameters window
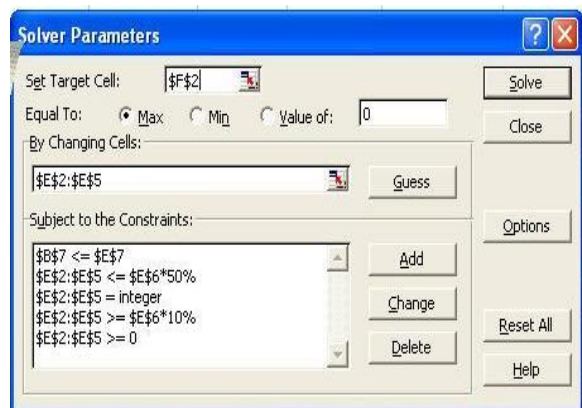
On the basis of the previously mentioned and set target function the problem is set in Solver that significantly makes the linear programming easier. By using solver we skip the phases of linear programming that do not provide the optimal solution and without the help of the computer those phases would be required.

The first step is entering of the Target Cell address, which contains the target function (F2). In the next step we select the maximization of the target function by choosing the option Max. Moreover, in the field for the variable declaration we enter or select the Changing Cells.

Constraints are defined with the press on the button Add. When we select the constraints we select the desired cell ranges in the worksheet and we use the predefined functions as we did for E7 (raw material) and E6 (total quantity of products). The conditions can be given by the use of the equalities (=) or inequalities ($\leq$, $\geq$) in the special frame reachable in Solver.

After the defining all needed parameters we start the optimization process by the click on the button Solve in the Solver Parameters window: After few seconds the values in the worksheet change and the window Solver Results appears which enables the user to keep the calculated values or to return the original ones.

In this window we can process the desired reports. Those reports include: Answer Report, Sensitivity Report and Limits Report. After we confirm our choice by the click on the OK button we can easily find the optimal solution of the set problem that should, in this case, look like one in the Table 5.

Table 5. Calculated solution

	A	B	C	D	E	F
1	Product	Raw material	Price	Profit	Pieces	Total profit
2	A	45	35	7	12	2036
3	B	33	24	4,4	12	
4	C	21	18	3,2	56	
5	D	12	10	1,8	32	
6	Raw material spent	Total pieces			112	
7		2496	Total raw material		2500	

Values calculated in the cells E2:E5 represent the optimal quantity of the products if we want to maximize our profit according to the set constraints. From the solutions we can conclude that we can produce 12 pieces of the products A and B, 56 pieces of the product C and the 32 pieces of the product D with the maximum profit of 2036 kunas.

5. Why are these methods underused?

Modern information technologies and the information systems based on them are the organizations' strategic tool of the trade. Use of the computers in the information-sharing processes became the one of the essential everyday activities in the organizations. Computers are, therefore, incorporated in the all kinds of analysis, statistical forecasts, planning systems, decision support systems, etc.

Financial modelling utilization as the efficient way of gaining the adequate information and solving of the many companies' problems is still not recognized and exploited in practice. Financial functions are intended for the carrying out of the simple analyses, loan calculation, amortization calculation, investment evaluating and therefore they represent the essential knowledge of the successful financial managers.

This paper proves the starting hypothesis that there are easily available methods that are cheap and acceptable to the potential users. What is more they do not require the extra investments because most of the users posses the installed copy of Microsoft Excel as the part of the standard computer equipment. It is worth mentioning that there other spreadsheets other than Microsoft Excel and some of them are equally rich with functions and options, but they are completely free. The bottleneck considering the use of such tools becomes a man that is not aware how to use the available tools and some individuals are not even aware such tools exist. The main problem and the urge is to motivate and enable the potential users to use the mentioned functions and tools.

6. Conclusion

The particular issues and its solutions that are presented in the paper depend on the kind of the decisions, the importance of the decision making process on the certain levels of management, the size of the organization, the level of employees' knowledge, available time for decision making, users access and permissions considering the use of available information, the changes in the organization and its environment, etc. But, it in the first place depends on the users' motivation to use and understand the new technologies tools. New trends in the decision making that every organization encounters require the use of such sophisticated methods in order to do business successfully and according to the modern tendencies.

To accomplish this mission it is less important to develop new methods and tools, it is far more essential to teach users how to efficiently use the available ones.

Nevertheless the situation on the field is far from perfect. The wider availability of new ICT (Information and Communication Technologies) did not solve the problem of its efficient implementation. Companies spend vast amounts of money for new hardware and software and the final results are mostly uncertain. Worldwide economics experts admit that ROI (Return of Investment) is quite doubtful for ICT investments. Recently the authors announced a research[9] as the guide that would help companies to come to terms about how to invest in skills and abilities of their end users as an invaluable factor of their development that does not change over the course of time.

References:

[1] Carlberg, C.: *Business analysis with Microsoft Excel*, second edition, Que, Indianapolis, 2001.

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[9] Čičin-Šain, M., Crković-Stumpf, B., Uroda, I.: *Research on the influence of human factor on developing the ICT by using theSpearman's coefficient of correlation,* microCAD, Miskolc, 2006.

[2] Čerić, V., Varga, M.: *Informacijska tehnologija u poslovanju*, Element, Zagreb, 2004.

[3] Čičin-Šain, M., Crković-Stumpf, B., Uroda, I.: *Research on the influence of human factor on developing the ICT by using the Spearman's coefficient of correlation*, microCAD, Miskolc, 2006.

[4] Langer, M.: *Microsoft Excel 2003 za Windows*, MIŠ d.o.o. Zagreb, 2004.

[5] Polimeni, R.S.: Handy, S.A.: Cashin, J.A.: *Troškovno računovodstvo,* Faber&Zgombić, Zagreb, 1999.

[6] Reisner, T.: *Vodić kroz Excel for Windows 95*, Znak, Zagreb, 1995.

[7] Samuelson, P.A., Nordhaus, W.D.: *Ekonomija,* četvrto izdanje, MATE, Zagreb, 1992.

[8] Sengupta, C.: *Financial Modeling Using Excel and VBA*, www.amazon.com

[9] Šutalo, I., Leko, V., Grubišić, N.: *Financijski management u praksi*, Masmedia, Zagreb, 1994.

[10] Walkenbach, B. *Excel 2002 – Biblija*, Mikro knjiga, Zagreb, 2002.