Model of Support for Decision-making for Project Selection, Having the Maximization of the EBIT Index as Criterion

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Abstract

Propelled by an increasing competitive condition, a great number of companies is changing the way to measure their development. Companies' indicators should not be restricted to financial indices, but they should accept the need of a constant alignment and integration among financial and non-financial indicators, also causing an integration to happen among all departments. The use of the system to measure indicators in order to manage the development of organizations presents some limitations, such as the managers' difficulty to relate process indicators with financial indicators. Another issue is the abundance of indicators that prevent the managers from making right decisions regarding which projects and investments must be prioritized in order for the organization to be able to improve the established performance. In this way, this study focuses on the development of a mathematical model aiming at the maximization of the EBIT index, based on the inter-relationship and hierarchy among the metrics that supply a more balanced vision, allowing managers to visualize the best decisions regarding the improvement and investment projects. It also enables a better result for the organization, having the maximization of the financial EBIT index as criterion.

Keywords: Development indicators. Metric hierarchy. Metric integration. Linear programming. Indicators. Indices. EBIT. EBITDA.

Introduction

At the age of global competitiveness, where changes occur at an unprecedented pace, the great challenge of organizations is focused on the capacity of searching for new technologies, new markets and management methods of business processes.

In face of this condition, the market imposes on entrepreneurs and executives the need to prepare with managerial instruments, techniques and decision-making methods in good time and with minimal possibilities of error (FISCHMANN E ZILBER, 2000).

Therefore, the importance of performance indicators is verified as instruments capable of assisting in the development of business strategies, setting goals and expectations for the organizations. Subsequently, they allow verification of the property with which the decisions were made.

As every private company aims at gaining profit, the decision-making process based on systems of performance indicators requires managers from financial and operational areas to understand the impact that each indicator may have on coorporate finances. Managers who wish to be successful cannot be based anymore only on indicators and investments of their

area to the detriment of the others, nor use managerial intuition to make decisions. Therefore, they need a set of balanced indicators made of financial and non-financial indices that assists them in making the best decisions to hone organizational performance.

Before this complexity, decision-making is a very relevant process for contemporary business executives because it must guarantee that the strategies of the organization are being followed and their objectives met. In this sense, the increase of the complexity and quantity of data available for decision-making make the use of instruments that assist in this process necessary.

The optimization processes aim to offer a representation of the real world, with the objective of allowing the generation of an alternative, which will be considered great, according to the criterion established by the analyist (ANDRADE, 2002).

In this way, this study aims to contribute with relating the EBIT / EBITIDA financial indices with their operational indicators through a model of metric hierarchy, and from there develop an optimizing mathematical model in order to enable the creation of scenarios that lead to better investment options in the organization's operational area, having the maximization of the EBIT index as criterion.

EBIT – Earning Before Interest and Taxes, according to Marques et al. (2008), corresponds to a profit measure connected more to the result of operational nature, which does not include financial result, dividends or interest over own capital, result of equity equivalence and other non-operational results. This index aims at which is the accounting profit starting from the activities strictly connected to the business.

EBITDA – Earning Before Interest, Taxes, Depreciation and Amortization, corresponds to the profit before Interest, Taxes, Depreciation and Amortization. This measure consists of EBIT, not taking into consideration the effects of the provisions of tangible assets depreciation and intangible assets amortization that had previously been deducted as expenses from the period in the result demonstration.

Therefore, the proposed model shall maximize EBIT, since the investment projects directly bring the values related to depreciation and amortization with them. EBITDA is a measure approximated to the business' cash flow potential, and it does not correspond to the effective physical cash flow. Analyzing EBITDA individually may bring the risk of a mistaken interpretation of the real financial situation of the company as a consequence.

The proposed model was applied to a multinational, with 20,000 collaborators operating in several countries, of which 1,100 are in Brazil. The application of the proposed model happened at a branch in the ABC region, in Grande São Paulo, which is from the automobile sector, with an industrial area of 2,500 square meters, 400 employees and annual turnover of approximately 100 million dollars. It stands out in the global context as a supplier of components for all automakers based in Brazil, including light and heavy vehicles.

Analysis of investment alternatives

Investment projects

In order to improve productive capacity and keep cash flow growth, the matrix reviews the need to carry out investments in fixed assets at their branches.

At the beginning of the second semester, the matrix asks its branches to begin the investment analysis process (CAPEX) for the following fiscal year.

From this moment on, the plant's director requests all its managers (logistics, maintenance, quality, product and process engineering) to make investment proposals for the following year. The development of the proposals in case there is need of investment is carried out individually by the managers with their teams, which are usually proposed bound

to the needs of their respective areas and operational indicators of interest. The economic viability is seen by the managers through the gain and impact it produces on strictly operational and local indicators, not taking into consideration whether there will be a global effective gain, as well as their expenses and depreciations in the financial indicators of the organization. The top management of the group suggests strategic investments of high value.

The investment proposals developed by the managers are sent to the department called OPEX (Operational Excellence), where the projects are consolidated with their respective investments, gains and impacted operational indicators, thus being forwarded to the branch director.

Regarding the method of evaluation used by the company to assess its investments, a meeting among the director and managers is held where each of the managers presents the projects with gains and justifications, which are based on the present needs of each area and operational indicators. At this stage, the gains and investments of each project are never verified in order to reflex the EBIT index, considered to be the financial index to measure operational performance. Based on the biggest gains and impacts on operational indicators, the managers choose alongside the board of directors the projects that will make the portfolio of proposed projects (CAPEX) for the following fiscal year. For all projects, the ascertainment of gains and investment is carried out, as well as the payback. The selected projects with all information about investments and gains are sent to the financial department in order to perform projections of future results. The main index presented at this stage of analysis is EBIT.

Before this context, a model is needed which considers the analysis of all proposed investments, except for preferences and/or individual interests from each manager or department, where a better proposal that maximizes the EBIT index of the company may be found.

As result of all projects proposed by managers of each area, a list is generated for a better understanding, shown in Table 1, which corresponds to the real situation lived by the company in 2011.

Table 1 presents the information from each project with its respective investments, life cycle for depreciation calculation, and considerations for gain calculation. Finally, in the last two columns, there is the operational indicator, which suffers impact with the project and the monthly depreciation value derived from the invested value and the equipment's life cycle. This data was used in the application of the developed model. The portfolio of projects proposed by the company's managers (CAPEX) amounts to R$ 13,275,000.00 with 22 projects.

Table 1 – Investment projects proposed by managers

#	Projects	Investment (R$)	Asset's life cycle (years)	Considerations for reduction calculation	Impacted indicator	Monthly depreciation
1	Metal remelt	2,500,000.00	9	85% reutilization of aluminum scraps coming from machining	Direct raw material - Aluminum	23,148.15
2	Metal remelt	1,700,000.00	10	80% reutilization of aluminum scraps originated by machining	Direct raw material - Aluminum	14,166.67
3	Weight reduction of blank	3,000,000.00	3	4% reduction of aluminum consumption	Direct raw material - Aluminum	83,333.33
4	Water consumption	65,000.00	10	8% reduction of water expense because one part will come from artesian well	Utilities - Water	541.67
5	Energy consumption	450,000.00	10	10% reduction of average expense of energy	Utilities – Energy	3,750.00
6	Gas consumption	370,000.00	10	15% reduction of gas consumption	Utilities – gas	3,083.33
7	Sprays for painting system	300,000.00	5	20% reduction of liquid paint consumption	Direct raw material – liquid paint	5,000.00

8	Sprays for paining system (Airless)	195,000.00	4	12% reduction of liquid paint consumption	Direct raw material – liquid paint	4,062.50
9	Packaging automation	350,000.00	10	1 operator = 2,800/month – total reduction of 5 operators	Workforce	2,916,67
10	Packaging automation	255,000.00	10	1 operator = 2,800/month – total reduction of 3 operators	Workforce	2,125.00
11	Robot for painting line	250,000.00	10	Total reduction of 3 operators (1 operator = 2,800/month)	Workforce	2,083,33
12	X-Ray automation	50,000.00	10	Total reduction of 3 operators (1 operator = 3,200/month)	Workforce	416,67
13	Robot for pre-treatment loading	120,000.00	10	Total reduction of 3 operators (1 operator = 2,800/month)	Workforce	1,000.00
14	Oil consumption	250,000.00	10	35% reduction of oil consumption	Indirect materials – oil for machines	2,083.33
15	Automatic press (casting)	500,000.00	10	Total reduction of 3 operators (1 operator = 2,800/month)	Workforce	4,166.67
16	Robot for pre-treatment loading (machining)	100,000.00	10	Total reduction of 3 operators (1 operator = 2,800/month)	Workforce	833.33
17	Reutilization of powder paint	55,000.00	5	8% reduction of paint consumption	Direct raw material – powder paint	916.67
18	Equipment for measuring (machining)	520,000.00	5	Scrap reduction in machining department from 4% to 2% - average scrap cost R$ 50,000.00	Scrap	8,666.67
19	Optimizing transport	400,000.00	4	20% reduction of shipping cost	Shipping	8,333.33
20	Reducing rework	970,000.00	7	Reduction in the rework indicator from 15% to 8%	Rework	11,547.62
21	Reducing packaging material	540,000.00	7	10% reduction of input consumption for parts packaging	Indirect material – packaging	6,428.57
22	Reducing cooling fluid	335,000.00	5	80% reduction of cooling fluid consumption	Indirect material – cooling fluid	5,583.33

Proposed model

The mathematical model proposed is a model of linear programming. It considers the structure of metric hierarchy, all investment alternatives of each project, and the characterization of excluding projects, that is to say projects with the same objective that among all, only one can be implemented with the goal of maximizing the EBIT index.

The selection of projects that must be implemented to maximize EBIT is supplied by the model through a binary variable (Pj) associated with each project and if:

$P_J = 1$, the project must be selected;

$P_J = 0$, the project must not be selected.

The Objective Function of the proposed model is:

$$\text{Max } Z = \text{Rec} - \sum_{j=1}^{n} (D_J - R_{J*} P_J) - DO - DC - \sum_{j=1}^{n} \frac{F_J * P_J}{V_J} \quad (1)$$

Liable to the following restrictions:

$$\sum_{j=1}^{n} F_J * P_J \leq \text{Disp} \quad (2)$$

The evaluated situation presents four excluding projects (P_1 e P_2; P_7 e P_8), which are treated as:

$P_1 + P_2 = 1$; (3)

$P_7 + P_8 = 1$; (4)

Where:

Z: EBIT index to be maximized;
Rec: net income of the fiscal period;
$D_{J:}$ present expense related to the project;
$R_{J:}$ cost reduction that the project provides;
DO: operational expenses;
DC: current depreciation;
$F_{J:}$ value of the investment of the chosen project 'j';
$V_{J:}$ life cycle of the selected project;
$P_{J:}$ binary variable associated with the project 'j';
n: number of projects under evaluation;
Disp: Available resource (R$) for investment.

Application of the model to an automobile parts maker

The proposed model was applied to evaluate different scenarios in order to demonstrate its efficiency and potential as a decision-making tool.

Company's condition prior to investments

The company presents in the financial statement, shown in Table 2, negative net operating profit (EBIT) with a value of R$ 679,851.67, that is to say, -5.67%. This value is influenced by the current depreciation that the company has in the amount of R$ 350,000.00, due to investments made in assets. Total expenses (operational expenses and cost of products sold) total R$ 12,329,851.67, higher than net incomes at the same period in the amount of R$ 12,000,000.00.

A good part of the expenses, about 80%, concentrates in variable costs of products sold. In these costs, all operational expenses are considered to manufacture the product, such as utilities (electric power, water and gas), direct and indirect raw material and workforce used for production.

Operational expenses in the amount of R$ 2,696,300.00 are related to the indirect workforce and factory support personnel, and expenses with the sales department and others.

However, as previously mentioned, EBITDA regards the result before financial expenses, taxes, depreciation and amortizations. Therefore, it always presents a higher value than EBIT, in a negative amount of R$ 329,851.67, that is to say -2.75%.

In these negative EBIT and EBITDA conditions, it means that the company is not generating operating profit through its main activity.

Table 2 - Statement of the result in present scenario

Statement of the result	
Operating net income	12,000,000.00
(-) Cost of the products sold	9,633,551.67
(=) Gross profit	2,366,448.33

(-) Operating expenses	2,696,300.00
(-) Depreciation and amortization (new projects)	
(-) Depreciation and amortization (current)	350,000.00
EBIT (R$)	-679,851.67
EBIT (%)	-5.67%
(+) Depreciation and amortization (total)	350,000.00
(=) EBITDA (R$)	-329,851.67
(=) EBITDA (%)	-2.75%

Scenario 1

In Scenario 1, a situation is simulated in which demand seems stable by using the proposed model. The inputs are not readjusted and the company makes R$ 5,000,000.00 available for the branch, which is our company under study, for CAPEX investment. In this scenario, the company would consider the projects presented in Table 1 as investment alternatives. The proposed model should select the best projects that meet the threshold of available CAPEX, obtaining maximum EBIT. The objective of this scenario is to verify the model's behavior for an intermediate situation of financial resources availability.

Results obtained in Scenario 1

The company would present a negative EBIT in the amount of R$ 69,553.49 (- 0.58%). Taking into consideration the expenses and depreciation due to new investments, the total value was R$ 12,069,553.49, which is still superior to the incomes from the same fiscal period, keeping EBIT negative. Table 3 shows the statement of the result suggested by the proposed model.

Table 3 – Statement of the result in Scenario 1

Statement of the result	
Operating net income	12,000,000.00
(-) Cost of the products sold	8,964,372.53
(=) Gross profit	3,035,627.47
(-) Operating expenses	2,696,300.00
(-) Depreciation and amortization (new projects)	58,880.95
(-) Depreciation and amortization (current)	350,000.00
EBIT (R$)	-69,553.49
EBIT (%)	-0.58%
(+) Depreciation and amortization (total)	408,880.95
(=) EBITDA (R$)	339,327.47
(=) EBITDA (%)	2.83%

Scenario 1 would bring a reduction in the costs of sold products in the amount of R$ 669,179.14 and an increment in depreciation of R$ 58,880.95. The company would still maintain – 0.58% negative EBIT, but with a significant improvement.

The proposed model selected 16 project among the 22 presented in Table 1 – projects 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, and 22, which total R$ 4,840,000.00. The projects selected by the model would impact on the reduction of expenses in the indicators of rework, utilities, direct and indirect raw material, and workforce.

A question to be considered is the fact that the model maximizes EBIT by using a value of R$ 4,840,000.00, that is to say there would be R$ 160,000.00 remaining from the

CAPEX total available, which could be investments in other branches or improve the conditions of this own branch.

Scenario 2

Scenario 2 represents the decision over which projects to select, according to the managerial model when making decisions about the portfolio of projects (CAPEX) from the company under study. Then, it was subdivided into 3 scenarios – 2A, 2B, and 2C. As for Scenario 1, the projects were selected for all scenarios so that they would not exceed the R$ 5,000,000.00 from CAPEX provided by the company's matrix.

The scenarios developed by the authors based on the managerial model when making decisions about CAPEX of the company under study were:

Scenario 2A – Only three projects with high investment and return were selected. One of the decisions to select these projects was that two of them are indicators of direct raw material related to aluminum, which represents about 40% of the company's total costs. The other project refers to direct raw material related to the consumption of liquid paint. The monthly depreciation of these three was calculated in the amount of R$ 102,500.00, much higher in relation with the scenario of the proposed model and which is not result of the analysis by the managers at the moment of decision of the projects.

Scenario 2B – Six projects were selected, superior to Scenario 2A. The approach with the indicators was wider, however it is still the project that has impact on the aluminum indicator and with highest investment (R$ 2,500,000.00). In the managerial view, aluminum is a concerning factor due to expenses and, consequently, more attractive to receive investments that contemplate its reduction. Other indicators were considered, such as utilities (water), scrap, rework and indirect materials of packaging. Scrap and rework are considered to be worrisome, because they affect productivity indicators and are reported daily to the matrix. This fact also generates emphasis for the managers in the sense of the need to obtain reductions in both indicators. Based on these decisions, the monthly depreciation was R$ 58,666.01.

Scenario 2C – In this scenario, 15 projects were selected contemplating all the range of indicators and with low investment. One of the indicators that was highlighted in this scenario was workforce, contemplating seven projects. One of the characteristics for this kind of decision is due to the fact that the company wants to increase its productivity through workforce reduction projects and which will not necessarily improve the EBIT index. The monthly depreciation was R$ 56,809.52.

Table 4 shows the projects selected by the defined scenarios. Each project's details, such as application, necessary investment (R$), life cycle (years), considerations for the reduction calculation, indicator of impact, and monthly depreciation can be found in Table 1:

Table 4 – Projects selected according to the company's managerial model

Scenarios	Selected Projects
2A	2, 3, and 7
2B	1, 4, 18, 19, 20, and 21
2C	4, 5, 6, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, and 21

Comparison among the results obtained in Scenarios 1, 2A, 2B, and 2C

The results obtained from using the proposed model would generate a better result in terms of EBIT, compared to the results obtained from the company's managerial model. This shows the model's effectiveness before decisions made subjectively and without visibility of impacts in the other indicators and financial indices.

Table 5 shows the results from all scenarios – the company's situation before the investments, Scenario 1 (proposed by the model) and Scenarios 2A, 2B, and 2C developed according to the decision-making managerial model over the company's investments.

The results presented in Table 5 highlight that the proposed model was indeed the one that obtained the best result in the EBIT index, with operating loss of R$ 69,553.49 (-0.58%), having as a premise the authorization to invest at most R$ 5,000,000.00.

Table 5 – Results obtained in each developed scenario

	Before investments	Scenario 1	Scenario 2A	Scenario 2B	Scenario 2C
Operating income	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
Cost of the products	9,633,551.67	8,964,372.53	9,292,530.14	9,250,437.15	9,065,649.46
Gross profit	2,366,448.33	3,035,627.47	2,707,469.86	2,749,562.85	2,934,350.54
Operating expenses	2,696,300.00	2,696,300.00	2,696,300.00	2,696,300.00	2,696,300.00
Depreciation and amortization (new)		58,880,95	102,500.00	58,666.01	56,809.52
Depreciation and amortization (present)	350,000.00	350,000.00	350,000.00	350,000.00	350,000.00
EBIT (R$)	(679,851.67)	(69.553,49)	(441,330.14)	(355,403.16)	(168,748.98)
EBIT (%)	-5.67	-0.58	-3.68	-2.96	-1.41
EBITDA (R$)	(329,851.67)	339,327.47	11,169.86	53,262.85	238,050.54
EBITDA (%)	-2.75	2.83	0.09	0.44	1,98

Conclusions and final considerations

Several other scenarios were developed and analyzed, varying the available capital and some restrictions of subjective order. The proposed model obtained significantly better results for the company in all of them, even leading to the attainment of a positive EBIT with smaller investments than if the culture of decision used by the company were applied.

The EBIT index proved to be more appropriate in relation with the EBITDA index because it considers the depreciation values in investment projects. Moreover, EBITDA disregards the invested values, repeatedly showing the false vision that the generated operating profit is a result only of improvements without investment.

The scenarios were developed from information from the result of the company under study and the application of the proposed model. In order to maximize the index, sales were considered to be constant and gains and losses were not generated with the inflation.

In the developed scenarios, including those not presented in this study, the following availability of resources were considered to be invested – R$ 5,000,000.00, R$ 6,300,000.00, and R$ 11,000,000.00 for a portfolio of project of R$ 13,275,000.00. The results obtained with the model were better in all developed scenarios, considering the available resource and the models of managerial decisions adopted by the company.

In the scenarios that R$ 11,000,000.00 were considered to be available, the proposed

model selected projects that led the company to obtain a positive EBIT, which did not happen with the managerial model used by the company. In these scenarios, the effectiveness of the model to treat excluding projects can also be evaluated.

The proposed model may help the company's managers to understand the relation between the operational indicators and the financial EBIT indicator, and also the impacts on investments in projects. It may also assist in consensus decision-making, guided by an index and which eliminates the paradigms that companies maintain regarding decisions made for investments, discarding the decisions based on departmental interests and cultural habits, always prioritizing the indicators.

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