

# BREAK-EVEN IN THE DECISION MAKING PROCESS

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## Abstract

*Integrated in a competitive environment, the companies are forced to know better their costs, to determine as precisely as possible the sales prices and the profit margins achievable per product. When the entrepreneurs initiate a new business, invest in a new project or when they supervise the current work, the study of breakeven allows minimizing of the risks and the uncertainties, and also allows measuring the performance of the projects.*

*Break-Even is an indicator that allows the company management to set minimal commercial targets to meet the expenses of the enterprise or that sets the degree of utilization of production capacities in relation to a desired level of profit.*

*It highlights the correlations between the dynamic of production, implicit of income and the dynamic of costs, grouped into variable costs and fixed costs. Used in a prospective fashion, Break-Even allows planning and optimizing of the enterprise's sales and costs, not only short-term but also medium and long term.*

**Keywords:** *break-even, costs, turnover, profit, decision.*

## 1. Introduction

This paper identifies a simple and effective method of analysis which helps entrepreneurs in planning and optimization of sales and costs, and therefore profits, in the context of an environment governed by the uncertainties and risks.

The study develops the concepts and shows the importance of the break-even analysis in sizing the volume at which production becomes profitable, highlighting the correlation between revenues and costs, or in determining the degree of utilization of production capacities in relation to a desired level of profit.

Break-even analysis is a way to quickly answer a number of important questions about the profitability of a company's products or services. Break-even analysis can be used with either a product or service.

The first part presents the concepts and usefulness of specific indicators. In the second part of the paper, we present case studies with presentation and interpretation of results.

The subject approached in our work was the object of numerous research reflected in academic articles, in professional journals, in accounting and management control books. Existing studies support our demarche and are summarized in the specialized literature section.

## 2. Break-even analysis - tool in making management decisions

Economic sense is an essential element for success in business, but to lead a company only after

flair is certainly a risky act. Any decision, regardless of the extent of its implications, involves accepting risk. Leading an enterprise through decisions involves continuous risk taking. The management accounting and cost calculation becomes useful in decision making because it provides the opportunity to distinguish profitable from the unprofitable activity.

Integrated in a competitive environment with a multitude of products and production processes, enterprises have felt the need to know very well its costs to determine as precisely as possible selling price and profit on each product.

Management accounting is the one that opens the "black box". It shows the stages in the transformation of inputs into outputs.

### 2.1. Specific indicators break-even analysis. Concepts and utility

Break-even analysis is used to give answers to question such as "what is the minimum level of sales that ensure the company will not experience loss" or "how much care sales be decreased and the company still continues to be profitable".

Break-even analysis is extremely important before starting a new business (or launching a new product) because it gives answers to crucial questions such as "how sensitive is the profit of the business to decreases in sales or increases in costs". This analysis can be also extended to early stage business in order to determine how accurate the first prediction was and monitor whether the firm is on the right path or not. Even mature business must take into consideration their current break-even point and find ways to lower that benchmark in order to increase profit.

Owners and managers are constantly faced with decisions about selling prices and cost control. Break-

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even analysis is the analysis of the level of sales at which a company or a project would make zero profit. As its name implies, this approach determines the sales needed to break-even. Break-even analysis can be very useful in following practical situations:

- at starting a new activity;
- when introducing new products into production, in which case can be determined the turnover for the new product;
- with expanding general level of activity of the company;
- when making projects in fixed assets (modernization or automation).

We can use break-even analysis to answer the above questions from a pure cost and profit perspective and when marketing departments are considering strategies that involve the granting of discounts or conduct promotional campaigns. Next question often arises: "Should we offer a discount?" The answer to this question is far beyond simple and straightforward. It involves the examination of many factors such as the competition, the elasticity of demand etc. If the discount offer is made with a final objective to increase profit through an increase in sales volume caution should be exercised on the fact that the expected increase in sale (incremental sales) will be adequate to make up for the "lost" profit from the discount offer.

Break-even analysis is based on categorizing production costs between those which are variable and those which are fixed.

**Variable cost** consists only of variable expenses delineated in each product, whether direct or indirect, costs that vary depending on the volume business activity without necessarily exists proportionality between costs and changes in production volume variance.

In contrast, **fixed costs** are considered period costs that are borne regardless of production volume and they refer to the full capacity of the company to produce and sell, reflecting entirely in annual profit. Taking into account the fixed costs it is considered to approximate the full costs of the actual values.

The temptation to explore information (cost; result) leads to the study of cost-volume-profit relation.

The cost-volume-profit relation is, in fact, a model for predicting the outcome, which highlights the correlations between the factors that may influence the profits of an enterprise. It involves three elements:

- Cost - the cost of making the product or providing a service
- Volume - the number of units of products produced or hours/units of service delivered
- Profit - Selling Price of product / service - Cost to make product / provide service = Operating Profit

The first two items are information available to business managers, about their own business, products and services. This type of information is not generally available to those outside the business. They constitute important operating information that can help

managers assess past performance, plan for the future, and monitor current progress. As for the third item, a business can't stay in business very long without profits.

Based on the distinction between variable costs and fixed costs, break-even analysis is a useful instrument for decision. Using break-even analysis we can analyze a single product, a group of products, or evaluate the entire business as a whole.

Specific indicators (break-even point, the coverage factor, factor of safety and confidence interval) are used to reveal different aspects of profitability or unprofitability. Each of these indicators has clear meanings and ability to suggest various ways to improve the business.

**2.1.1. The Break-Even Point** is the sales volume that enables a zero profit. At this critical point total sale equals total expenses (fixed and variable) of the company. When sales are below the break-even point a company is operating at a loss; above the break-even point they will be operating at a profit.

Mathematically, the break-even point ( $Pe$ ) is calculated as the ratio between fixed costs ( $CF$ ) and unit contribution margin ( $cb_u$ ):

$$Pe = \frac{CF}{cb_u}$$

The unit contribution margin is the difference between the selling price ( $pv$ ) and variable costs ( $cv$ ):

$$cb_u = pv - cv$$

If the enterprise gets a mix of products, the break-even is calculated based on the medium contribution margin. This contribution is the ratio between global contribution margin ( $CB$ ) and the amount of product ( $i$ ) manufactured and sold ( $qv_i$ ):

$$cb_u = \frac{CB}{\sum qv_i}$$

**2.1.2. The coverage factor** ( $Fa$ ). This indicator provides information about the product or products that have the highest capacity to absorb fixed costs and make a profit. Production and sale policy will focus on products with the highest coverage factor, permitting optimization of the production and sale program.

The coverage factor can be calculated for each product or global, with the following formulas:

a) For each product:

$$Fa_i = CB_i / CA_i * 100$$

$CB_i$  = the global contribution margin for the product  $i$

$CA_i$  = turnover for the product  $i$

b) Global:

$$Fa = CB / CA * 100$$

or

$$Fa = CF / CA * 100$$

$CB$  = the global contribution margin for the entire production manufactured and sold;

CA = turnover for the entire production manufactured and sold

CA\* = critical turnover, i.e. break-even sales value

**2.1.3. The Dynamic safety coefficient (Ks)** indicates how much sales can fall to reach the balance point and not get into the losses. There are three formulas for calculating this coefficient:

a)  $Ks = 100 * (CA - CA^*) / CA$

CA = sales value

CA\* = critical turnover, i.e. break-even sales value

b)  $Ks = R / CB * 100$

R = profit

CB = global contribution margin for the entire production manufactured and sold

c)  $Ks = 100\% - g$

100% = the maximum activity level

g = degree of activity in the break-even point

**2.1.4. The range of safety or the margin of safety (Is)** allows calculating the influence of the reduction in sales volume on the result. It is the excess of expected future sales above the break-even point, in other words it indicates how much sales volume can be reduced without risk of incurring losses.

$$Is = CA - CA^*$$

CA = expected future sales

CA\* = sales at break-even point.

Statistical studies indicate the following situations:

- unstable situation, if CA is increased by up to 10% than CA\*
- relatively stable situation, if CA is increased by up to 20% than CA\*
- comfortable situation, if CA exceeds more than 20% CA\*

## 2.2 The calculation of specific indicators of cost-volume-profit relation. Break-even analysis - Case study

The company S.C. Silvarom S.A. has the aim to create furniture. The company manufactures and sells three products, A, B, C. Using the information in the table below will analyze indicators expressing the cost - volume - profit relation.

Explanation	Product
	<b>A</b>
1. Quantity produced and sold (q <sub>v</sub> )	10.000
2. Unit selling price (p <sub>v<sub>u</sub></sub> )	1.000
3. Total variable costs (CV <sub>T</sub> )	6.500.000
4. Fixed costs	
Turnover (CA)	10.000.000
Unit variable cost (c <sub>v<sub>u</sub></sub> )	650

Unit contribution margin (cb <sub>u</sub> )	350
Global contribution margin (CB)	3.500.000
Financial result (R)	

Explanation	Product
	<b>B</b>
1. Quantity produced and sold (q <sub>v</sub> )	7.000
2. Unit selling price (p <sub>v<sub>u</sub></sub> )	3.000
3. Total variable costs (CV <sub>T</sub> )	22.505.000
4. Fixed costs	
Turnover (CA)	21.000.000
Unit variable cost (c <sub>v<sub>u</sub></sub> )	3.215
Unit contribution margin (cb <sub>u</sub> )	-215
Global contribution margin (CB)	-1.505.000
Financial result (R)	

Explanation	Product
	<b>C</b>
1. Quantity produced and sold (q <sub>v</sub> )	9.000
2. Unit selling price (p <sub>v<sub>u</sub></sub> )	4.000
3. Total variable costs (CV <sub>T</sub> )	27.500.000
4. Fixed costs	
Turnover (CA)	36.000.000
Unit variable cost (c <sub>v<sub>u</sub></sub> )	3.000
Unit contribution margin (cb <sub>u</sub> )	1.000
Global contribution margin (CB)	9.000.000
Financial result (R)	

Explanation	TOTAL
1. Quantity produced and sold (q <sub>v</sub> )	26.000
2. Unit selling price (p <sub>v<sub>u</sub></sub> )	
3. Total variable costs (CV <sub>T</sub> )	56.005.000
4. Fixed costs	8.000.000
Turnover (CA)	36.000.000
Unit variable cost (c <sub>v<sub>u</sub></sub> )	
Unit contribution margin (cb <sub>u</sub> )	
Global contribution margin (CB)	10.995.000
Financial result (R)	2.995.000

The calculation of the previous indicators:

$$\text{Turnover (CA)} = q_v * pv_u$$

$$CA_A = 10.000 * 1.000 = 10.000.000 \text{ lei}$$

$$CA_B = 7.000 * 3.000 = 21.000.000 \text{ lei}$$

$$CA_C = 9.000 * 4.000 = 36.000.000 \text{ lei}$$

$$\text{Unit contribution margin } cb_u = pv_u - cv_u$$

$$cb_u = 1.000 - 650 = 350 \text{ lei}$$

$$cb_u = 3.000 - 3.215 = -215 \text{ lei}$$

$$cb_u = 4.000 - 3.000 = 1.000 \text{ lei}$$

$$\text{Unit variable cost (cvu)} = CVT/qv$$

$$cvu = 6.500.000/10.000 = 650 \text{ lei}$$

$$cvu = 22.505.000/7.000 = 3.215 \text{ lei}$$

$$cvu = 27.000.000/9.000 = 3.000 \text{ lei}$$

$$\text{Global contribution margin CB} =$$

$$cb_u * qv$$

$$CB = 350 * 10.000 = 3.500.000 \text{ lei}$$

$$CB = -215 * 7.000 = -1.505.000 \text{ lei}$$

$$CB = 1.000 * 9.000 = 9.000.000 \text{ lei}$$

$$\text{Financial result} = \text{Turnover (CA)} - \text{Total variable costs (CV}_T) - \text{Fixed costs} = 2.995.000 \text{ lei}$$

After analyzing the primary indicators, we can make the following considerations:

The overall activity of the enterprise is profitable, it releasing a positive result (profit) in the absolute amount of 2.995 million lei;

Product A and C are profitable, each having a positive unit contribution margin, 350 lei/unit for A, 1000 lei/unit for C; they have the ability to cover fixed costs and to develop a profit to pay part of the fixed costs not covered by the product unprofitable B; the product B has a negative unit contribution margin (-215 lei/unit), the selling price (3000 lei/unit) cannot cover the unit cost (3215 lei/unit).

Following improve profitability, the company may decide to abandon the manufacture of B if it is found that there is no demand for this product and its production is not economically justified; otherwise, keep the factory and try to recoup by increasing price or reducing costs by reviewing the variable costs that compose it.

**Case 1. The enterprise produces and sells a single product, A, thus:**

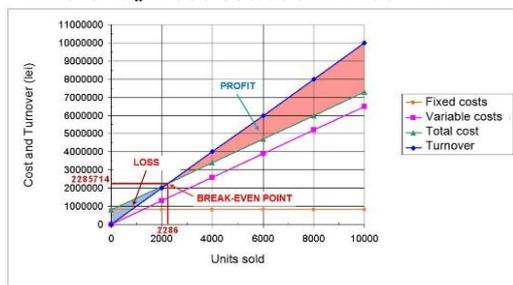
**Break-even point:**

$$Pr = CF/cb_u$$

- Fixed costs (CF) = 800.000 lei
- Unit variable costs (cv) = 650 lei
- Unit selling price (pv) = 1.000 lei
- Quantity produced and sold = 10.000 unit

$$cb_u = pv - cv = 1.000 - 650 = 350 \text{ lei}$$

$$Pr = CF/cb_u = 800.000/350 = 2.286 \text{ unit.}$$



The company must produce and sell 2.286 units to fully cover variable costs and fixed costs, so that both profit and loss are equal to zero. Any unit of product manufactured and sold over this amount will make a profit of 350 lei as unsold or not manufactured any unit involves a loss of 350 lei.

$$CA^* = CF / RC = 800.000 / 0,35 = 2.285.714 \text{ lei}$$

$$RC = CB / CA * 100 = 3.500.000 / 10.000.000 * 100 = 35\%$$

The company's activity has evolved a factor of coverage of 35% coverage, which provides coverage of fixed costs and make a profit.

To calculate the break-even point using graphical method is drawn diagram CPV.

OX axis is the quantity produced and sold and OY axis is the cost and turnover.

The break-even point corresponds to a quantity of 2.286 units produced and sold and to a turnover of 2.285.714 lei. In the red area is the profit, the blue area is the loss.

Note that as the quantity produced increases, the share of fixed expense per unit will be lower, since the total fixed costs, maintaining the same level, without being influenced by the volume of production, will be distributed to a larger number of products. This leads to lower costs of production and increase profits.

**Case 2. The enterprise produces and sells a mix of products (A, B, C)**

**The break-even point:**

*The unit margin contribution is:*

$$cb_u = CB / \sum qv_i = 10.995.000 / (10.000 + 7.000 + 9.000) = 423 \text{ lei/unit.}$$

$$Pr = CF/cb_u = 8.000.000 / 423 = 18.912 \text{ unit.}$$

The company must produce and sell 18.912 units to cover all expenses through revenues and to obtain zero profit.

Have known the weight of each product:

$$g_i = qv_i / \sum qv_i$$

$$g_A = 10.000 / 26.000 = 0,38;$$

$$g_B = 7.000/26.000 = 0,26;$$

$$g_C = 9.000/26.000 = 0,35$$

*The break-even point for each product: Pr<sub>i</sub> = g<sub>i</sub>*

\* Pr

$$Pr_A = g_A * Pr = 0,38 * 18.912 = 7.187 \text{ unit}$$

$$Pr_B = g_B * Pr = 0,26 * 18.912 = 5.106 \text{ unit}$$

$$Pr_C = g_C * Pr = 0,35 * 18.912 = \underline{6.619 \text{ unit}}$$

18.912 unit

The critical turnover for 18.912 units is 48.750.761 lei, as follows:

$$RC = CB / CA * 100 = 10.995.000 / 67.000.000 * 100 = 16,41\%$$

$$CA^* = CF / Rc = 8.000.000 / 16,41\% = 48.750.761 \text{ lei}$$

**The coverage factor**

– For each product:

$$Fa_A = CB_A / CA_A * 100 = 3.500.000 / 10.000.000 * 100 = 35\%$$

$$Fa_B = CB_B / CA_B * 100 = -1.505.000 / 21.000.000 * 100 = -7,16\%$$

$$F_{AC} = CB_C / CA_C * 100 = 9.000.000 / 36.000.000 * 100 = 25\%$$

For profitable product A and C, the coverage factor is positive indicating their ability to support fixed costs and generate profit.

Critical analysis of the information obtained shows that A is the most profitable product, with a coverage factor of 35%, followed by the product C. For these products may decide to boost production and sale.

For product B, the selling price should be increased by 7,16% for cover its cost, or the cost should be decreased by 7,16%.

- The global coverage factor:

$$F_a = CB / CA * 100 = 10.995.000 / 67.000.000 * 100 = 16,41\%$$

$$F_a = CF / CA^* * 100 = 8.000.000 / 48.750.761 * 100 = 16,41\%$$

16.41 % of value of products produced and sold may cover fixed costs and provide profit. The amount of fixed costs and their share is required to be analyzed, for not having a wrong judgment.

The share of fixed costs in total sales is calculated as follows:

$$R_{CF} = CF / CA * 100 = 8.000.000 / 67.000.000 * 100 = 11,94\%$$

This means 11% of turnover is needed to cover all fixed costs, the remaining 4,47% (16.41% - 11.94%) represent potential profit. This information suggests that the production and sales ensure the profitability of the enterprise.

#### ***Dynamic safety coefficient***

$$K_s = (CA - CA^*) / CA * 100 = 67.000.000 - 48.750.761 / 67.000.000 * 100 = 27,23\%$$

The company can decrease sales by maximum 27.23% not to exceed the break-even point.

$$K_s = R / CB * 100 = 2.995.000 / 10.995.000 * 100 = 27,23\%$$

27,23% of the current activity generates a positive result.

#### ***The margin of safety***

$$I_s = CA - CA^* = 67.000.000 - 48.750.761 = 18.249.239 \text{ lei}$$

Sales may register a decrease of 18.249.239 lei to maintain profit.

The last two indicators assessed risk of becoming unprofitable. Negative values indicate losses. As these indicators have higher values, the risk is lower.

Some of the advantages of the break-even analysis are:

- allows to establish the size at which production becomes profitable
- determines the use of production capacity in

correlation with a desired level of profit

- allows to establish the production volume required to achieve a certain level of profit
- helps in studying the consequences of increasing sales or turnover
- highlights correlations between the dynamic of production respectively revenue and the dynamic of cost, grouped into variable costs and fixed costs

### **3. Conclusions**

In conclusion, the break-even point is one of the most important information of a business plan. Break-even is a very useful tool, especially when starting a new activity or a project to validate the realism of the project. It helps to reduce risk and uncertainty and to establish a minimum activity level required to avoid losing money.

The objective of the break-even analysis is to reduce uncertainty about the launch of a new project and the objective of the company is as break-even point to be as low as possible. This forces the company to study fixed costs and variable costs as well as turnover.

Also, when the company wants to invest in new machinery and high-tech, the breakeven analysis is recommended to assess the possibility of investing in these fixed assets or to estimate the results of an increase in production volume in relation to new production capacities.

However, a simplistic approach cannot justify a decision on a new project, even if the analysis would measure as accurately as possible the fixed costs and variable costs and would result in turnover depending on the market (selling prices in with respect to product quality). Break-even analysis is important for planning and optimizing sales and costs of the enterprise in the short, medium and long term in various sectors (manufacturing, commerce, services).

Break-even analysis is useful as a first step in developing financial applications, which can be use in invoicing and budgeting. The main purpose of this analysis is to have some idea of how much to sell, before a profit will be made.

The approach that the authors of this paper have done is theoretical and he recognizes the need for some case studies to understand the complexity of situations that involve the use of break-even analysis, could thus overcome the barrier between the academic discourse and the practice, which would be beneficial to both sides. Other lines of research could be identification of additional effective tools to help professionals in the consolidation of information necessary for making management decisions.

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