Global Facts

Cigar Box Method®

Manual for the use of CB1: Cost price calculation made easy!

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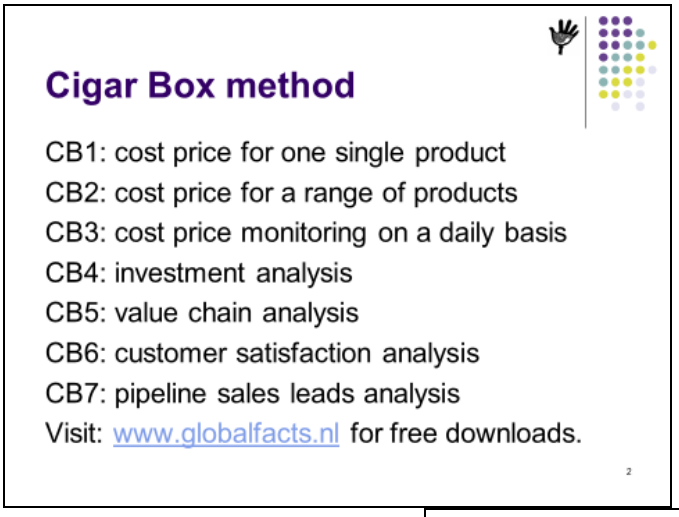
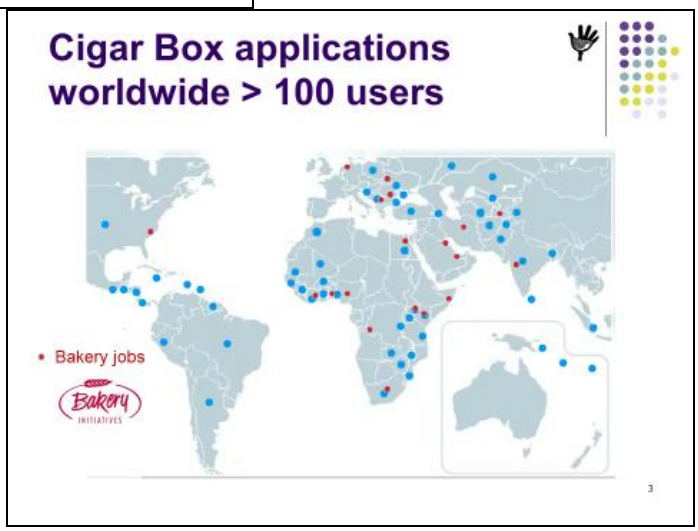




Contents of the Training module on CB1

Chapter 1 Introduction: About this Training module on CB1

Who should use this module?

- Entrepreneurs in production: (food) processing, manufacturing, handy-crafts.[1]
- Organizations working with these entrepreneurs.
- Students in business economics.

What will you learn?

- Which parameters and formulas are used for costing and pricing.
- How to obtain correct information.
- How to use this information to make professional cost price calculations using an Excel spreadsheet, called the Cigar Box.
- How to make a production and sales plan.

What is costing?

- Costing is the process of calculating all expenses required in producing and selling a product.

What is pricing?

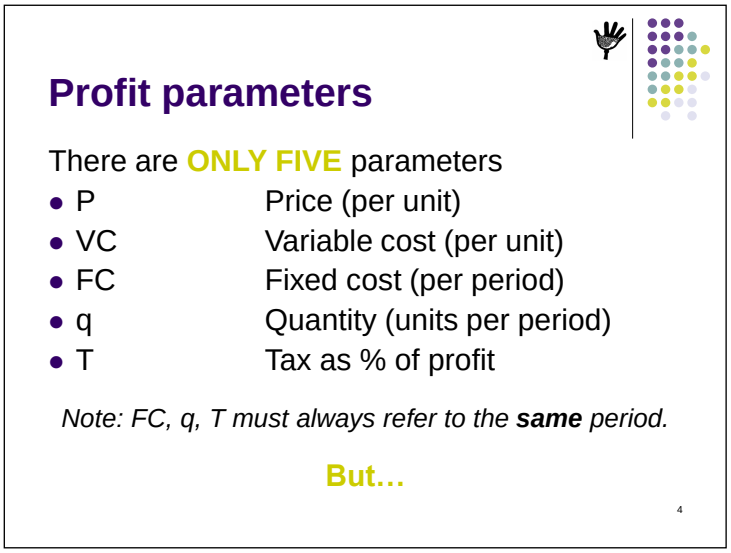
- Pricing is the process of determining the amount of money for which a product will sell in the market.

Why is this important?

- To cost and price products correctly means the difference between making a profit or losing money – between success, survival or failure. Costing and pricing are **skills** that are necessary to manage a business. They are used to develop sales and pricing terms, analyze a company's break-even point, and calculate business earnings.
- Calculating your costs accurately and setting an appropriate price for your products, will allow you to:
    - Cover your production costs
    - Sell in sufficient quantity to make a profit

[1] Though the principles of costing and pricing are universal, specially adapted modules exist for entrepreneurs in Farming and for those in Services.

Chapter 2 Profit parameters



It is international convention to write q - quantity in small letters. Capital Q stands for 'quality'. All other parameters are written in capital letters: P, VC, FC, T.

P (price) and **VC** (variable cost) are always expressed **per unit**. E.g. the price of bread per loaf, price of maize per bag, price of sugar per kg. The VC of a bottle of water is per bottle or per liter; VC of a leather bag is the cost per bag; etc.

FC (fixed cost), **q** (quantity) are always expressed **per period** of time. E.g. the rent per month, the salaries per week, road tax per year. The quantity sold by the company must always refer to the same period as the fixed cost. If the fixed cost are calculated per year, then the quantity sold must also be in units per year.

T (tax) refers to **profit tax**, not to the other taxes like social tax, road tax. The latter ones are all part of the fixed costs. Profit tax is a very important element of the decision making process of entrepreneurs and determines how much money is actually earned at the end of the year. However, the amount of profit tax actually paid is a fiscal, rather than an economic matter and is therefore not relevant in a module on costing and pricing. Profit Tax is not further discussed in this module.

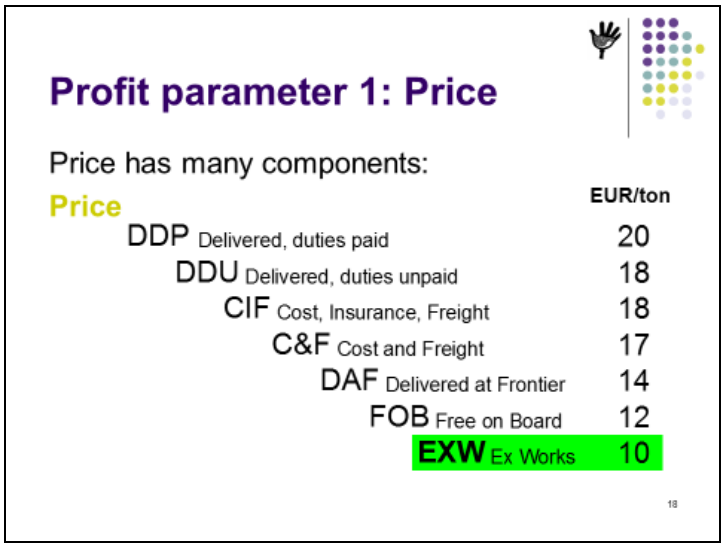
Consequently, there are only four profit parameters that will be discussed in this module. Although there are only four, each parameter has many **components**. Let's analyze this in the next paragraphs.

2.1. Price P

All costs and earnings are always calculated **without VAT** (value added tax). The VAT rates differ per country and per product category. VAT is calculated as a % markup on the net sales price. E.g. VAT is 20%; the net sales price is 100, then VAT = 20 and the sales price including VAT = 100 + 20 = 120. If prices are quoted with VAT, then the VAT must be deducted.

Sales price (incl. VAT) - VAT = Sales price (net)

An invoice reads: "The price is $18 per box, CIF Rotterdam". CIF is the delivery term and are called INCO-terms, these are standardized by the International Chamber of Commerce. This is further elaborated in ACCESS MODULE 13.



In profit calculations, we work only with **EXW price**, the Ex Works price. This is the net price we receive to pay the goods from the factory. All delivery costs have to be subtracted from the invoiced price to arrive at the Ex Works price.

Sales price (net) – VC4 Delivery cost = Ex works price

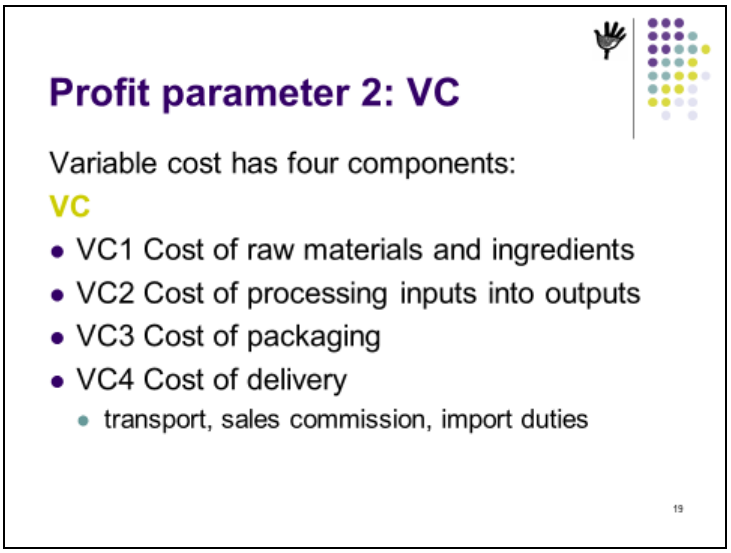
2.2. Variable cost of delivery VC4

Examples of VC4 delivery costs are:

- Transport to the client
- Handling charges
- Documents
- Insurance
- Distribution commission
- Sales commission

2.3. Variable cost of production VC

Variable cost are the expenses which have to be made to make the product. Variable cost varies with the quantity produced. If one unit costs 10, 2 units will cost 20, etc. If there is **no production**, then **VC = zero**.



In (food) processing, manufacturing and handicraft business, there are three types of variable costs: VC1, VC2 and VC3.

2.3.1 VC1

VC1 is every which is **consumed**. For food products this means 'eating'. For non-food products, like a leather bag, consumption means 'used'.

Food products; VC1 depends on the recipe, determined by a food technologist in the factory and it is usually checked by the laboratory. This is standard procedure. The main cost component is the raw material: the apple in the apple juice, the cucumber in the pickles, the tomato in the tomato paste. The minor components are the ingredients: sugar in the jam, salt in the ketchup, oil in the tinned fish, etc. See example 1 below (spicy curry sauce)

CB1 Calculation sheet for VC1 Food Products (cost of raw material and ingredients)								
Nbr	Input	Unit	price delivered per unit	cleaning losses	price net weight	share % in FG	quantity in FG	VC1
1	Scallion - fresh	kg	80.00	35%	123.08	6.9%	17.3	2,132
2	Scotch bonnet pepper -fresh	kg	38.00	6%	40.43	4.7%	11.6	471
3	Thyme - fresh	kg	140.00	10%	155.56	1.2%	3.0	466
4	Onion - fresh	kg	60.00	25%	80.00	35.1%	87.8	7,023
	Raw material						**119.8**	**10,092**
5	Salt	kg	11.50			4.1%	10.2	117
6	Garlic saromex	kg	83.25			6.9%	17.3	1,442
7	Water	kg	0.50			26.3%	65.7	33
8	Vinegar 5%	kg	69.25			6.7%	16.7	1,158
9	Sodium benzoate	kg	90.00			0.1%	0.2	22
10	Sodium metabisulphate	kg	58.53			0.0%	0.1	7
11	Patty special yellow	kg	440.00			0.1%	0.3	145
12	Betapak curry powder	kg	202.50			5.3%	13.1	2,660
13	Maggi season-up (chicken)	kg	279.00			2.6%	6.6	1,828
	Ingredients						**130.2**	**7,412**
	Theoretical batch weight	kg				100.0%	250	**17,504**
	Actual production weight		processing losses		4.0%	96.0%	240	**18,234**
	Actual VC1 per kg						**VC1**	**76.0**

Non-food products; VC1 again depends on the 'recipe' of the designer or engineer: E.g. to produce a silk pillow, one needs fabric, thread, pillow stuffing, tassels and a zipper. All these items together compose the pillow and this is what is 'consumed' by the final customer. See example (coffin).

CB1 Calculation sheet for VC1 Non-food products (cost of raw material and implements)								
Nbr	Input	Unit	price delivered per unit	cleaning losses	price net weight	share % in FG	quantity in FG	VC1
1	Acacia wood	kg	400.00	15%	470.59	75.0%	15.0	7,059
2	Spur tree wood	kg	900.00	12%	1,022.73	25.0%	5.0	5,114
	Raw material						**20.0**	**12,172**
5	Paint	lt	900.40				8.0	7,203
6	Nails	pcs	0.50				45.0	23
7	Screws	pcs	1.80				8.0	14
8	Fabric, silk	kg	180.00				0.1	18
9	Thread	m	20.00				8.0	160
10	Tassels	pcs	34.00				15.0	510
11	Pillow stuffing	kg	60.00				0.3	18
	Implements						**84.4**	**7,946**
	Theoretical weight	kg				100.0%	20	**20,119**
	Actual production weight		processing losses		0.0%	100.0%	20	**20,119**
	Actual VC1 per coffin						**VC1**	**20,119**

To **obtain correct data for VC1** is not difficult. The general rule is: make a list of the inputs used and multiply these by their prices (excl. VAT!).
Three points have to be taken care of:

1. The price of the input must include the cost of its delivery to the factory.
2. The price of the input must be corrected for processing losses.
3. The cost of the input must be corrected for its share in the output.

1. Price, delivered factory is the price of the product plus all delivery costs.

Buying price (excl. VAT) + all delivery cost = Price, delivered

Examples of delivery costs are:
- Harvesting cost in an orchard
- Transport from orchard to factory
- Loading and offloading charges
- Procurement commission

2. Correction for processing losses.
Many natural raw materials cannot be used directly, but require cleaning (potatoes need to be peeled, a cow skin needs to be trimmed on the edges, wooden poles need to shaved). These **processing losses** cause the input to be more expensive than its buying price. E.g. if a wooden pole costs 10 and there are 20% shaving losses, the shaved pole will cost 10 / (100%-20%) = 12.50.

Price input = Price, delivered / (100% - processing loss %)

3. Correction for quantity in the final product.
Depending on the composition of the final product, an input is used in more or less quantity. E.g. mango puree consists for 99.9% mango and 0.1% citric acid. But the fruit contents in a mango drink may be only 25%. The cost of the input is therefore its price

Cost input = Price input x (share % in final product)

Correct measurement of processing losses is essential in VC1 calculation.

2.3.2 VC2

VC2 is the cost of **processing** the inputs into an output.

Examples of processing costs are:
- Steam for heating
- Electricity to run equipment
- Water to clean cow skins
- Casual labor to peel potatoes
- Detergents to clean factory
- Welding rods

In food industry, VC2 has long been denied as important. Steam, water, electricity and casual labor, were all very cheap. In the recent years almost all governments have stopped subsidizing gas/fuel/water which has led to spectacular price increases. And increases in VC2. This triggered change in behavior: insulation of cooking equipment, recycling of hot water. It is only the beginning, but the trend is clear: companies saving on VC2 with efficient equipment and operations are more competitive.

Utility costs are measured **per hour**, but VC2 must be expressed **per unit**. Therefore, the cost per hour must be divided by the number of units processed per hour. E.g. a sewing machine consumes 100 Watt per hour at 0.20 per kWh is 20 per hour. If 10 trousers are sewn per hour, the utility cost amounts to 20 / 10 = 2 per trouser.

Processing cost per hour / Units produced per hour = Processing cost per unit

To obtain **correct data for VC2** requires the following steps (see table below):

1. describe the process steps from intake of inputs to storage of the output;
2. list all equipment used;
3. calculate the capacity of every step – determine the bottleneck: this is the process step with the lowest throughput per hour (step 12 in the example) – this is the true processed output per hour[2];
4. calculate the utility use (water, steam, electricity) for each equipment;
5. calculate the labor requirement per process step;
6. calculate the price of utilities and labor per hour;
7. the processing cost per hour is the sum these costs
8. divide the processing cost per hour by the quantity per hour (the bottleneck capacity from step 3) to arrive at VC2: 136 / 2.0 = 68

CB1 Calculation sheet for VC2 (mango puree)

Process step		Process description and equipment used	Number	Process type *)	Capacity in ton per hour	RM or FP **)	Steam use in ton per hour	kW use per hour	Casual workers needed per hour
A Intake	1	Weigh bridge	1	Batch	270	RM		220	1
	2	Reception bunkers (washing)	5	Cont.	15	RM			1
	3	Grading/inspection conveyers	2	Cont.	20	RM			2
B Extraction	4	Crushing/chopping machines	2	Cont.	15	RM			
	5	Accumulator (collecting, mixing)	1	Cont.	15	RM			
	6	Screw pumps	2	Cont.	15	RM			
	7	Heaters	2	Cont.	15	RM	0.80		2
	8	Grinding/crushing (three-stage)	2	Cont.	20	RM		80	
	9	Accumulators of juice	2	Cont.	15	RM			
	10	Pumps	2	Cont.	15	RM			
C Evaporation	11	Evaporator (5 kg mango = 1 kg puree)	1	Cont.	20 RM -> 4 FP	FP	4.12	140	1
D Filling / pasteurization	12	Heater, sterilizer + cooler	1	Batch	2.0	FP	1.08	25	2
	13	Filling line 18 heads 3000 units/hr	1	Cont.	2.7	FP		12	7
	14	Capping machines	3	Cont.	2.7	FP			
E Labeling	15	Auto-labeling machine	1	Cont.	10	FP		15	3
	16	Pallet, plastic wrapping machine	1	Cont.	10	FP			
F Storage	17	Moving products to storage facility		Cont.	-	FP			3
						Total	**6.00**	**492**	**22**
*) Batch means the product flow is not continuous					Price per unit/hour		17.73	0.05	0.20
Cont. means the production flow is continuous					Price per hour		106.4	25.2	4.40
					Processing cost per hour				**136**
**) RM = tons of raw material					Processing volume per hour				2.00
FP = tons of finished product					**Processing cost per ton**			**VC2**	**68**

Correct measurement of utility and labor use is essential in VC2 calculation.

2.3.3 VC3

VC3 is the cost of **packaging**. Primary packaging is what holds the finished good: a bottle, a cap and a label. Secondary packaging holds the primary packs: 24 bottles in a carton box with a sticker on the box. Tertiary packaging holds the secondary packs: 66 boxes per pallet, with shrink wrap and a sticker on the outside. Packaging cost is expressed per unit. A calculation example is given in the following table.

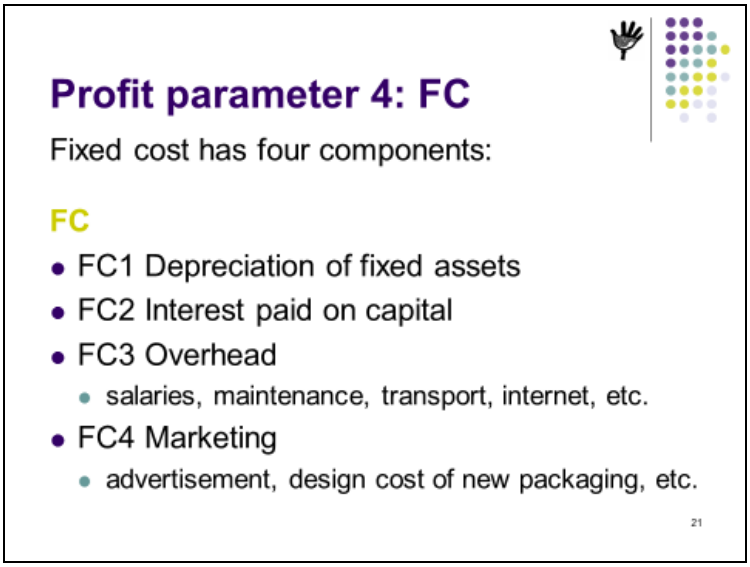
[2] Please note that capacity calculation requires additional training which is not covered in this Manual.

CB1 Calculation sheet for VC3 (golden ear rings)					
Type of packaging		**Article**	**Quantity**	**Price**	**Amount**
Primary	1	Jewelry box (23x60mm)	1	23.00	23.00
	2	Silken pillow (20x55mm)	2	4.10	8.20
	3	Lock	1	2.50	2.50
		Sub-total			***33.70***
Secondary	4	Primary packs in secondary	24	33.70	808.80
	5	Carton box	1	18.00	18.00
	6	Label	1	1.50	1.50
		Sub-total			***828.30***
Tertiary	7	Secondary packs in tertiary	67	828.30	55,496.10
	8	Euro pallet	1	15.00	15.00
	9	Shrink wrap	2	0.80	1.60
	10	Export label	1	1.50	1.50
TOTAL					**55,514.20**
Total number of units in final packaging					1,608
				VC3	**34.52**

Please note that the sub-total cost of the primary packaging is repeated in the cost for the secondary packaging. In the same way, the cost of the secondary packaging is repeated in the cost of the tertiary packaging. The total cost in the above example is 55,514.20. This is the cost of 24 * 67 = 1,608 units. Hence, the packaging cost per unit, VC3 = 55,514.20 / 1,608 = 34.52.

2.4. Fixed costs FC

Variable cost varies with the quantity produced. Fixed costs remain the same, regardless of the quantities produced. Even if there is **no production** the fixed costs must be paid. There are three types of fixed costs: FC1, FC2, FC3, and FC4



2.4.1 FC1

FC1 is the **depreciation** of the fixed assets: buildings, machinery, equipment, planting material of perennial flower, trees, etcetera.

Owners and management have a tendency to conveniently forget to depreciate and thus artificially lowering their cost price. This will inevitably result into lack of cash for future investments, even for replacement investments. The Cigar Box suggests to include always a realistic amount of depreciation, which, if saved on a separate bank account, will enable the entrepreneur to make the future investments needed. The most realistic way to value existing (old) assets is to take the **replacement value**: what does the assets cost today?

Depreciation = (purchase value – residual value) / economic life in years

Depreciation is defined as the purchase value of the asset minus residual value at the end of the economic life, divided by the number of years. The economic life depends on the cost of maintenance and repair of the asset, which tend to increase over time. The equipment should be replaced when annual repair and maintenance costs become higher than the annual depreciation[3].

CB1 Calculation sheet for FC1 Depreciation

Nbr	Asset	Quantity	Purchase price	Purchase value	Residual value	Asset value	Economic life in years	Depre-ciation %	Depreciation per year
1	Shade house, wooden A-frame, poly (ha)	12.00	52,500	630,000	10,000	620,000	5	20%	124,000
2	Spray irrigation system and injectors (ha)	12.00	14,400	172,800	10,000	162,800	8	13%	20,350
3	Planting material (6 bulbs / sqm - 5 years)	20,000	4.50	90,000	-	90,000	5	20%	18,000
4	Land, levelling, access road, fencing	12.00	22,000	264,000	200,000	64,000	20	5%	3,200
5	Nursery (50% poly tunnel; 50% shade netting)	1.00	95,000	95,000	-	95,000	5	20%	19,000
6	Irrigation + fertigation (pumps, basin, tanks)	1.00	200,000	200,000	-	200,000	8	13%	25,000
7	Packhouse (280m2) - complete	1.00	90,000	90,000	10,000	80,000	12	8%	6,667
8	Cool cells (80m3) + generator 15 kVA	2.00	60,000	120,000	10,000	110,000	12	8%	9,167
9	Office and Transport	1.00	40,000	40,000	-	40,000	10	10%	4,000
	TOTAL			**1,701,800**	**240,000**	**1,461,800**		**FC1**	**229,383**

2.4.2 FC2

FC2 is the **interest paid** on loans. This cost is usually not transparent as bank loans are often hidden. Interest rates in the west range from 5-8%, but can be as high as 25% per year in emerging economies. Shortage of working capital is often the result of the fact that the owners believe that they will not be able to repay the working capital loans at such interest rates, which is a clear proof that education in cost pricing is still very much needed.

[3] For further reading see e.g. http://en.wikipedia.org/wiki/Depreciation

CB1 Calculation sheet for FC2 Interest

Nbr	Loan	Loan amount	Interest %	Interest per year
1	Equipment loan Exim Bank - 7 years	1,600,000	12%	192,000
2	Working capital loan Standard Bank - 3 years	100,000	24%	24,000
3		-		-
	TOTAL	**1,700,000**	**FC2**	**216,000**

If there are no loans, the Cigar Box suggests to use a debt amount of at least 40% of the asset value. Why? Because a healthy balance sheet shows a debt-equity ratio of at least 40-60. Higher debt percentages of debt also happen: 50-50, 60-40 and 70% debt and 30% equity. The reason is the use of the leverage factor in financing. If the interest paid on debt is less than the profitability, then debt capital should be used to increase the return on equity. However, if the interest paid on debt is higher than the profitability, than less debt capital must be used. See text books on finance for further understanding.

The leverage principle.

Profitability larger than interest paid on debt

Capital	Share	Investment	Profit	Return	Name
Equity	60%	120	13.6	**11.3%**	return on equity
Debt	40%	80	6.4	8.0%	interest rate
Total	100%	**200**	**20.0**	10.0%	profitability

Profitability equal to the interest paid on debt

Capital	Share	Investment	Profit	Return	Name
Equity	60%	120	12.0	**10.0%**	return on equity
Debt	40%	80	8.0	10.0%	interest rate
Total	100%	**200**	**20.0**	10.0%	profitability

Profitability lower than the interest paid for debts

Capital	Share	Investment	Profit	Return	Name
Equity	60%	120	10.4	**8.7%**	return on equity
Debt	40%	80	9.6	12.0%	interest rate
Total	100%	**200**	**20.0**	10.0%	profitability

For further reading see e.g. http://en.wikipedia.org/wiki/Leverage_(finance)

2.4.3 FC3

FC3 is the **overhead** cost. This is one amount in which all overhead costs over the agreed period, usually a year, are summed. See table below for an example.

CB1 Calculation sheet for FC3 Overhead

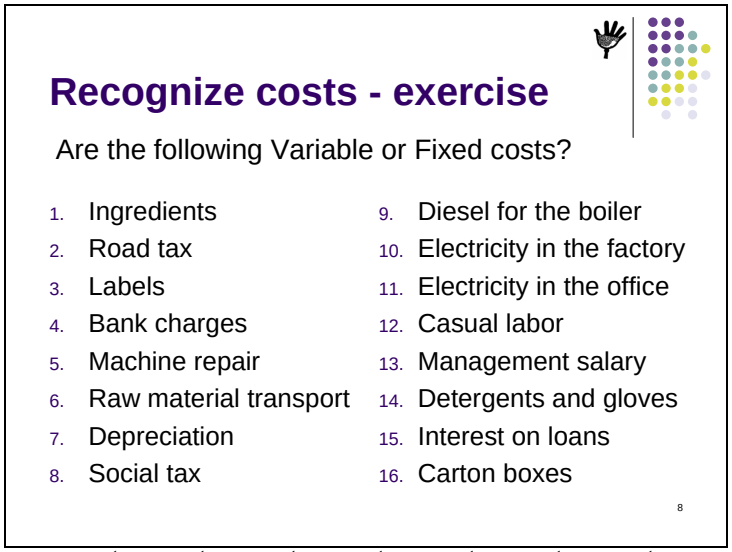
Nbr	Description	Amount per month	Months per year		Annual cost
1	Salaries	235,000	12		2,820,000
2	Social taxes (40%)	94,000	12		1,128,000
3	Rent	100,000	12		1,200,000
4	Telephone, fax, internet	168,000	12		2,016,000
5	Cleaning, office utilities, disposables	34,900	12		418,800
6	Milk advertisement 'Chowy-shup'	60,000	3		180,000
7	Fuel, car repair, toll, road tax	236,000	12		2,832,000
8	Utilities (share of office 16% and marketing 5%)	14,238	12		170,856
9	Maintenance, repair work, new spare parts	420,000	2		840,000
10	Other cost	30,000	12		360,000
	TOTAL			**FC3**	**11,965,656**

2.4.4 FC4

FC4 is the fixed cost of marketing and advertisement. This is one amount in which all marketing costs over the agreed period, usually a year, are summed.

Exercise 1: Recognize variable and fixed costs

Question: are the following costs variable or fixed?



Answers: 1=VC, 2=FC, 3=VC, 4=FC, 5=FC, 6=VC, 7=FC, 8=FC
9=VC, 10=VC, 11=FC, 12=VC, 13=FC, 14=VC, 15=FC, 16=VC.

Chapter 3 Profit Formulas

Two methods of profit calculation are being presented: the bookkeeping method and the cost accounting method. Thereafter formulas for calculating the cost price for 1 product and for multiple products is given. This chapter closes with four formulas on break-even: break-even price, break-even quantity, break-even variable costs and break-even fixed costs.

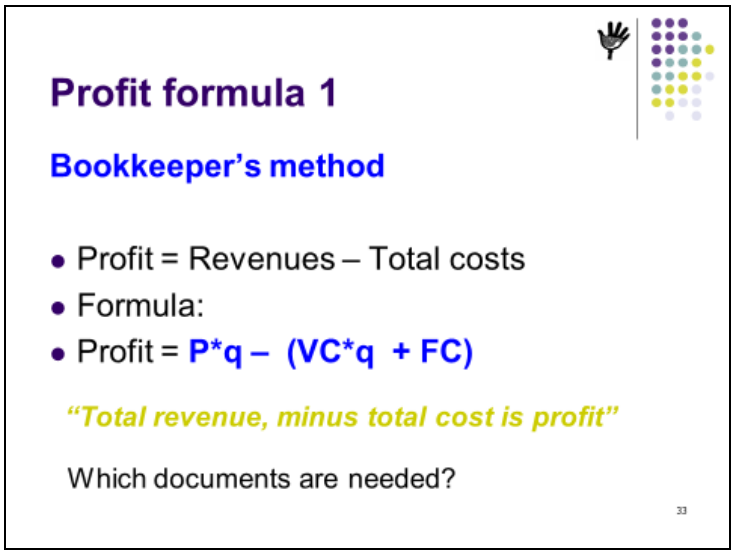
INTERMEZZO
This chapter combines theory with exercise; formulas, data, calculations. I strongly suggest the student of this module to adopt a rigid way of exercising and always follow these three steps:

1. write the formula, 2. fill the data, 3. then calculate the answer

I have seen many times, that students start to calculate immediately, because it is seemingly simple. Many times, the answers were wrong, because a figure was wrongly entered or a wrong formula was used. Even the brainiest students get confused because there are so many formulas. Pleeease follow this advice!

3.1. Bookkeeping formula

The bookkeeping method is, as the word says, used in bookkeeping systems. Revenues from sales are summed up, and all the costs – variable and fixed – are deducted to calculate the profit. If there is a profit, profit tax has to be paid. As stated before, taxes are ignored in this textbook.



Both price (P) and variable costs (VC) are calculated **per unit,** and therefore these are multiplied by q (quantity) to arrive at the total per year. Hence, P*q = total revenue per year and VC*q = total variable cost per year.

Exercise 2: the following parameters are given: P=50, q=30, VC=20 and FC=700.
Question: how much is the profit?
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

Answer: Revenues = P*q = 50*30 = 1500
Cost = VC*q + FC = 20*30 + 700 = 600 + 700 = 1300
Profit = revenue - cost = 1500 -1300 = 200

Exercise 3: the following parameters are given: P=6, q=1000, VC=4 and FC=1000.
Question: how much is the profit?
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

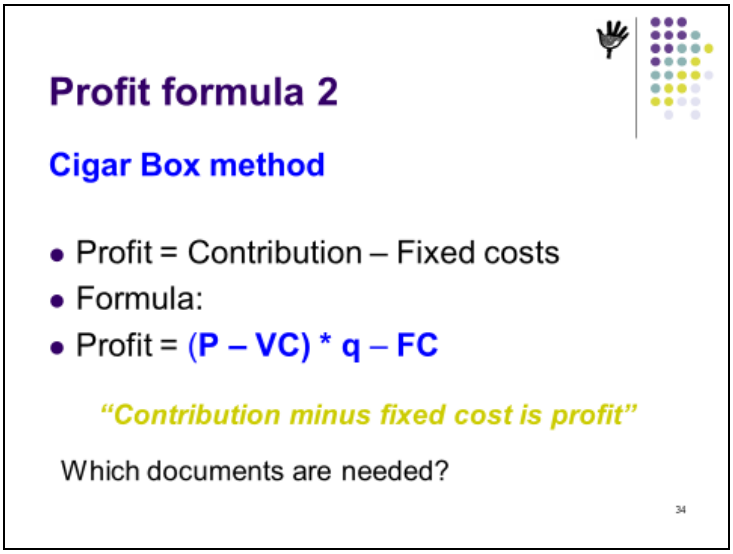
Answer: Revenues = P*q = 6*1000 = 6000
Cost = VC*q + FC = 4*1000 + 1000 = 4000 + 1000 = 5000
Profit = revenue - cost = 6000 -5000 = 1000

Profit calculation using the BOOKKEEPING formula

Questions	P	q	Revenue	VC	FC	Cost	Profit
Exerc. 2	50	30	1,500	20	700	1,300	200
Exerc. 3			0			0	0
			0			0	0

3.2. Cost accounting formula

In cost accounting total sales are not calculated but **contribution**. Contribution are the **earnings** after production and selling. It is calculated by multiplying the **margin** per unit by the number of units of a product sold. The margin earned on a product is the price (EXW) minus the variable cost needed to produce it.



Assume that a bottle of juice costs 25 to produce and pack. If its sales price is 35 EXW, then the factory earns 10 on each bottle it sells: the margin is 10. If the factory sells 100,000 bottles per year, the contribution from juice is 1,000,000. This is not profit, because the fixed costs still have to be paid. Assume these are 800,000 then a profit of 200,000 is made.

Profit calculation using the COST ACCOUNTING formula

Questions	P	VC	Margin	q	Contribution	FC	Profit
Juice	35	25	10.00	1,000,000	100,000	800,000	200,000
Exerc. 4			0		0		0
Exerc. 5			0		0		0

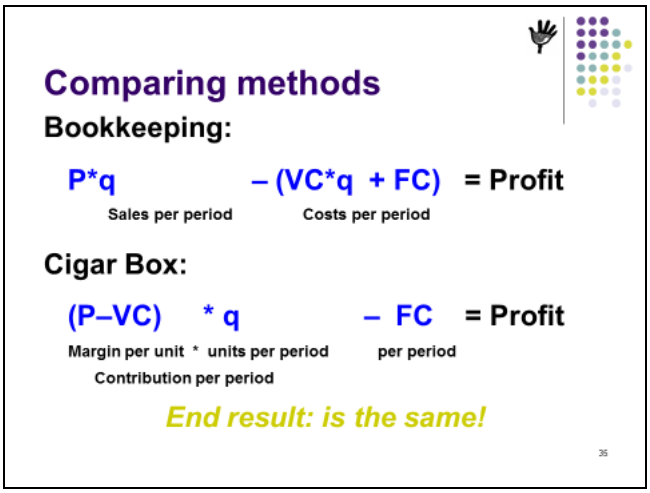
Exercise 4: the following parameters are given: P=50, q=30, VC=20 and FC=700.
Question: how much is the profit?
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

Answer: Margin = P - VC = 50 - 20 = 30
Contribution = margin * q = 30 * 30 = 900
Profit = contribution - fixed cost = 900 - 700 = 200

Exercise 5: the following parameters are given: P=6, q=1000, VC=4 and FC=1000.
Question: how much is the profit?
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

Answer: Margin = P - VC = 6 - 4 = 2
Contribution = margin * q = 2* 1000 = 2000
Profit = contribution - fixed cost = 200 - 1000 = 1000

NOTE: THE ANSWERS OF EXERCISES 2 & 4, AND OF 3 & 5 ARE THE SAME!



WHY COST ACCOUNTING IF THE ANSWERS ARE THE SAME?

The reason for using cost accounting is explained using an example. Assume that a company produces three products A, B and C. The sales prices and volumes are given in the table Year 1. Total revenues from sales are 5000. The cost of the ingredients, processing and packaging amounted to 4300, hence the contribution was 700. With 500 fixed costs, a profit of 200 was made. Please verify the figures of Year 1.

Year 1	A	B	C	Total
P	100	150	200	
q	15	10	10	
Revenues	1500	1500	2000	5000
Variable costs				4300
Contribution				700
Fixed costs				500
Profit before tax				**200**

Year 2	A	B	C	Total
P	100	150	200	
q	15	20	13	
Revenues	1500	3000	2600	7100
Variable costs				6350
Contribution				750
Fixed costs				500
Profit before tax				**250**

Because of the success, the company expanded its activities. New orders came in for products B and C, and sales in Year 2 rose to 7100. The variable costs also increased to 6350 and the contribution went up to 750. With equal fixed cost, year 2 saw a profit increase by 25% to 250. The bookkeeper suggested to uncork the champagne!

Let us now analyze the same factory using the cost accounting method. As explained above, in cost accounting we first calculate the individual margins of each product A, B and C. This requires knowledge on the variable costs for each product: how many ingredients? Which processing costs? What packaging costs? The cost accountant came up with the correct data and displayed them in table Year 1. It turned out that product B, had a **negative margin**. The bookkeeper was right, the profit was indeed 200 in year 1. Please verify the figures!

Year 1	A	B	C	Total
P	100	150	200	
Variable cost/unit	80	160	150	
Margin/unit	20	-10	50	
q	15	10	10	
Contribution	300	-100	500	700
Fixed costs				500
Profit before tax				**200**

Year 2	A	B	C	Total
P	100	150	200	
Variable cost/unit	80	160	150	
Margin/unit	20	-10	50	
q	15	0	13	
Contribution	300	0	650	950
Fixed costs				500
Profit before tax				**450**

When the new orders for products B and C came in, management decided to accept only the new order for product C and to cancel all orders for product B. The result was spectacular: with lower sales of 4100 (please verify!) a larger contribution was achieved of 950 and with same fixed cost of 500, the profit in year 2 was 450. An increase of 125%.
Question: what happened with the bookkeeper?

3.3. Cost price (1 product)

The cost price of a product is defined as the **total cost per unit**. That is the sum if the variable costs and the fixed cost per unit.

Cost price = variable cost + fixed cost per unit

In formula: **TC/q = VC + FC/q**

Consider the following company where the sales quantity increased from 20 to 25 and eventually to 50 units per year: the cost price came down from 55 to 40 per unit.

VC	FC	q	FC/q	TC/q
30	500	20	25	55
30	500	25	20	50
30	500	50	10	40

Exercise 6. J&J produces 35,000 bags of cassava chips every month with a variable cost of 30 cents and a monthly fixed cost of 7,700. December demand rose to 40,000 bags.
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

Questions:
a. What is the total cost in normal months?
b. What is the fixed cost per bag in December?
c. What is the total cost per bag in December?
d. What is the total cost in December?
e. What is the total cost per bag in normal months?

a. Total cost (normal months) = VC * q (normal months) + FC = 0.30 * 35,000 + 7,700 = 18,200.
b. Fixed cost per bag (December) = FC / q (December) = 7,700 / 40,000 = 0.19
c. Total cost per bag (December) = VC + FC / q (December) = 0.30 + 7,700 / 40,000 = 0.30 + 0.19 (previous answ
d. Total cost (December) = VC * q (December) + FC = 0.30 *40,000 + 7,700 = 12,000 + 7,700 = 19,700.
e. Total cost per bag (normal months) = VC + FC / q (normal months) = 0.30 + 7,700/35,000 = 0.30 + 0.22 = 0.52.

3.4. Cost price (>1 product)

The cost price calculation of multiple products differs from the calculation of one product only because the fixed costs must be divided over all products. Big books have written by accountants on how to 'accurately' divide the fixed costs. The truth is, **any attribution system** leads to the same end-result, it has **no effect on the bottom line**.

3.4.1 Fixed cost attribution

The reason is that, in existing enterprises, the fixed costs are fixed, they have to be paid anyway. Once a building has been purchased, equipment installed and an expensive accountant appointed, the mortgage, interest and salaries must be paid. Must be paid from the **contribution** of the products. The task for management is to maximize contribution within the capacity of the enterprise.

Consider a company with two products A and B. A earns 5000 and B earns 2000. The total contribution is 7000. Assume the fixed costs to be 6000 and the profit is 1000.

Now, we say, lets divide the fixed costs equally over A and B as is done in the table: A brings a profit of 2000 and we lose money on B -1000. The end result is the same: a profit of 1000.

Product	Contribution	Fixed cost attribution	Profit
A	5000	3000	2000
B	2000	3000	-1000
Total	**7000**	**6000**	**1000**

So, what is the conclusion? We stop making product B? NO, not at all, because B has a **positive** contribution, B helps to pay for the fixed costs! No matter in which way we attribute the fixed costs to A and B, the profit result will be the same.

3.4.2 Fixed cost attribution systems

If you, either as owner or manager, insist to know the cost price of each product, then the fixed costs will have to be divided. Fixed cost are divided using a key: a attribution system. Four attribution systems are presented here:

1. Quantity (q)
2. Sales (P * q)
3. Total variable costs (VC * q)
4. Contribution (P-VC) * q

Below, the 4 systems are presented. The results are very different.

	1. Quantity		2. Sales			3. Total variable cost			4. Contribution		
Prod	q	q%	P	P*q	P*q%	VC	VC*q	VC*q%	Margin	Contr	Cont%
A	1000	25%	2.0	2000	40%	0.5	500	17%	1.5	1500	71%
B	3000	75%	1.0	3000	60%	0.8	2400	83%	0.2	600	29%
Tot	4000	100%		5000	100%		2900	100%		2100	100%

Product A has low volume (1000), but high margin (75% - margin=1.5 /price=2.0). Product B is the opposite: high volume (3000) and low margin (20%). This is a common situation in many enterprises.

Now, let's calculate cost prices using these four keys. Assume fixed cost of 1000.

Key 1 - Quantity

Prod	q	FC%	VC	FC	FC/q	TC/q	P	Profit/q	Profit
A	1000	25%	0.50	250	0.25	0.75	2.0	1.25	1250
B	3000	75%	0.80	750	0.25	1.05	1.0	-0.05	- 150
Tot	4000	100%		1000					1100

This result is not satisfactory, because it would lead to the conclusion that product B makes a loss and hence needs to be closed down, or adjusted. Yet, **B's contribution is positive** (P-VC) * q = (1.0 - 0.8) * 3000 = 600.

Key 2 - Sales

Prod	Sales	FC%	VC	FC	FC/q	TC/q	P	Profit/q	Profit
A	2000	40%	0.50	400	0.40	0.90	2.0	1.10	1100
B	3000	60%	0.80	600	0.20	1.00	1.0	-0.00	- 0
Tot	5000	100%		1000					1100

This result is also not satisfactory, because it would lead to the conclusion that product B makes no profit, so why make it? The answer: **B's contribution is positive**. The end result is the same: 1100 profit.

Key 3 - Total variable cost

Prod	VC*q	FC%	VC	FC	FC/q	TC/q	P	Profit/q	Profit
A	500	17%	0.50	170	0.17	0.67	2.0	1.33	1330
B	2400	83%	0.80	830	0.276	1.076	1.0	-0.076	- 230
Tot	2900	100%		1000					1100

This result is not satisfactory, because it would lead to the conclusion that product B makes a big loss, while **B's contribution is positive**. The end result: 1100 profit.

Key 4 - Contribution

Prod	Contr	FC%	VC	FC	FC/q	TC/q	P	Profit/q	Profit
A	1500	71%	0.50	710	0.71	1.21	2.0	0.79	790
B	600	29%	0.80	290	0.096	0.896	1.0	0.104	310
Tot	2100	100%		1000					1100

This result is satisfactory, product B makes a profit, thanks to **B's positive contribution**. The end result, however, is the same: 1100 profit.

The Cigar Box suggest to use **Key 4 Contribution** to divide the fixed costs. Key 4 is based on the principle of the 'strongest shoulders, carry the heaviest weight'. It is a fair and solid attribution key. It uses 3 of the four basic parameters (P-VC)*q and correctly reflects the importance of **contribution** of each product.

Exercise 7. Joyce and Anushik produce leather bags. They have 6 stitching machines and semi-automatic press to print leather. The asset value is 10000 and the depreciation is 10% per year. The have a loan of 4000 at 25% interest. Their monthly overhead cost is 500. They produce two types of bags: big-bags for transport of stones by camels (A) and fashion bags for teenage girls (B). There is big demand for the girls bags and they sell 500 bags per month at 5 EXW. The variable cost is 4. The camel bags are sturdy leather bags capable of holding 25 kg each. They sell 50 pairs per month at 30 EXW. The VC of one bag is 5.
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.
Questions:

a. What is the fixed cost per year?
b. What is the total variable cost per year?
c. What are the sales per year?
d. What is the profit per year?
e. What is the cost price of A and B, using Key 3 Total Variable Cost?
f. What is the contribution of A and B?
g. What is the cost price of A and B, using Key 4 Contribution
h. What do you recommend to Joyce and Anushik?

Answers at the end.

3.4.3 Shared assets and non-shared assets

If the assets in a factory are shared by more or less all products, the fixed attribution is trivial, as shown above. Contribution is the recommended key.

If product A makes use of a very expensive greenhouse with spray irrigation, while crop B is grown on the open field, it is not fair to assign the fixed costs of the greenhouse to crop B. In this case, there are **non-shared assets**, then fixed cost attribution is **relevant**. The CB1 sheet for calculation of FC1 (see above) is modified to reflect this difference.

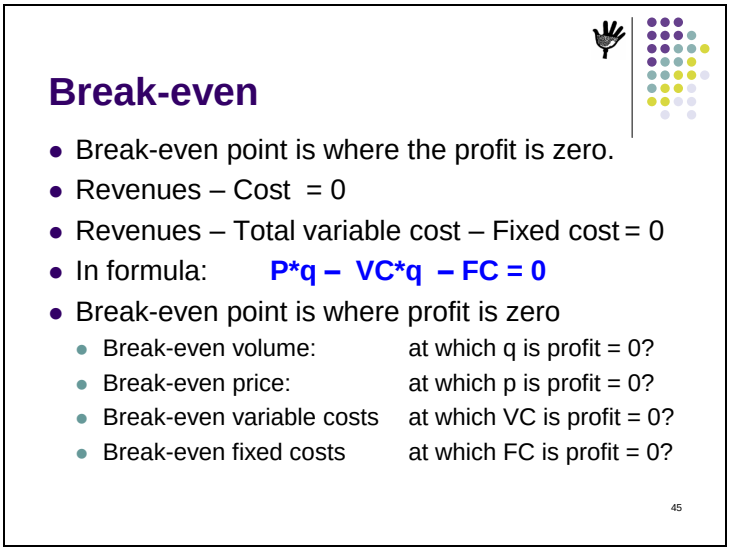
The total depreciation FC1 does not alter, but it is distributed among A and B. Assuming that items 1 – 3 are only used by A, then the total depreciation cost rests on A. If the other assets are shared, then a distribution key must be used, preferably Key 4 – Contribution. Assuming crop A contributes 67% and B only 33%, than the resulting FC1 for A is 207,262 and FC1 for B is only 22,121.

CB1 Calculation sheet for FC1 Depreciation with Non-shared assets

Nbr	Asset	Asset value	Economic life in years	Depre-ciation %	Depreciation per year	Share % A	Share % B	FC1 A	FC1 B
1	Shade house, wooden A-frame, poly (ha)	620,000	5	20%	124,000	100%	0%	124,000	-
2	Spray irrigation system and injectors (ha)	162,800	8	13%	20,350	100%	0%	20,350	-
3	Planting material (6 bulbs / sqm - 5 years)	90,000	5	20%	18,000	100%	0%	18,000	-
4	Land, levelling, access road, fencing	64,000	20	5%	3,200	67%	33%	2,144	1,056
5	Nursery (50% poly tunnel; 50% shade netting)	95,000	5	20%	19,000	67%	33%	12,730	6,270
6	Irrigation + fertigation (pumps, basin, tanks)	200,000	8	13%	25,000	67%	33%	16,750	8,250
7	Packhouse (280m2) - complete	80,000	12	8%	6,667	67%	33%	4,467	2,200
8	Cool cells (80m3) + generator 15 kVA	110,000	12	8%	9,167	67%	33%	6,142	3,025
9	Office and Transport	40,000	10	10%	4,000	67%	33%	2,680	1,320
	TOTAL	**1,461,800**		**FC1**	**229,383**			**207,262**	**22,121**

The same system is done for FC2 Interest. In only very rare cases will it be necessary to partition FC3, prior to using a key. The Cigar Box recommends to attribute FC3 according to Key 4 – Contribution.

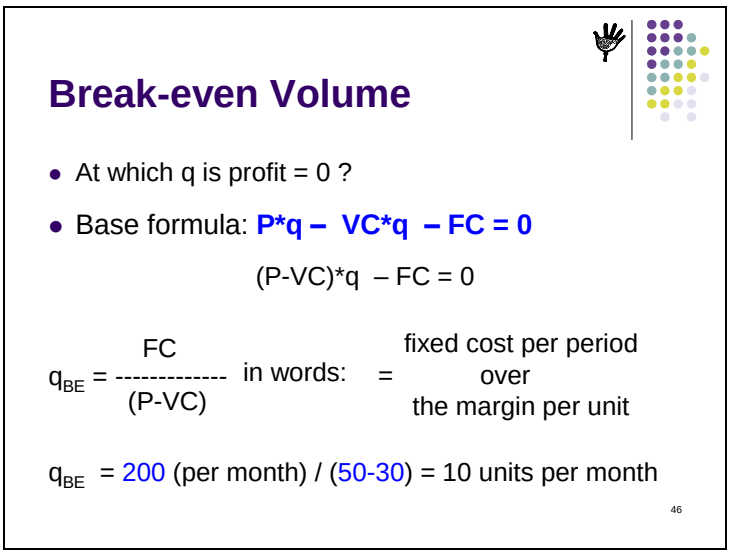
3.5. Break-even formulas



Contrary to popular believe, the break-even point can be calculated for each of the four profit parameters. The reason for calculating a particular break-even point is to find out beyond which level of the parameter, a profit is made.

The break-even point is calculated of the **most unknown parameter**. If the quantity which can be sold is the most unknown parameter then quantity risks have to calculated accurately. The break-even volume then sets the target: *'sales people, please sell more than the break-even volume'*.

3.5.1 Break-even volume



Consider the case of Southern Fruit. They process fruits and want to expand to aseptically packed mango puree. The market price for (imported) puree in the capital is 1000 and our EXW price will thus be 900. The cost of the local mango is only 3 cents per kilogram. Most of them are rotting under the trees. The processing

ratio is 3 kg of raw mango for 1 kg of puree. We know the energy and steam use, as well as the cost of the packing material. Our VC is 700.

To process the mango, most of the existing equipment can be used. But for the aseptic filling a new pasteurizer and filler needs to be bought. We calculated the fixed costs for the mango puree at 300,000 per year. The question which remains is: HOW MUCH CAN WE SELL??

In this case, the calculation of the break-even quantity of mango puree is very relevant, three parameters are known, the sales volume is unknown.

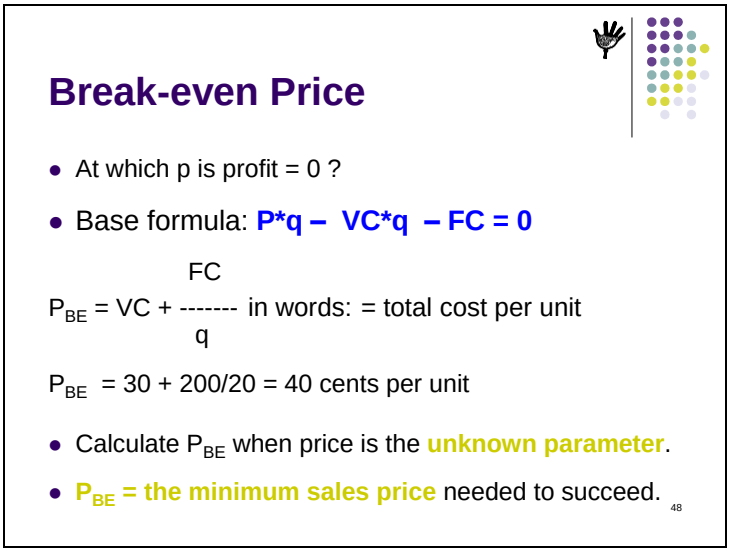
As derived in the slide above, the break-even quantity is calculated as follows:

Break-even quantity = Fixed cost / margin

In formula: **q(BE) = FC / (P-VC) = 300,000 / (900 - 700) = 1,500 ton**

If we can obtain contracts for over 1500 tons, the operation will be profitable!

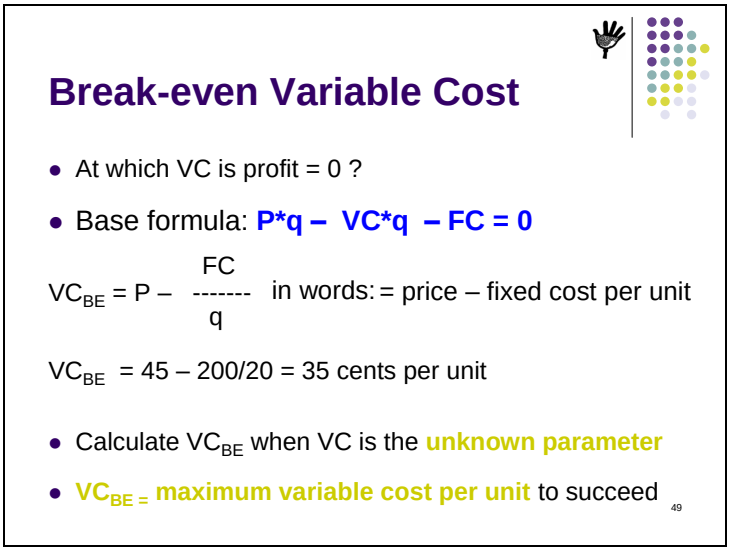
3.5.2 Break-even price



The break-even price is calculated when price is the unknown factor. This frequently happens in production of a unique product, like handicraft. What is the market going to pay? Another example is contract farming: variable and fixed cost are known, as well as the contracted quantity. But at what price should we sell? In such a situation the break-even price is calculated.

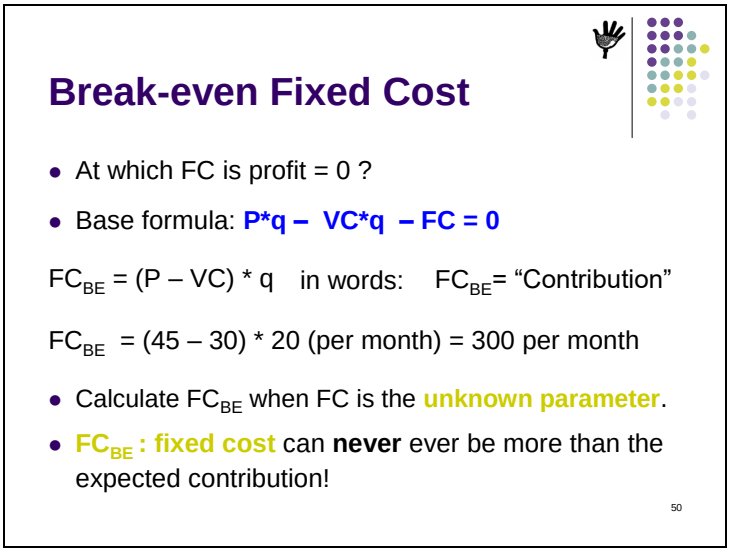
Price setting is dealt with in more detail in the next chapter. In this paragraph we only explain the formula. As can be seen in the slide, the break-even price is the price which equals the cost price, or the total cost per unit: VC + FC/q. In situations with multiple products, FC must be attributed with a key, as explained in the previous section.

3.5.3 Break-even variable cost



The break-even variable cost is calculated when VC is the unknown factor. This frequently happens in production of competitive consumer products. E.g. in the global textile industry, cost leadership is the strategy of most companies and the calculation VC (BE) is done for every product, using the formula in the slide above.

3.5.4 Break-even fixed costs



The break-even variable cost is calculated when FC is the unknown factor. This rarely happens in production companies, but more in **service companies**. In these situations, management must realize that the break-even point of their fixed costs is equal to the contribution of their total portfolio.

3.6. More Exercises

Exercise 8.

J&J produces 35,000 bags of cassava chips every month with a variable cost of 30 cents and a monthly fixed cost of 7,700. December demand rose to 40,000 bags. J&J marketing department tells you that the average sales price is 50 cents, but for Christmas, the price goes up by 10%.
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

Questions:
a. What is the profit in normal months?
b. What is the break-even volume in normal months?
c. What is the profit in December?
d. At what variable cost does J&J break even?
e. At which fixed cost does J&J break even?
f. What do you recommend J&J?

Exercise 9.

Marlene and Fatima estimate their fixed cost at 20,000 per year. With a variable cost of 30, they produce 400 boxes of pineapples per harvest. Make your own assumptions!
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.
Suggestion: try to understand where you have data gaps and make reasonable assumptions

Questions:
a. Calculate the margin per box; and the margin %?
b. Calculate the fixed cost per box.
c. The price is 45 per box, what is the break-even q ?
d. How can you have 5000 profit from 58,500 revenues (two options) ?

Chapter 4 The Cigar Box

In this chapter an exercise is given on how to use the Cigar Box with real data. One CB1 sheet is used for one single product. In case of multiple products, multiple CB1 sheets must be made. Another Cigar Box, called CB2, offers the opportunity of multiple sheets, which link back to a central overview sheet. The principle of CB2 is exactly the same as used in CB1, with one added feature: it automatically attributes fixed cost using Key 4 – Contribution (see section 3.4.2).

In this Module CB1 is explained. The Cigar Box has 2 columns and 8 boxes. In the left column, all amounts are **per unit**. The unit used is called the calculation unit. In this example, the calculation unit is USD per ton. Others are: KES per lb; Euro per drum; etc. In the right column the amounts are **per period**. Here, in USD per year. Obviously the currency in both columns must be the same.

CIGAR BOX 1 - Mango puree 24 Brix, aseptic bags of 220 kg in steel drums

	USD per ton			USD per year	
Price (DDP Rotterdam)	1,000	*100%*	Total Revenue	2,721,600	
Import duties, 10%	100	*10%*	Total Cost	2,331,906	
Transport, sales commission 3%	144	*14%*	**Profit Before Tax**	**389,694**	
Price (EXW)	**756**	*76%*	Profitability %	14%	
Price (Raw Material, delivered factory)	71		Asset value	1,800,000	
Processing ratio (kg RM for 1 kg FG)	5.0		Depreciation %	7.8%	
Raw Material cost	357	*65%*	**FC1**	**140,000**	*41%*
Other ingredients	17	*3%*			
VC1	**374**	*68%*	Debt (40% of Asset value)	720,000	
			Interest rate	18.7%	
Production cost per hour (steam, electricity)	136		**FC2**	**134,400**	*39%*
Production volume per hour (ton/hour)	2				
VC2	**68**	*12%*	Number of FTE employed	15	
			Salaries staff incl. social taxes	50,000	*15%*
Cost of packing (aseptic bag, drum)	21.8		Other overhead, repairs, maintenance	20,000	*6%*
Number of drums per ton	4.5		**FC3**	**70,000**	*20%*
VC3	**99**	*18%*			
			FC	**344,400**	*100%*
FG losses %	2.0%		FC % attributed to product	100.0%	
VC	**552**	*100%*	**FC (attributed to product)**	**344,400**	
Gross margin	**204**		Volume sold q (ton)	3,600	
Gross margin %	27%		**Contribution**	**734,094**	
Variable Cost per unit (VC)	**552**	*85%*	**Break even volume (sales)**	**1,689**	
			Break even volume (raw material)	18,000	
Fixed Cost per unit (FC/q)	**96**	*15%*			
			Output capacity per hour in ton	2.0	
Total Cost per unit (VC+FC/q)	**648**	*100%*	Working hours per day	22	
			Length of harvesting season in days	110	
Profit per unit (P-VC-FC/q)	**108.2**	*14%*	**Max. output capacity per year**	**4,840**	
			Capacity utilization %	74.4%	

*Note: figures in **blue** are assumptions; figures in **pink** are calculated in another sheet; figures in **black** are formulas*

P profit FC VC P-VC q contribution profit per unit Break-even Capacity Utilization

The CB1 sheet in Excel, including all cost calculation support sheets mentioned in Chapter 2 Profit parameters, are free of charge and an integral part of this Module.

Furthermore, a PowerPoint presentation (Cigar Box Training CB1.ppt) has been prepared which discusses the individual 8 boxes of CB1. They elaborate the above displayed example of mango puree, packed in aseptic bags of 220 kg, packed in a steel drum.

Good Luck!

Chapter 5 CB2 Portfolio analysis

5.1. Contribution analysis

This paragraph is about the importance of having a balanced portfolio and how to balance it. It introduces Cigar Box 2 – Portfolio Analysis.

5.2. Reducing costs

This paragraph takes you back to cost price calculation. It helps you to identify key cost indicators (KCIs) and analyzes which cost components to focus one.

5.3. Increasing the sales price

This paragraph describes how you can push your sales price up in order to attain an acceptable contribution. It explains price elasticity of a product and the trade-off between a change in price of the product and changes in quantities sold.

5.4. Making a production and sales plan

This paragraph starts from the assumption that you understand contribution analysis and how to reduce costs. Once this is done, using an understanding of each product market combination (PMC) the critical break-even points are calculated. These form the basis for marketing efforts to sell more quantity, or at a higher price, or with lower delivery costs. Finally, a year plan is made, setting targets for each product.

5.5. Operational monitoring

Once a year plan is made, it is important to monitor progress. It introduces Cigar Box 3 – operational monitoring. In its simplest version CB3 focuses on daily collection of data on KCIs. These are subsequently benchmarked and used for performance improvement.

Chapter 6 ANSWERS:

Exercise 7:

a. FC = FC1 + FC2 + FC3 = 1000 + 1000 + 6000 **= 8,000**;

- FC1 = asset value * depreciation % =10,000 * 10% = 1000
- FC2 = debt value * interest rate % = 4,000 * 25% = 1000
- FC3 = monthly expenses * 12 = 500 * 12 = 6000

b. Total VC = VC(Prod. A) * q (Prod. A) + VC(B) * q(B)
= 5 * 1200 (=50 pairs per month!) + 4 * (500 * 12)
= 6,000 + 24,000 **= 30,000**

c. Sales = Sales revenue A + Sales revenue B
= P (A) * q (A) + P (B) * q (B)
= 15 (30 per pair!) * 1200 + 5 * 6000
= 18,000 + 30,000 **= 48,000**

d. Profit = Sales revenue – total variable cost – fixed cost
= 48,000 - 30,000 – 8,000 **= 10,000**

e. Cost price, using Key 3 – Total Variable Cost

Prod	P	q	Sales	VC	VC*q	FC%	FC	FC/q	TC/q	Profit/q	Profit
A	15	1200	18000	5	6000	20%	1600	1.33	**6.33**	8.67	10,400
B	5	6000	30000	4	24000	80%	6400	1.07	**5.07**	-0.07	-400
Tot		7200	48000		30000	100%	8000				10,000

f. Contribution (A) = Margin (A) * q (A) = (15 – 5) * 1200 = 10 * 1200 **= 12,000**
Contribution (B) = Margin (B) * q (B) = (5 – 4) * 6000 = 1 * 6000 **= 6,000**

g. Cost price, using Key 4 - Contribution

Prod	P	q	Sales	VC	Contri-bution	FC%	FC	FC/q	TC/q	Profit/q	Profit
A	15	1200	18000	5	12000	67%	5333	4.44	**9.44**	5.56	6,667
B	5	6000	30000	4	6000	33%	2667	0.44	**4.44**	0.56	3,333
Tot		7200	48000		18000	100%	8000				10,000

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