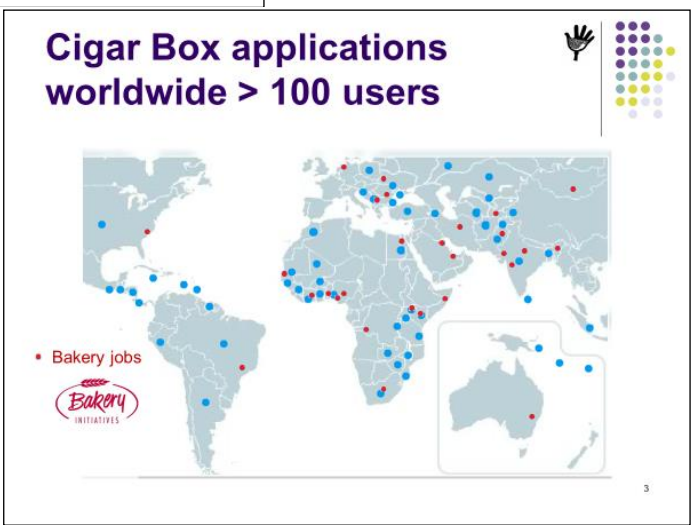
Cigar Box Method®

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

by Olivier van Lieshout
Global Facts
www.globalfacts.nl



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, distribution and selling a product. Cost are divided into Variables Costs and Fixed Costs. Variable costs fluctuate with the quantity produced. Fixed costs must be paid even if there is no production [2].

What is pricing?

- Pricing is the process of fixing a price point. This is the amount of money for which a product will sell best in the market. It is determined by the clients' ability and willingness to pay.

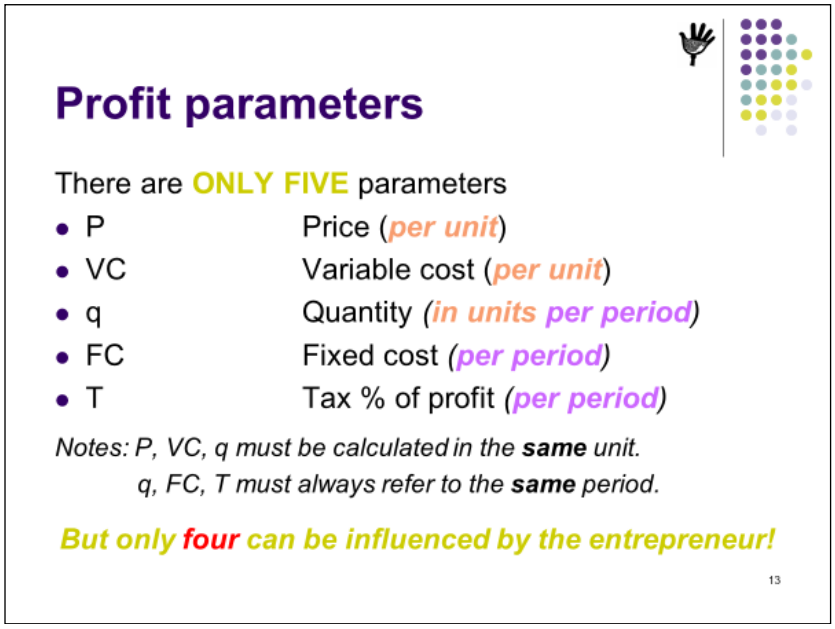
Why is this important?

- To calculate costs and fix price points 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 point for your products, will allow you to:
    - Cover your production costs.
    - Sell in sufficient quantity to make a profit[3].

[1] Though the principles of costing and pricing are universal, Global Facts made adapted modules for entrepreneurs in Farming and for those in Services.
[2] Most accountants in the world use Direct and Indirect costs. This leads to wrong decision-making and is therefore not used in the Cigar Box Method.
[3] The inverse relationship between price and quantity sold is called price elasticity.

Chapter 2. Profit parameters



It is Cigar Box Method 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.

q (quantity) is expressed in units per period: E.g. 100 loafs per day; 1,400 tons per year.

FC (fixed cost), is expressed **per period**. 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 costs 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 variable or fixed costs. Profit tax is a very important element of the decision-making process of entrepreneurs and determines how much money is earned at the end of the year. However, the amount of profit tax 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[4].

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.

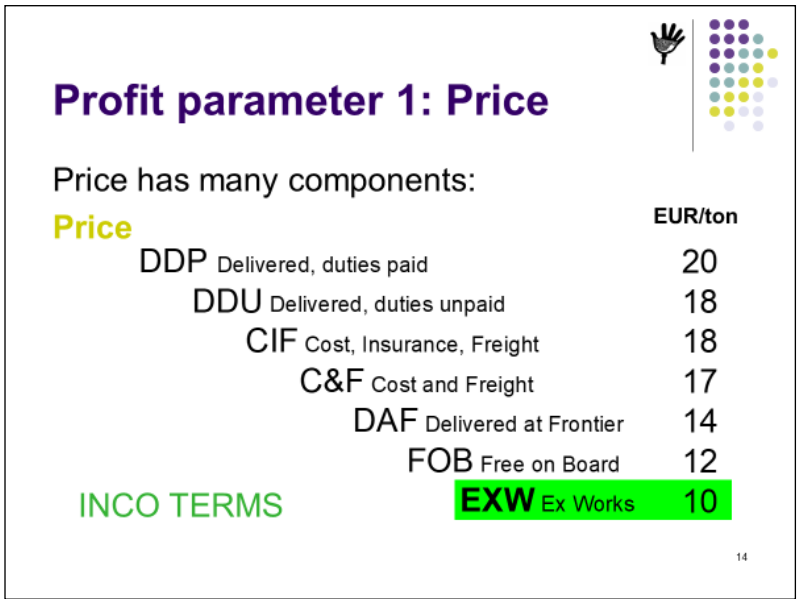
[4] Tax is the domain of accountants and fiscal specialists. These people usually know very little about cost accounting and their opinion on costing and pricing usually leads to wrong business decisions.

2.1 Price

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 = $P_{(net)}$

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 must be subtracted from the invoiced price to arrive at the Ex works price. In agriculture this is called the farm gate price.

$P_{(EXW)} = P_{(net)} – VC4$

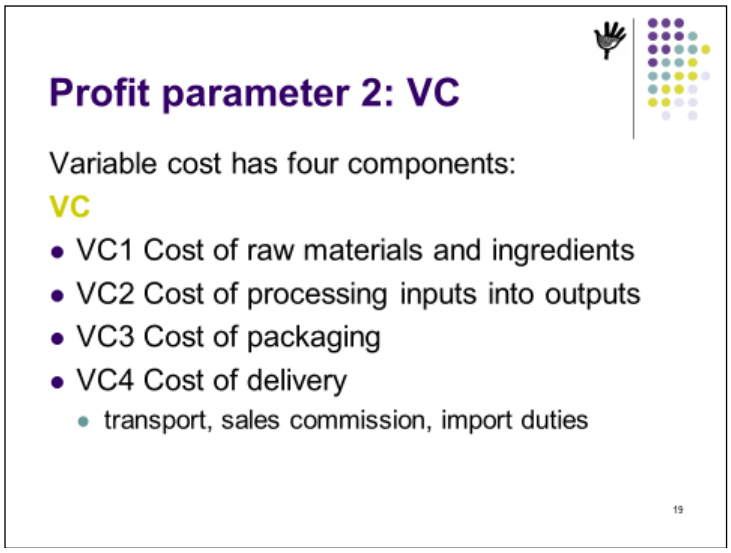
2.2 VC4. Variable cost of delivery

Examples of VC4 delivery costs are:

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

2.3 VC. Variable cost of production

Variable cost are the expenses which must be made to make the product. Variable cost varies with the quantity produced. If 1 unit costs 10, 2 units will cost 20. If there is **no production**, then **VC = zero**.



In (food) processing, manufacturing and handicraft business, there are three types of variable production 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'.

1. **Food products**; VC1 depends on the recipe. It is determined by the food technologist. Composition and quality of the ingredients and final product are usually checked in 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 flour in the bread. The minor components are ingredients such as: sugar in the jam, salt in the ketchup, oil in the tinned fish, yeast in the dough. See Table 1 below (spicy curry sauce).

2. **Non-food products**; VC1 again depends on the 'recipe' of the designer or engineer. When making a coffin, the maker needs wooden planks, screws, nails and paint for the box. For the pillow and interior decoration, he needs silk fabric, thread, pillow stuffing, tassels and a zipper. All these items together are 'consumed' by the final customer. See Table 2 (coffin).

Table 1. VC1 for Spicy Curry Sauce

VC1 calculation sheet for Food Products (raw material and ingredients)								JMD
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**

Table 2. VC1 for a Wooden Coffin

VC1 calculation sheet for Non-food products (raw material and implements)								JMD
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**

3. **Bakery products** vary from simple bread to decorated multilayer birthday cakes. VC1 is the cost of all ingredients used. VC1 must be calculated for:
   - Dough
   - Filling
   - Decoration

In this manual, we will only calculate the cost of dough.
For simple bread, without filling or decoration, VC1 = Cost of dough * Baking loss.

VC1 (bread) = Cost of dough * Baking loss

For dough making, flour is the basis of the recipe and it is set at 100%, regardless of the actual weight. The other ingredients are added as a percentage of the flour. E.g. 5% yeast, 3% salt, 2% sugar, and 55% water. Example: if a bag of flour weighs 50 kg, then 2.5 kg of yeast, 1.5 kg of salt, 1 kg of sugar and 27.5 liters of water are added. The total weight of the dough batch is 82.5 kg.

To calculate the cost of the dough, the ingredient percentages are multiplied by their prices per kg. The cost of 1 kg of dough is the weighted average kg price of all ingredients.

In Table 3 the ingredient prices are given in $ per kg. Multiplying the ingredient prices with the percentages gives the cost of dough. In this example its $0.48. Because the total recipe is 165%, 1 kg of dough costs $0.48 / 165% = $0.29.

Table 3. VC1 for Bread

Ingredients	Recipe	Batch	Ingr. price/kg	Cost dough	Cost/batch	Cost %
Wheat flour	100%	50.0 kg	$0.45	$0.45	$22.50	93.6%
Yeast	5.0%	2.5 kg	$0.30	$0.02	$0.75	3.1%
Salt	3.0%	1.5 kg	$0.07	$0.00	$0.11	0.4%
Sugar	2.0%	1.0 kg	$0.40	$0.01	$0.40	1.7%
Water	55%	27.5 kg	$0.01	$0.01	$0.28	1.1%
Dough	**165%**	**82.5 kg**	**$0.29**	**$0.48**	**$24.03**	**100%**
Dough pieces from batch		85				
Weight of 1 dough piece		971 gr				
Baking loss (moisture)		-12%				
Weight after baking in kg		72.6 kg	$0.33 /kg	$0.33 /kg		
Weight of 1 loaf after baking		854 gr		$0.28 /loaf		
Actual weight of average loaf		852 gr		$0.28 /loaf		
Difference (must be less than 3 gr)		-2.1 gr				

During proofing and baking, weight is lost (mostly water that evaporates in the oven). This usually ranges from 8-16%. Assume 12% loss, then the cost of the bread is 12% higher, or $0.29 * (1+12%) = $0.33 per kg. If the final weight of an average loaf is 854 grams, then VC1 for the loaf = $0.33 * 854/1000 = $0.28.

This method gives the exact VC1 per kg, regardless of the quantity of flour used. To check the calculation, the cost of the batch (82.5 kg) is also calculated. It is $24.03. If the batch produces 85 loafs, then the cost of 1 loaf is $24.03 / 85 = $0.28. The same result.

Obtain correct data for VC1 is not very difficult. As explained above, the general rule is to make a list of the inputs used and multiply these by their prices.

However, three points must be taken care of:
1. The price of the inputs must exclude VAT.
2. The price of the input must include the cost of its delivery to the factory.
3. The price of the input must be corrected for processing losses.

1. Price excluding VAT

The input price must exclude VAT, because BAT is compensated by VAT on Sales.

Sales price, net = Sales price, incl. VAT / (1+VAT%)

2. Price, delivered factory

The price delivered is the price of the product plus all delivery costs.

Price, delivered = Input price (excl. VAT) + Delivery costs

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

3. 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 be shaved). These **processing losses** cause the input to be more expensive than its buying price.

There are two ways of calculation: 1. Yield and 2. Processing ratio. Both can be used.

Yield is the % of the input that remains after cleaning. E.g. if a wooden pole costs 10 and there are 20% shaving losses, the shaved pole will cost 10 / (100%-20%) = 12.50. The higher the yield, the lower VC1.

Yield = (100% - processing loss %)

Processing ratio is the quantity of input needed to get 1 ton of output. E.g. to produce 1 ton of apple juice concentrate (AJC) of 68 Brix, 6 tons of apples are needed.

Processing ratio = quantity input / quantity output

The Cigar Boxes favors processing ratio, because it has an intuitive relationship with cost: the higher PR, the higher VC1.

Raw material cost = $P_{(RM)}$ * Processing ratio

Correct measurement of processing ratio 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
- Gas for heating the oven
- Electricity to run equipment
- Water to clean cow skins
- Casual labor to peel potatoes
- Casual labor to pack bread
- Detergents to clean factory
- Mouth caps and uniforms
- Spare parts for equipment repair
- Welding rods
- Etc.

In food industry, VC2 has long been denied as important. Steam, water, electricity and casual labor, were all very cheap. In the recent years, most 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.

VC2 per unit = Processing cost per hour / Units produced per hour

E.g. a sewing machine consumes 6 kW per hour at $0.20 per kWh. This is $1.20 per hour. If five trousers are sewn per hour, the utility cost amounts to $1.20 / 5 = $0.24 per trouser.

Obtaining **correct data for VC2** requires the following steps (see Table 4):

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[5];
4. Calculate the utility use (water, steam, electricity) for each equipment;
5. Calculate the labor requirement per process step;
6. Obtain 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 per hour / 2.0 ton per hour = $68 per ton

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

Table 4. VC2 for Tomato paste 25Brix

VC2 calculation sheet for Tomato paste 25 Brix									USD
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 tomato = 1 kg paste)	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	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		$106.41	$25.19	$4.40
				Processing cost per hour					$136.00
**) RM = tons of raw material				Processing volume per hour					2
FP = tons of finished product				Processing cost per ton				VC2	$68.00

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

2.3.3 VC3

VC3 is the cost of **packaging material**.

- Primary packaging is what holds the finished good. E.g. 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 calculated for the selling unit. This is the unit that appears on the invoice to the client, usually in the secondary or tertiary packaging. Retailers buy 50 cartons of soap, unpack it and sell it individually to the final consumers.

In Table 5, a calculation example is given for a gift pack: 2 golden ear rings packed in a small jewelry box with a tiny lock (primary pack). These jewelry boxes are subsequently packed in a carton box (24 pieces per carton – secondary packaging) and shipped from India to overseas markets on euro-pallets (tertiary packaging). Each pallet holds 67 carton boxes and it shrink-wrapped. In a 20ft container 33 euro-pallets are loaded. Container loading costs are calculated under VC4.

Table 5. VC3 for packaging material of golden earrings

VC3 calculation sheet for golden earrings					INR
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
	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**
Total number of units in final packaging					1,608
				VC3	**Rs 34.52**

The 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 of packaging material in the above example is Rs 55,514.20. (This excludes the golden earrings!)

The selling unit is the tertiary unit (a pallet). It holds 24 primary packs * 67 secondary packs (cartons) = 1,608 primary units per pallet (tertiary unit). Hence, the packaging cost per unit, **VC3 = Rs 55,514 / 1,608 = Rs 34.52**.

If VC3 is expressed in tons, then the cost of the selling unit is multiplied by the number of selling units per ton.

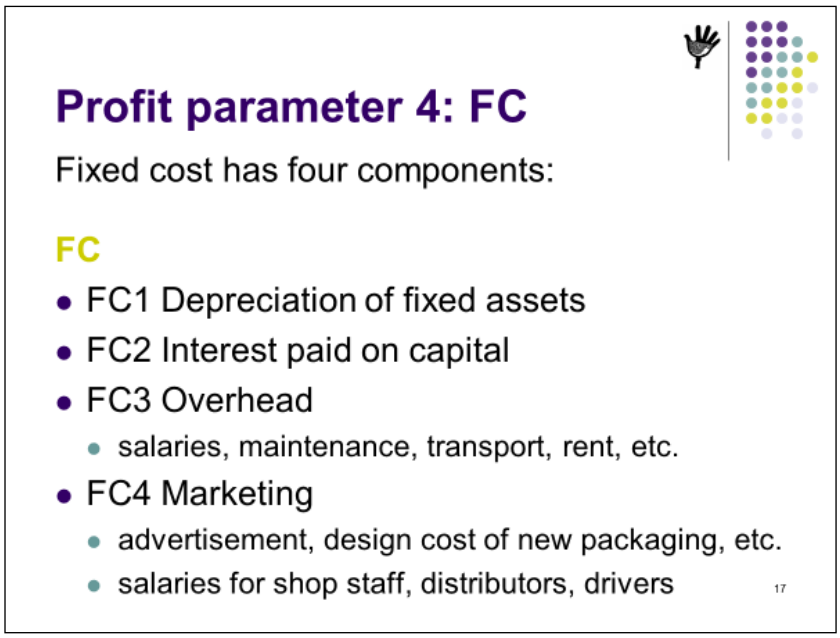
VC3 per ton = Packaging cost of selling unit * units per ton

Example.

- In one carton there are 20 bottles of 250gr, it weighs 5 kg.
- The primary pack costs $0.15 all in.
- The carton box costs $0.50.
- The packaging material in carton = 20*$0.15 + 1*$0.50 = $3.00+$0.50 = $3.50 per carton.
- 1 ton = 1000 kg = 1000/5kg = 200 cartons.
- **VC3 = $3.50*200 = $700 per ton**

2.4 FC. Fixed costs

Variable cost varies with the quantity produced. Fixed costs remain the same, regardless of the quantities produced. Even if there is **no production**, fixed costs must be paid. There are four 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 tend to conveniently forget to depreciate and thus artificially lower their cost price. This will inevitably result into lack of cash for future replacement investments. The Cigar Box suggests users to include a realistic amount of depreciation.

If this money is saved on a separate bank account, it 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[6].

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

Table 6. FC1 Depreciation calculation

FC1 Depreciation calculation sheet				USD					
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

The table above shows depreciation for a flower farm in Burundi. The farm grows (A) roses for export under shade houses with a spray irrigation system, and (B) pot plants in the open field for the local market. The investment in shade house, spray installation and planting material, should not burden the pot flowers. Hence, the share of (A) is 100% and of (B) it is 0%.

The other assets like the nursery, water pumps, packhouse, cool cells and transport are used by both products and the cost is shared 67%-33% based on value sold.

Table 7. FC1 Depreciation calculation with Non-shared assets

FC1 Depreciation calculation with Non-shared assets					USD				
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

2.4.2 FC2

FC2 is the **interest paid** on loans and bank charges. This is not transparent when bank loans are confidential. Interest rates in the west range from 3-8% but can be as high as 30% per year in emerging economies. Shortage of working capital often results from 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 price calculation is still very much needed.

Table 8. FC2 calculation of interest

FC2 calculation sheet for Interest		USD		
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 using a debt amount of 40% of the asset value. Why? Because a healthy balance sheet shows a debt-equity ratio of about 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 profitability is higher than the interest rate, than debt capital should be used to increase return on equity. See Table 9. However, if the profitability is (much) lower than the interest rate, than more equity, and less debt capital must be used. See text books on finance for further understanding[7].

Table 9. FC2. Leverage principle

FC2. Leverage principle					
Profitability 10%	*higher*	*than interest rate of 6%*			
Capital	**Share**	**Investment**	**Amount**	**Rate**	**Parameter**
Equity	60%	€120.0	€15.2	12.7%	return on equity
Debt	40%	€80.0	€4.8	6.0%	interest rate
Total	100%	**€200.0**	**€20.0**	10.0%	profitability
Profitability 10%	*equal to*	*interest rate of 10%*			
Equity	60%	€120.0	€12.0	**10.0%**	return on equity
Debt	40%	€80.0	€8.0	10.0%	interest rate
Total	100%	**€200.0**	**€20.0**	10.0%	profitability
Profitability 10%	*lower*	*than interest rate of 14%*			
Equity	60%	€120.0	€8.8	7.3%	return on equity
Debt	40%	€80.0	€11.2	14.0%	interest rate
Total	100%	**€200.0**	**€20.0**	10.0%	profitability
Profitability 10%	*much lower*	*than interest rate of 25%*			
Equity	60%	€120.0	€0.0	0.0%	return on equity
Debt	40%	€80.0	€20.0	25.0%	interest rate
Total	100%	**€200.0**	**€20.0**	10.0%	profitability

[7] 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.

Table 10. FC3 calculation of overhead costs

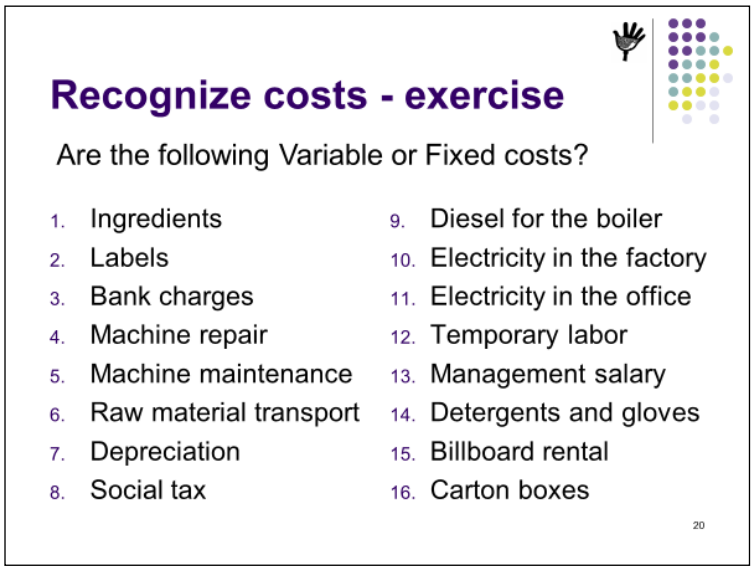
FC3 Calculation sheet for Overhead costs					BIRR
Nbr	Description	Amount per month	Months per year		Annual cost
1	Salaries	235,000	12		2,820,000
2	Social taxes (40%)	94,000	12		1,128,000
3	Rent	100,000	12		1,200,000
4	Telephone, fax, internet	168,000	12		2,016,000
5	Cleaning, office utilities, disposables	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, 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 sales and marketing. This is one amount in which all marketing costs over the agreed period, usually a year, are summed. If the company owns its own distribution fleet and/or retail shops, then fixed costs for staff salaries are under FC4 and not in FC3. Other costs are advertisement, cost of branding, design of packaging material, etc.

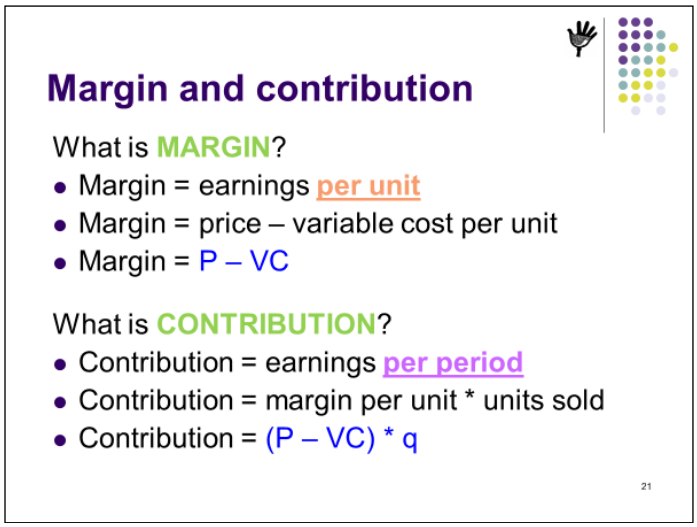
Exercise 1: Recognize variable and fixed costs

Question: are the following costs variable or fixed?

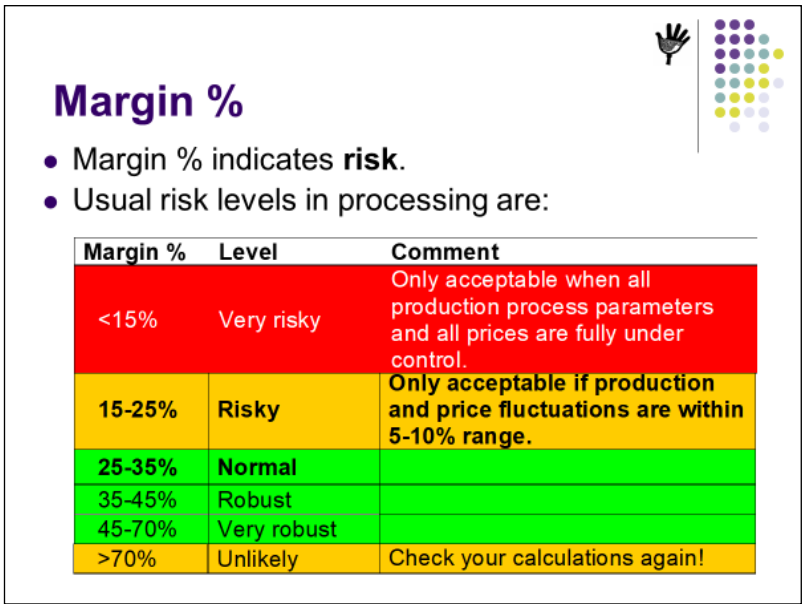


Chapter 3. Margin and Contribution

Once P, VC, and q are known, Margin, Margin % and Contribution can be calculated.



Margin % = (Price - VC) / Price * 100%



Notes:

- When the margin is below 15%, a small reduction in the sales price or an increase in input prices, will lead to a negative margin. That is why this margin % is **only** acceptable if all parameters are fully under control. E.g. in when producing under a contract with fixed prices.
- Margins above 70% are unlikely because of competition in agro-processing.
- The Cigar Box uses a **traffic light** system: RED = danger/stop! ORANGE = warning/improve! GREEN = safe/continue!
- All percentages are guidelines. Verification of assumptions determines the true risk of business.

Chapter 4. Profit Formulas

In this chapter, **two methods of profit calculation** are presented: Bookkeeping method and Cigar Box method which is a cost accounting method.

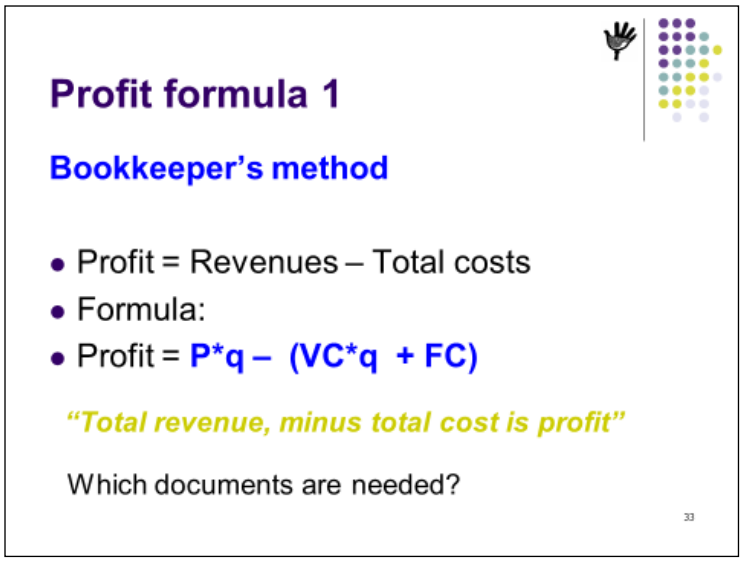
INTERMEZZO
This chapter combines theory with exercise; formulas, data, calculations. I strongly suggest the reader of this module to adopt a rigid way of exercising and always follow these three steps:

1. Write the formula; 2. Fill the data; 3. 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 many formulas. Pleeeeeeeease follow this advice!

4.1 Bookkeeping method

The bookkeeping method is, as the word says, used in bookkeeping systems. Revenues from sales are summed up for a specific period: month, quarter, year. The same for variable and fixed costs. These are deducted from revenues to calculate profit. If there is a profit, profit tax must be paid. As stated before, taxes are ignored in this textbook.



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.

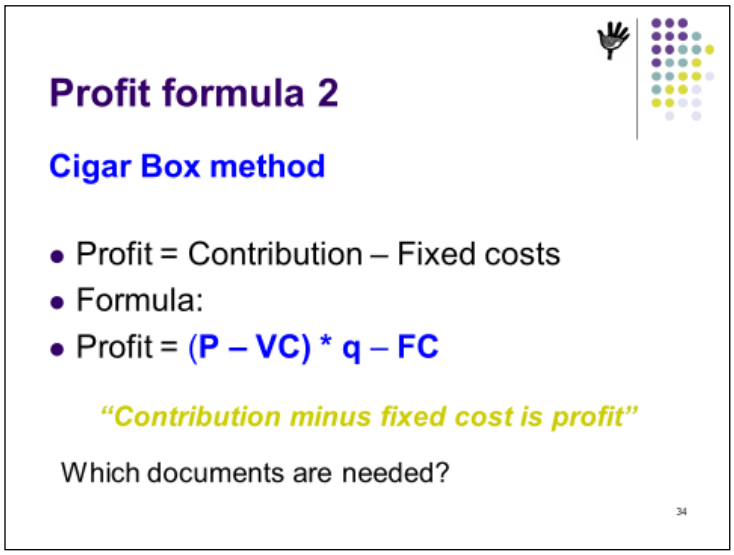
Exercise 3: the following parameters are given: P=6, q=1000, VC=4 and FC=1000.
Question: how much is the profit?
Suggestion: 1. write the formula, 2. fill the data, 3. calculate the answer.

Profit calculation using the BOOKKEEPING formula

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

4.2 Cigar Box method

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 the 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 must be paid. Assume these are 800,000 then a profit of 200,000 is made.

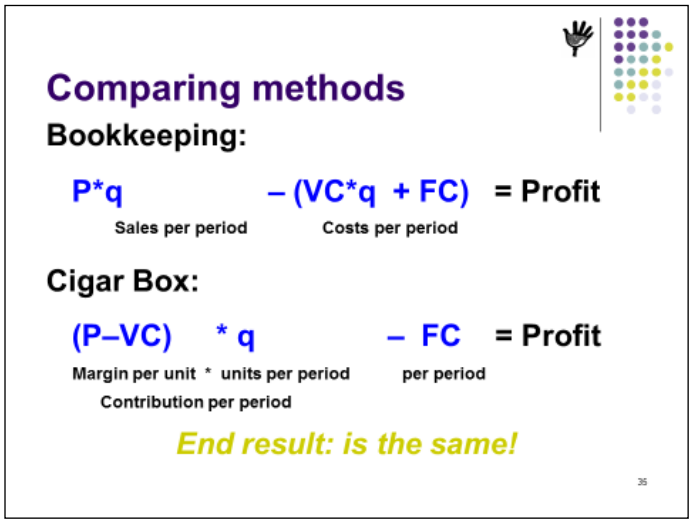
Profit calculation using the CIGAR BOX formula

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

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.

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



4.3 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?

4.4 CB1. Cost price for 1 single 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?

4.5 CB2. Cost prices for >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**.

Chapter 5. Fixed cost attribution

Fixed cost attribution is common practice in bookkeeping and accounting, but it is not very relevant. The reason is that, in existing enterprises, fixed costs are indeed fixed, and must 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** generated by selling products or services.

The task for management is to maximize Contribution within the limitations of the installed 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 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.

5.1 Fixed cost attribution systems

If you, either as owner or manager, insist to know the total cost price of each product, then the fixed costs will have to be divided. Fixed costs are divided using a key: an 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 common in many enterprises.

Now, let's calculate cost prices using these four keys. Assume FC = 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 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 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 result, again, is the same: 1100 profit.

The Cigar Box suggest using **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 $10,000 and the depreciation is 10% per year. They have a loan of $4,000 at 25% interest. Their monthly overhead cost is $500. They produce two types of bags. Big-bags for transport of stones by camels and fashion bags for teenage girls. 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 big-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 are the Contributions 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.

Chapter 6. Break-even formulas

Break-even

- Break-even point is where the profit is zero.
- Revenues – Cost = 0
- Revenues – Total variable cost – Fixed cost = 0
- In formula: **P*q – VC*q – FC = 0**
- Break-even point is where profit is zero
  - Break-even volume: at which q is profit = 0?
  - Break-even price: at which p is profit = 0?
  - Break-even variable costs at which VC is profit = 0?
  - Break-even fixed costs at which FC is profit = 0?

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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 unpredictable parameter**. If quantity sold is the most unpredictable parameter, then quantity risks must calculated accurately. The break-even volume then sets the target: *'sales people, please sell more than the break-even point'*.

6.1 Break-even quantity

Break-even Volume

- At which q is profit = 0 ?
- Base formula: **P*q – VC*q – FC = 0**

(P-VC)*q – FC = 0

$$q_{BE} = \frac{FC}{(P-VC)}$$ in words: = fixed cost per period over the margin per unit

q_{BE} = 200 (per month) / (50-30) = 10 units per month

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Consider the case of Southern Fruit in Jamaica. 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 quantity sold is unknown.

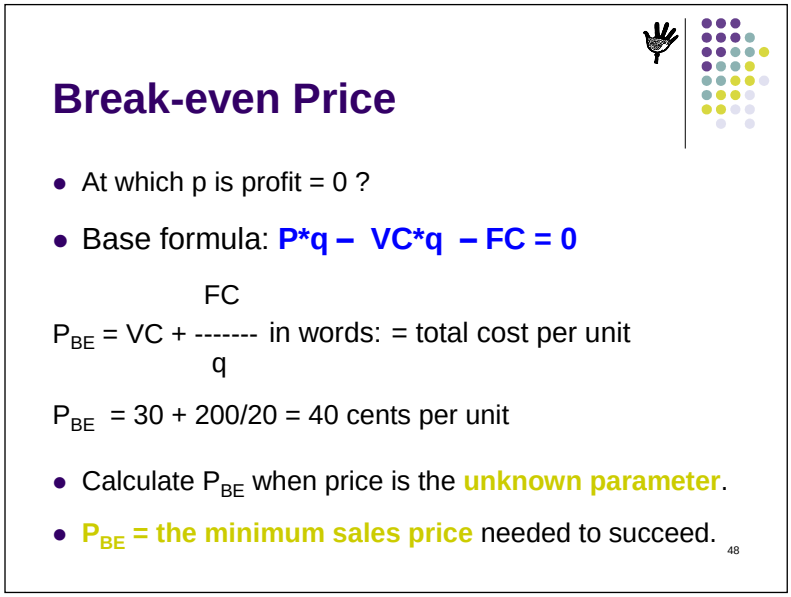
The break-even quantity is calculated as follows:

Break-even quantity = Fixed cost / margin per unit

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!

6.2 Break-even price



The break-even price is calculated when price is the unpredictable 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.

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.

6.3 Break-even variable cost

Break-even Variable Cost

- At which VC is profit = 0 ?
- Base formula: **P*q – VC*q – FC = 0**

$VC_{BE} = P - \frac{FC}{q}$ in words: = price – fixed cost per unit

VC_{BE} = 45 – 200/20 = 35 cents per unit

- Calculate VC_{BE} when VC is the **unknown parameter**
- **VC_{BE} = maximum variable cost per unit** to succeed

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The break-even variable cost is calculated when VC is the unpredictable 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.

6.4 Break-even fixed costs

Break-even Fixed Cost

- At which FC is profit = 0 ?
- Base formula: **P*q – VC*q – FC = 0**

$FC_{BE} = (P - VC) * q$ in words: FC_{BE}= "Contribution"

FC_{BE} = (45 – 30) * 20 (per month) = 300 per month

- Calculate FC_{BE} when FC is the **unknown parameter**.
- **FC_{BE} : fixed cost** can **never** ever be more than the expected contribution!

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The break-even variable cost is calculated when FC is the unpredictable factor. This rarely happens in production companies, but more with **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.

Chapter 7. 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.

Jarlene 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 %. Is it acceptable?
   What is the maximum reasonable price?
b. Calculate the fixed cost per box.
c. The price is 45 per box, what is the break-even q ? What is the profit
d. What should you do to realize 5000 profit with 58,500 in revenues (Give two options) ?

Chapter 8. CB1 Cost price analysis

8.1 Overview

CB1 has 2 columns and 8 boxes. In the left column, everything is calculated per unit. In this example, the calculation unit is USD per ton. In the right column, everything is calculated per period, usually 1 year. Blue numbers are collected from the company. Blue numbers are assumptions for the future and must be verified. Data in black are formulas. When a value is calculated in another table it is linked. Pink is a link.

CB1 - Tomato paste 25 Brix, aseptic bags of 220 kg in steel drums			2010	
	USD per ton			USD per year
P			**Profit**	
Price (DDP Moscow)	1,000		Total Revenue	3,600,000
VC4 Import duties, 10%	91		Total Cost	3,410,154
VC4 Transport, sales commission 3%	144		**Profit Before Tax**	**189,846**
VC4 Other	-		Profitability %	5%
Price (EXW)	**765**		**Cash flow** (+depreciation -loan repayment)	**185,846**
VC			**FC**	
Price (Raw Material, delivered factory)	71		Asset value	1,800,000
Processing ratio	6.0		Depreciation %	7.8%
Raw Material cost	429	*70%*	**FC1**	**140,000** *40%*
Other ingredients	12	*2%*		
VC1	**441**	*72%*	Debt (40% of asset value)	720,000
			Interest rate	18.7%
Production cost per hour (steam, electricity)	124		**FC2**	**134,400** *38%*
Production quantity per hour (ton/hour)	2.0			
VC2	**62**	*10%*	Number of FTE employed	15
			Salaries staff incl. social taxes	50,000 *14%*
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**	*16%*	**FC4**	10,000 *3%*
			FC	**354,400** *100%*
Finished good losses after production %	2.0%		FC % attributed to product	100.0%
VC	**614**	*100%*	**FC (attributed to product)**	**354,400**
P-VC			**q**	
Margin	**151**		Quantity sold q (ton)	3,600
Margin %	20%		**Contribution**	**544,246**
VC	**614**	*86%*	**Break-even quantity (sales)**	**2,344**
			Break-even quantity (raw material)	14,065
Fixed Cost / q	**98**	*14%*	**Break-even**	
Profit per unit			Output capacity per hour in ton	2.0
Total Cost / q	**712**	*100%*	Working hours per day	22
			Length of harvesting season in days	100
Profit / q	**53**		**Max. output capacity per year**	**4,400**
			Capacity utilization %	82%
Capacity utilization				
*Note: figures in **blue** are assumptions; figures in **pink** are calculated in another sheet; figures in **black** are formulas*				

Box P calculates the **ex-works price**. P-VC4.

Box VC calculates the **variable costs**. VC1, VC2 and VC3. The % of VC1, VC2 and VC3 are very useful benchmarks to analyze the efficiency of a factory.

Box P-VC calculates the margin and margin %. Margin % is automatically benchmarked.

Box q entering the quantity sold, gives the contribution per year.

Box FC calculates the **fixed costs**. FC1, FC2, FC3, and FC4 and their % share of total FC. These are very useful benchmarks to analyze the efficiency of a factory.

Box Profit calculates total revenue, costs, **profit**, profitability (benchmarked) and cash flow.

Box q(BE) calculates the **break-even** quantities in terms of sales and raw material required. It also calculates installed capacity and capacity utilization (benchmarked).

Box Profit per unit calculates fixed cost per unit, total cost per unit and **profit per unit**.

8.2 CB1 for Tomato puree 25 Brix

This example is from Kyrgyzstan. It calculates profit of exporting tomato paste 25 Brix. It is processed from fresh tomatoes of 4.5 Brix. Tomato paste is packed in aseptic bags of 220 kg, packed in an aseptic bag in a steel drum. This is the selling unit.

Box P. Sales price is $1000 per ton DDP Moscow. Import duty is 10% of the DDU price. Transport costs and 3% sales commission amount to $144 per ton. **P(EXW)=$765**.

Box VC. VC1. Price of fresh tomato is $71 per ton delivered to the plant. To produce 1 ton of concentrated puree, 6 tons of fresh tomato is required. Thus, the tomato in the past costs $71*6=$429 per ton. Other ingredients cost $12. **VC1=$441 /ton.**

VC2. The processing is fully automated. All labor is fixed. Utility costs to run the machines and evaporator amount to $124 per hour. The output is 2 ton of paste per hour. **VC2= $124/2 = $62 per ton.**

VC3. The cost of the selling unit is $21.8 per drum. The drum weighs 220kg (net). For 1 ton 4.55 drums are needed. **VC3 = $21.8 * 4.55 = $99 per ton.**

FG Losses after packing are 2% of total production.

VC. = (VC1 +VC2+VC3) * (1+2%). **VC = $614 per ton**.

Box P-VC The margin is **$151 per ton**, or 20% of the P(EXW). It colors orange indicating that it is risky, and acceptable only if production and price fluctuations are within 10%.

Box q The company sold **q=3,600 tons** of paste. **Contribution = $151*3600 = $544,246**.

Box FC FC1. The replacement value of the assets amounts to $1.8 Million. The average depreciation was 7.8%. See calculation in table. **FC1 = $140,000 per year.**

SN	Investment	Value USD	%	Depreciation
1	Land	-	10%	-
2	Building	250,000	5%	12,500
3	Primary processing equipment	400,000	8%	32,000
4	Two effect evaporator (2 t/hr)	850,000	8%	68,000
5	Packaging line	130,000	8%	10,400
6	Trucks	130,000	10%	13,000
7	Office	40,000	10%	4,100
8				
	Total	**1,800,000**	**7.8%**	**140,000**

FC2. The owner was not willing to provide loan information. Hence, as explained above, we used 40% of the asset value, or $720,000. We estimated that the loan must be repaid in 5 years, or $144,00 per year. This does not affect FC2 but reduces the cash flow. The going interest rate in Kyrgyzstan was 18.7% per annum.
FC2 = $134,000 per year.

FC3. The company employs 25 people, 5 full-time and 20 for 6 months during the production season. This is equivalent to 15 FTE. Including other overhead **FC3=$70,000 per year**.

FC4. To find new customers, the company visits ANUGA in Germany and PROEXPO in Moscow. **FC4 = about $10000 per year**.

FC = FC1+FC2+FC3+FC4. The company only produces and sells tomato paste, hence 100% of the fixed costs are attributed to this product. **FC (attributed) = $354.400.**

Box Profit Total revenue was $3.6 Million; total costs were $3.41 Million resulting in $185,846 profit, or 5% of turnover. The cash flow is profit + depreciation – loan repayment. **Cash flow = $189,846 + $ 140,000 - $ 144,000 (see under FC2) = $185,846 per year**.

Box q(BE) q(BE) = FC(attributed) / margin = $345,400 per year / $151 per ton = 2,344 ton/year and the corresponding q(BE-RM) = q(BE) * Processing ratio = 2344*6.0 = 12,065 ton. This is the minimum quantity of tomato that must be procured to be able to produce the breakeven quantity.

Box Capacity. The bottleneck in the line is 2.0 ton per hour (see VC2 calculation in Table 4). The lines can effectively run 22 hours because it must be cleaned regularly. The tomato season is 100 days. The maximum capacity is thus 2*22*100= 4,400 tons per year. At 3,600 tons actually sold, the company runs at 82% utilization.

8.3 CB1 for Bread, 700gr sliced and packed.

This example is from Nigeria. It calculates profit of selling sliced and packed sandwich bread of 700gr. This is the selling unit. 20% is sold through the shop in front of the bakery. 80% is sold to distributors who in turn sell it to street vendors who sell it to the final consumers.

CB1 Bread				2018	
Sandwich bread, 700 gram sliced and packed in cellophane					
	USD per kg			USD per year	
Price (delivered market)	0.75		Sales	378,000	
VAT, 5%	0.04		Total Cost	311,178	
VC4 Transport + Sales commission 5%	0.03		**Profit Before Tax**	**70,000**	
VC4 Other costs	-		Profitability %	19%	
Price (EXW)	**0.68**		Cash flow	**62,438**	
Cost of the dough, according to recipe	0.29		Asset value (Own capital = 50%)	82,500	
Processing ratio, baking losses	-12%		Depreciation %	7.5%	
Cost of dough	0.33	*69%*	**FC1**	**6,188**	*17%*
Other ingredients (filling, decoration)	-	*0%*			
VC1	**0.33**	*69%*	Debt (50% of Asset value)	41,250	
			Interest rate	19.0%	
Production cost per hour (oil, electricity, labor)	5.12		**FC2**	**7,838**	*21%*
Production quantity per hour (kg/hour)	56				
VC2	**0.09**	*19%*	Number of FTE employed	10	
			Overhead salaries, maintenance	15,000	*41%*
Cost of packing (flow pack, labels)	0.03		Other overhead	6,600	*18%*
Number of selling units per kg	1.43		**FC3**	**21,600**	*59%*
VC3	**0.04**	*8%*	**FC4**	1,250	*3%*
			FC	**36,875**	*100%*
Returned goods	0.02	5%	FC % attributed to product	100.0%	
VC	**0.48**	*100%*	**FC (one single product)**	**36,875**	
Margin	**0.21**		Quantity sold q (kg/yr)	504,000	
Margin %	30%		**Contribution**	**103,697**	
Variable cost	0.48	*87%*	**Break even quantity (sales)**	**179,223**	
Fixed Cost / q	0.07	*13%*	Break even quantity (raw material)		
Total Cost / q	**0.55**	*100%*	Output capacity in kg per hour	70	
			Working hours per day	23	
Profit / q	**0.13**	*24%*	Length of production season in days	360	
			Max. output capacity per year	**579,600**	
			Capacity utilization %	87%	
*Note: figures in **blue** are assumptions; figures in **pink** are calculated in another sheet; figures in **black** are formulas*					

Box P. Sales price is 220 Naira per loaf. Rate of exchange is 400 Naira per dollar. VAT is 5% and the cost of distribution is 13 naira per kg. **P(EXW)=$0.68 per kg**.

Box VC. VC1. Flour costs Naira 9000 per 50 kg bag ($0.45 per kg). The other ingredients cost is given in Table 3. VC1 for Bread. No filling, no decoration. **VC1=$0.33 per kg.**

VC2. The ovens and other machinery cost $5.12 per hour and the actual output is 80 loafs or 56 kg per hour. All labor is fixed. **VC2= $5.12/56 = $0.09 per kg.**

VC3. The selling unit is one loaf (no secondary packaging). The cost is 10 naira or $0.03 per loaf. The loaf weighs 700 gr, so 1.43 loafs per kg. **VC3 = $0.03 * 1.43 = $0.04 per kg.**

FG Losses are 5% of total production (unsold loaves returned to bakery).

VC. = (VC1 +VC2+VC3) * (1+5%). **VC = $0.48 per kg**.

Box P-VC Margin is **$0.21 per kg**, or 30% of the P(EXW). Benchmark is green which is OK.

Box q The company sells 200 loaves per day **q=504,000 kg per year**. **Contribution = $0.21*504,000 = $36,875 per year**.

Box FC FC1. The replacement value of the assets is $82,500. The average depreciation was 7.5%. **FC1 = $6,188 per year.**

FC2. The owner was not willing to provide loan information. Hence, as explained above, we used 50% of the asset value, or $720,000. We estimated that the loan must be repaid in 3 years, or $13,600 per year. This does not affect FC2 but reduces the cash flow. The interest rate in Nigeria is 19% per annum. **FC2 = $7,838 per year**.

FC3. The company employs 10 full-time people. Including other overhead **FC3=$21,600 per year**.

FC4. Some promotion 500,000 naira per year. **FC4 = $1,250 per year**.

FC = FC1+FC2+FC3+FC4. They produce 80% bread and 20% cake and pastry. Hence, 80% of the fixed costs are attributed to bread. **FC (attributed) = $29,500.**

Box Profit Total revenue was $378,000; total costs were $303,800 resulting in $74,197 profit, or 20% of turnover. The cash flow is profit + depreciation – loan repayment. **Cash flow = $74,197 + $6,188 - $13,600 (see under FC2) = $66,635 per year**.

Box q(BE) q(BE) = FC(attributed) / margin = $29,500 per year / $0.21 per ton = 143,379 kg per year or 569 loaves per day.

Box Capacity. The bottleneck is the oven. It can bake 100 loaves or 70 kg per hour. The bakery can operate 23 hours per day, 360 days per year. The maximum capacity is thus 70*23*360 = 579,600 kg per year. With 504,000 loaves it works at 82% utilization.

Chapter 9. CB2 Portfolio analysis

This chapter outlines the topics which will be addressed in the CB2 Manual (to be written).

9.1 Contribution analysis

This is about the importance of having a balanced portfolio and how to balance it.

9.2 Reducing costs

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

9.3 Increasing the sales price

This describes how you can push your sales price upwards 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.

9.4 Making a production and sales plan

This 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.

9.5 Operational monitoring

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

Chapter 10. Answers

Exercise 1:

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.
Answers:

Exercise 2:

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:

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

Exercise 4:

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

Exercise 5:

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

Exercise 6:

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

Exercise 7:

This is a long story. The first step you take is list the facts. Item by item:

- Joyce and Anushik produce leather bags.
- They have 6 stitching machines and semi-automatic press to print leather.
- The asset value is $10,000 and the depreciation is 10% per year.
- The have a loan of $4,000 at 25% interest.
- Their monthly overhead cost is $500.
- They produce two types of bags:
    - Big-bags for transport of stones by camels (A)
    - 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 big-bag is $5.

Now it is easier to answer the questions.

7a. What is the <u>fixed cost</u> per year?

1. Formula: FC = FC1 + FC2 + FC3 + FC4
   FC1 = asset value * depreciation % =10,000 * 10% = 1000
   FC2 = debt value * interest rate % = 4,000 * 25% = 1000
   FC3 = monthly expenses * 12 = 500 * 12 = 6000
   FC4 = not given = 0

2. Data: FC = 1000 + 1000 + 6000 + 0
3. Answer: **FC = 8,000**

7b. What is the total variable cost per year?

1. Formula: Total VC = VC(Prod. A) * q (Prod. A) + VC(B) * q(B)
2. Data: Total VC = 5 * 1200 (=50 pairs per month!) + 4 * (500 * 12)
3. Answer: **Total VC = 30,000**

7c. What are the sales per year?

1. Formula: Sales = Revenue A + Revenue B
   Sales = P(A) * q(A) + P(B) * q(B)
2. Data: Sales = 15 (30 per pair!) * 1200 + 5 * 6000
3. Answer: **Sales =48,000**

7d. What is the profit per year?

1. Formula: Profit = Sales revenue – total variable cost – fixed cost
2. Data: Profit = 48,000 – 30,000 – 8,000
3. Answer: **Profit = 10,000**

7e. What is the cost price of A and B, using Key 3 Total VC?

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

7f. What are the Contributions of A and B?

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

7b. What is the cost price of A and B, using Key 4 Contribution?

1. Formula: Contribution = Margin * q
   Contribution(A) = Margin(A) * q(A)
2. Data: Contribution(A) = (15 – 5) * 1200 = 10 * 1200
3. Answer A: **Contribution(A) = 12,000**

4. Data: Contribution(B) = (5 – 4) * 6000 = 1 * 6000
5. Answer A: **Contribution(B) = 6,000**

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	P	VC	Margin	q	Contribution	FC	Profit	q BE
2a	0.50	0.30	0.20	35000	**7,000**	7,700	-700	**38500**
2b	0.50	0.30	0.20	35000	**7,000**	7,700	-700	**38500**
2c	0.55	0.30	0.25	40000	**10,000**	7,700	**2,300**	**30800**

8a. What is the profit in normal months?

4. Formula: Profit (normal months) = (P-VC) * q (normal months) – FC.
5. Data: Profit = (0.50-0.30) * 35,000 – 7,700 = 0.20 * 35,000 – 7,700 =
6. Answer: **Profit = -/- 700**. Hence a loss!

8b. What is the break-even volume in normal months?

4. Formula: q(BE) = FC / (P-VC).
5. Data: q(BE) = 7,700 / (0.50-0.30)
6. Answer: **q(BE) = 38,500**

8c. What is the profit in December?

1. Formula: profit (December) = (P-VC) * q (December) - FC
2. Data: profit = (0.55-0.30) * 40,000 - 7,700 = 0.25 * 40,000 – 7,700
3. Answer: **profit = 2,300**.

Questions	P	VC	Margin	q	Contribution	FC	Profit	q BE	VC BE	FC BE
2d	0.50	0.30	0.20	35000	**7,000**	7,700	-700	**38500**	**0.28**	**7,000**
2e	0.50	0.30	0.20	35000	**7,000**	7,700	-700	**38500**	**0.28**	**7,000**
2f	0.50	0.28	0.22	35000	**7,700**	7,000	**700**	**31818**	**0.30**	**7,700**

8d. At what variable cost does J&J break even?

1. Formula: VC(BE) = P – FC / q (normal months)
2. Data: VC(BE) = 0.50 – 7,700 / 35,000
3. Answer: **VC(BE) = 0.28**.

8e. At what fixed cost does J&J break even?

1. Formula: FC (BE) = Contribution = (P – VC) * q (normal months)
2. Data: FC = (0.50–0.30) * 35,000
3. Answer: **FC =7,000**.

8d. What do you recommend J&J?

1. Situation: Both VC and FC are above their break-even points.
2. Problem: Lowering VC or FC to break-even still leads to loss.
3. Solution: Try to **lower VC and FC** to break-even.
4. Result: If VC=0.28 and FC=7000, then profit = 700.

Exercise 9:

- Jarlene 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

9a. Calculate the margin per box;

1. Formula: margin =(P – VC)
2. Data: margin = (50–30)
3. Answer: **margin = 20**

9a. Calculate the margin %. Is it acceptable?

1. Formula: margin% = (P – VC) / P * 100%
2. Data: margin% = (50–30) / 50 * 100%
3. Answer: **margin% = 40%**
4. Acceptable: yes, it is a robust margin.

9a. What is the maximum reasonable price?

The maximum margin in a competitive market is 70%.

1. Formula: P(max) = VC / (1-70%)
2. Data: P(max) = 30 / (1-0.70)
3. Answer: **P(max) = 100**

9b. Calculate the fixed cost per box

Problem is that we only q per harvest. FC is for the year. So, how many harvests per year?
Assumption: 3 harvest per year

1. Formula: FC/q
2. Data: FC/q = 20,000 / 400 * 3 = 20,000 /1,200
3. Answer: **FC/q = 16.67**

Q	P	q	Revenue	VC	Margin	Mrg %	FC	FC /q	TC /q	Cost	Profit	BE
3.a	50.0	1200	**60000**	30.0	20.00	40%	20000	16.67	46.7	**56000**	**4000**	**1000**
3.b	50.0	1200	**60000**	30.0	20.00	40%	20000	16.67	46.7	**56000**	**4000**	**1000**
3.c	45.0	1200	**54000**	30.0	15.00	33%	20000	16.67	46.7	**56000**	**-2000**	**1333**
3.d1	45.0	1300	**58500**	25.8	19.23	43%	20000	15.38	41.2	**53500**	**5000**	**1040**
3.d2	45.0	1300	**58500**	30.0	15.00	33%	14500	11.15	41.2	**53500**	**5000**	**967**

9c. The price is 45 per box, what is the break-even q? What is the profit?

1. Formula: q(BE) = FC / (P – VC)
2. Data: q(BE) = 20,000 / (45 – 30)
3. Answer: q(BE) = 1,333
4. Profit: **q(BE) = -/- 2000.** A loss!

9d. How can you have 5000 profit with 58,500 in revenues?
What is q?

1. Formula 1: Revenues = P * q
2. Data: 58,500 = 45 * q
3. Answer: q = 58,500 / 45 = 1,300

9d. Option 1 – Lower VC with same FC (= 20,000)

1. Formula: Total VC = Revenue – Profit – FC
   VC*q = P*q – Profit – FC
   VC = (P*q – Profit – FC) / q
2. Data: VC = (45 *1,300 – 5,000 – 20,000) / 1,300
   VC = 46,500 / 1,300
3. Answer 1: **VC = 25.8**

9d. Option 2 – Lower FC with same VC (= 30)

1. Formula: FC = Revenue – Profit – Total VC – FC
   FC = P*q – Profit – VC*q – FC
2. Data: FC = 58,500 – 5,000 – 30*1300
3. Answer 2: **FC = 14,500**

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