TECHNICAL UNIVERSITY OF LIBEREC
Faculty of Economics

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New Opportunities for the Development of Education at the Technical University of Liberec

Specific objective A2: Development in the field of distance learning, online learning and blended learning

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Study guide - calculations

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Národní plán obnovy

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Content

- Contribution margin
- Break-even point analysis
- Traditional x ABC costing
- Profit planing

I) Contribution margin

	Products			Total
	X	Y	Z	
Sales quantity	1,000	1,500	2,000	
Sales price (in €)	300	250	400	
Variable costs per unit (in €)	200	160	280	
Fixed product costs (in €)	40,000	50,000	120,000	
Fixed company costs (in €)				150,000

Tasks:

1) Calculate the contribution margin of each product (multistage calculation)
2) Decide which product is the most profitable

Contribution margin

	Products						Total	
	X		Y		Z		ths €	%
	ths €	%	ths €	%	ths €	%		
Sales revenue (in €)								
Variable costs (in €)								
Contribution margin I (in €)								
Fixed product costs (in €)								
Contribution margin II (in €)								
Fixed company costs (in €)								
Profit (in €)								

Contribution margin - solution

	Products						Total	
	X		Y		Z		ths €	%
	ths €	%	ths €	%	ths €	%		
Sales revenue (in €)	300	100	375	100	800	100	1,475	100
Variable costs (in €)	200	66.7	240	64.0	560	70	1,000	67.8
Contribution margin I (in €)	100	33.3	135	36.0	240	30	475	32.2
Fixed product costs (in €)	40	13.3	50	13.3	120	15	210	14.2
Contribution margin II (in €)	60	20.0	85	22.7	120	15	265	18.0
Fixed company costs (in €)							150	10.2
Profit (in €)							115	7.8

II) Calculation of the Break-even point in heterogeneous production

Calculation of BEP is based on:

1. ***variable cost per 1,- CZK of revenues***

   → **total VC/total revenues**

2. ***contribution margin of a certain structure of company´s output***

   → **1 – total VC/total revenues**

Determining the Break-even point

BEP = FC/contribution margin

BEP is expressed ***in value*** as such an amount of revenues that covers fixed costs spent

By the amount of output a company has neither profit nor loss → BEP

Calculation of revenues by which a company achieves a required amount of profit

$REVENUES_{RP}$ =

= (FC + required profit)/contribution margin

Calculation of the Break-even point in heterogeneous production

A company produces five types of products – A, B, and C. These products have the following costs and prices:

Table 1 The contribution of individual products to total revenues at the Break Even Point

Product	Product price (CZK)	Average variable costs (CZK)	Sales (pc)	Total revenues (CZK)	Total variable costs (CZK)
A	1,200	620	4,000	4,800,000	2,480,000
B	5,230	3,150	6,000	31,380,000	18,900,000
C	3,100	1,500	1,000	3,100,000	1,500,000
Total				**39,280,000**	**22,880,000**

Source: Own computation.

Fixed costs are 10,000,000 CZK.

Calculation of the Break-even point in heterogeneous production

Tasks:

1. Calculate the total revenues by which a company achieves the Break Even Point (assuming no changes in the output structure).
2. Calculate the contribution of individual products to the total revenues at the Break Even Point.
3. Assuming the constant output structure calculate the total revenues and revenues attributed to individual products by which a company will achieve the profit in the amount of 2,000,000 CZK.

Calculation of the Break-even point in heterogeneous production - solution

1) The calculation of the Break Even Point by the inhomogeneous production is based on variable costs per 1 CZK of sales and the contribution margin to sales by a set structure.

$$\text{VCpU} = \frac{VC}{TR} = \frac{22{,}880{,}000}{39{,}280{,}000} = 0.5825 \quad \text{(variable costs per 1 CZK)}$$

Variable costs per 1,- CZK of sales are 0.5825 CZK and the contribution margin to sales is 0.4175 CZK (= 1 – 0,5825).

$$TR_{BEP} = \frac{FC}{1-\text{VCpU}} = \frac{10{,}000{,}000}{1-0.5825} = \frac{10{,}000{,}000}{0.4175} = \underline{23{,}952{,}096\ \text{CZK}}$$

A company achieves the Break Even Point by revenues in the amount of 23,952,096 CZK.

Calculation of the Break-even point in heterogeneous production - solution

2) Share on total revenues = 4,800,000 / 39,280,000 * 100 = **12.22**

Revenues by achieving the BEP in CZK (Product A) = 23,952,096 * 12,22 / 100 **= 2,926,936**

Number of products = 2,926,936 / 1,200 = **2,439 products**

Product	**Share on total revenues (%)**	**Revenues by achieving the BEP (CZK)**	**Price per piece**	**Number of products by BEP in pcs**
A	12.2200	2,926,936	1,200	2,439
B	79.88780	19,134,847	5,230	3,659
C	7.8921	1,890,313	3,100	610
Total	100	23,952,096		

Calculation of the Break-even point in heterogeneous production - solution

$$\text{TRp} = \frac{FC+P}{1-\text{VCpU}} = \frac{10{,}000{,}000+2{,}000{,}000}{1-0.5825} = \frac{12{,}000{,}000}{0.4175} = \underline{28{,}742{,}515\ \text{CZK}}$$

A company achieves the profit in the amount of 2,000,000 CZK by the total revenues of 28,742,515 CZK.

The revenues of individual products by achieving the profit in the amount of 2,000,000 CZK (product A) = 28,742,515 * 12.22 = **3,512,325 CZK**

Product	Share on total revenues (%)	Revenues at the given profit (CZK)	Price per piece	Number of products at the given profit in pcs
A	12.2200	3,512,325	1,200	2,927
B	79.88780	22,961,816	5,230	4,390
C	7.8921	2,268,376	3,100	732
Total	100	28,742,515		

III) Comparison of traditional product costing with ABC

- Beta company manufactures products A and B for which this information is available:

Ratio	Unit of measure	Product A	Product B
Production and sale	pcs	25,000	5,000
Direct material	CZK/pcs	25	20
Direct wages	CZK/pcs	15	5
Machine hours (number of hours for the production of 1 pc)	hour/pc	1	2
Number of adjustments of machines for total production	---	4	20
Number of shipments to deliver the total quantity	---	40	80
Number of pcs in one delivery	pcs	625	62.50
Number of pcs produced per 1 adjustment	pcs	6,250	250

Comparison of traditional product costing with ABC

Overhead costs have this structure:

- machine adjustment costs = 120,000 CZK
- other production overheads = 700,000 CZK
- shipping and delivery costs = 180,000 CZK

Total overhead costs = 1,000,000 CZK

Tasks:

a) Calculate the production cost for products A and B in the traditional way using a **mark-up calculation**. As a cost-allocation base, use: - ***direct wages***,

- ***machine hours***.

b) Calculate production costs for products A and B using the ABC method.

c) Compare all calculated results.

Solution a)

Distribution of total overhead costs by *direct wages*

$$\text{Coeficient OC} = \frac{1{,}000{,}000}{(15 \times 25{,}000) + (5 \text{ x } 5{,}000)}$$

$$= \frac{1{,}000{,}000}{375{,}000 + 25{,}000} = 2.5\ (\mathbf{250\%})$$

Overhead costs (OC) of each product will represent 250% of direct labour costs.

Solution a)

- Calculation of production costs in CZK per one piece using mark-up calculation:

	A	B
Direct material	25	20
Direct wages	15	5
Overhead costs	37.5	12.5
Total costs	**77.5**	**37.5**

Solution a)

Distribution of total overhead costs by *machine hours*

$$\text{OC rate} = \frac{1{,}000{,}000}{(1 \times 25{,}000) + (2 \text{ x } 5{,}000)} = \frac{1{,}000{,}000}{25{,}000 + 10{,}000} =$$

$$\mathbf{28.60\ CZ}\boldsymbol{K}\mathbf{/machine\ hour}$$

Overhead costs (OC) of each product will represent 28.60 CZK per each machine hour.

Solution a)

- Calculation of production costs in CZK per one piece using mark-up calculation:

	A	B
Direct material	25	20
Direct wages	15	5
Overhead costs	28.60	57.20
Total costs	**68.60**	**82.20**

Solution b)

Allocation of overheads using the *ABC method*

Types of Overhead costs (OC)

- machine adjustment costs = 120,000 CZK
- other production overhead costs = 700,000 CZK
- shipping and delivery costs = 180,000 CZK

Solution b)

1. Allocation *of Machine Adjustment Costs* → CD_1 = number of machine adjustments

$$\text{Rate}_1 = \frac{\text{machine adjustement costs}}{CD_1(\text{nb. of machine adjustments})} = \frac{120\ 000}{4\ (\text{A}) + 20\ (\text{B})}$$
$$= \mathbf{5,000\ CZK/adjustment}$$

Total adjustment costs attributable to all products A:

Rate_1 x number of adjustments = 5,000 × 4 = 20,000 CZK

Solution b)

Adjustment costs attributable to **1 pc of product A** →

$$\frac{\text{machine adjustment costs}}{\text{number of products A}} = \frac{20{,}000}{25{,}000} = \mathbf{0.80\ CZK/1pc}$$

Total adjustment costs attributable to all products B:

$$\text{Rate}_1 \text{ x number of adjustments} = 5{,}000 \times 20 = 100{,}000 \text{ CZK}$$

Adjustment costs attributable to **1 pc of product B** →

$$\frac{\text{machine adjustment costs}}{\text{number of products B}} = \frac{100{,}000}{5{,}000} = \mathbf{20\ CZK/1pc}$$

Solution b)

Check:

Total adjustment costs of product A 20,000 CZK

Total adjustment costs of product B <u>100,000 CZK</u>

Adjustment costs 120,000 CZK

(this amount was allocated)

Solution b)

2. Allocation *of other production overhead costs* → CD_2 = number of machine hours

$$Rate_2 = \frac{\text{Other production overhead costs}}{CD_2\ \text{(total machine hours for the whole production)}}$$

$$= \frac{700{,}000}{(1 \times 25{,}000\ \text{A}) + (2\ \times 5{,}000\ \text{B})}$$

$$= \mathbf{20\ CZK\ /machine\ hour}$$

Solution b)

Other production overhead costs attributable to **1 pc of product A**:

Rate_2 x machine hours = 20 × 1 = **20 CZK/1ks**

Other production overhead costs attributable to **1 pc of product B:**

Rate_2 x machine hours = 20 × 2 = **40 CZK/1ks**

Solution b)

Check:

Total other production overhead costs for the product A:

Rate_2 x number of manufactured pieces = 20 x 25,000 = 500,000 CZK

Total other production overhead costs for the product B:

Rate_2 x number of manufactured pieces = 40 x 5,000 = <u>200,000 CZK</u>

Total other production overhead costs 700,000 CZK

(this amount was allocated)

Solution b)

3. Allocation *of shipping and delivery costs* → CD_3 = number of deliveries

$$\text{Rate}_3 = \frac{\text{Shipping and delivery costs}}{\text{CD}_3 \text{ (total number of deliveries)}} = \frac{180\ 000}{40\ \text{A} + 80\ \text{B}} = \mathbf{1,500\ CZK/delivery}$$

Solution b)

Total shipping and delivery costs of all products A:

Rate_3 x number of deliveries $= 1{,}500 \times 40 = 60{,}000$ CZK

Shipping and delivery costs per **1 piece of product A**

$$\rightarrow \frac{\text{schipping and deliver costs}}{\text{number of products A}} = \frac{60{,}000}{25{,}000} = \mathbf{2.40\ CZK/1pc}$$

Solution b)

Total shipping and delivery costs of all products B:

Rate_3 x number of deliveries $= 1{,}500 \times 80 = 120{,}000$ CZK

Shipping and delivery costs per **1 piece of product B** →

$$\frac{\text{shipping and deliver costs}}{\text{number of products B}} = \frac{120{,}000}{5{,}000} = \mathbf{24\ CZK/1pc}$$

Solution b)

Check:

Total shipping and delivery costs of products A	60,000 CZK
Total shipping and delivery costs of products B	120,000 CZK
Total Shipping and delivery costs	180,000 CZK
(this amount was allocated)	

Solution b)

Calculation of production costs in CZK per one piece using the ABC method:

	A	B
Direct material	25	20
Direct wages	15	5
OC for machine adjustment	0.80	20
Other production overhead costs	20	40
OC for expedition and delivery	2.40	24
Total costs	**63,20**	**109**

Solution c)

Comparison of calculated results:

Total cost of 1 pc of product in CZK:	A	B
Mark-up calculation (by direct wages)	77.50	37.50
Mark-up calculation (by machine hours)	68.60	82.20
ABC method	63.20	109.00

IV) Determination of profit in the following year

- Variable costs equals to 60% of revenues, the rest of the costs are fixed costs, which will not change in the next 2 years.
- Income tax will not be paid for 5 years.
- Profit in the current year reached 25 mil. CZK with revenues of CZK 250 million.

Tasks:

a) Determine the amount of costs in the next year if revenues will rise to CZK 300 million

b) Calculate the profit in the next year

c) Calculate the return on sales in each year

Determination of profit in the following year - solution

a) Costs next year

Total cost = revenues – profit = 250 – 25 = 225 million CZK

Variable costs = 60% of revenues: 250 x 0,6 = 150 million CZK

Fixed costs = total cost – variable costs = 225 – 150 = **75 million CZK (does not change)**

Total expected costs next year = Variable costs + fixed costs = 300 x 0,6 + 75 = 180 + 75 = **255 million CZK**

b) Profit next year:

Profit = Total Revenues – Total Cost = 300 – 255 = **45 million CZK**

Determination of profit in the following year - solution

c) Return on sales – first year:

ROS = profit / revenues * 100 = 25 / 250 *100 = 10%

Return on sales – second year:

ROS = profit / revenues * 100 = 45 / 300 *100 = 15%

Thank you for your attention