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Utilization of contribution margin in the costing system in production of components for wood working machines

Upotreba kontribucijske marže u sustavu troškova u proizvodnji dijelova strojeva za obradu drva

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ABSTRACT • *The aim of this paper is to propose optimization of costing method for planning a production-sales programme of the chosen engineering enterprise dealing with the production of components for wood working machines. This engineering company uses the calculation pattern methodology in the comprehensive cost accounting system. All costs components are absorbed by individual outputs in this cost calculation. The results of this calculation are not available for decision-making tasks. In order to solve the decision tasks relating to output assortment optimization, it is necessary to show separately variable costs influenced by changes in production volume and fixed costs not influenced by changes in production volume. For these reasons we propose a specific application of retrograde costing as a necessary condition for effective system of decision-making on the basis of contribution margin calculation. The contribution margin/standard hour is the criteria for the calculation in a critical place of production and this is very important information for developing an optimal production-sales programme.*

Key words: *calculation, costing, cost, profit, contribution margin*

SAŽETAK • *Cilj rada je predložiti metodu optimizacije troškova za potrebe planiranja proizvodno-prodajnog programa u tvrtki za proizvodnju dijelova za strojeve za obradu drva. Za kompletan obračun troškova tvrtka se koristi standardnim modelom obračuna, s nepotpunim troškovima. Pri obračunu troškova svi su elementi troška uključeni kao pojedinačne izlazne veličine. Rezultati takve kalkulacije ne mogu se upotrijebiti za donošenje odluka. Posebno je važno pri konačnoj optimizaciji zasebno prikazati varijabilne (mijenjaju se pod utjecajem promjene količine proizvodnje) i fiksne troškove koji se ne mijenjaju s promjenom opsega proizvodnje. Zbog navedenoga u radu se predlaže primjena aplikacije retrogradnog (unazadnog) obračuna troškova na temelju izračuna kontribucijske marže, što je nužan postupak za učinkovito donošenje odluka. Kriterij za izračun na kritičnome mjestu proizvodnje jest kontribucijska marža/norma sat, što je vrlo važan parametar za optimalan proizvodno-prodajni program.*

Ključne riječi: *kalkulacija, obračun troškova, trošak, dobit, kontribucijska marža*

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1 INTRODUCTION
1. UVOD

Plant managing requires an efficient costing and calculating system and hence its continuous development should be the priority of any top management. Calculating system is very important not only for monitoring the costs or costing of the company, but also for economical substance of quality management, (Gejdoš, 2007). The tendency is to make such a report of costs per product based on which it would be possible to determine its minimum selling price that would not cause loss to the company. In order to make this business strategy efficient, an optimal costing system must be developed (Škoda, 2004). The company calculation system is the basis for an IT supported controlling (Dubcová, 2004).

The main goal of this paper is the optimization of costing method for planning production-sales programme of the chosen engineering enterprise dealing with the production of components for wood working machines. On the basis of theoretical knowledge we have established the following hypotheses:

– full costing method is wrong for developing an optimal production-sales programme,
– for applying variable costing, the present calculation system must be improved by costs classification into fixed and variable costs,
– contribution margin per standard hour is the optimal criterion value in a critical place of production.

2 MATERIAL AND METHODS
2. MATERIJAL I METODE

Costing generally means an activity whose aim is to determine the actual or budgeted costs and other price components affecting the costing unit. The costing method is the way of estimation of assumed amount or consequent assessment of the actual value per specific output (Král, 2001). The choice of optimal costing method depends on several factors such as:

– Specification of the costing object (costing unit which can be given in pieces, kilos, litre, m, m^3, machine hours, working-hours, etc).
– Way of establishing costs of the costing object. We distinguish direct costs (specified per costing unit by norm or dividing - direct material, wages, taxes, etc.) and costs that are indirectly allocated to the costing object – indirect, overhead costs (energy, services, depreciation charges, fees, etc.) defined per costing unit by chosen costing techniques.
– The cost structure where the costs are verified per costing unit while the costing formula structure is expressed by individual operation requirements.

2.1 Absorption costing
2.1. Apsorpcija troškova

Costing methods that take into account all cost components, i.e. either all components of direct and indirect costs or all components of variable and fixed costs according to specifically used costing method, are summarily called absorption costing methods. All costs components are absorbed by individual outputs in this costing. This way of costing is called total costs calculation. The total costing can be expressed systematically as follows:

Direct (unit) costs
+ Indirect overhead costs
= Total costs of the output
+ Profit margin of the output
= Sale price of the output

2.2 Retrograde costing
2.2. Retrogradni troškovi

If we assume that an enterprise does not determine the sale price but the market, it is possible to use the so called retrograde calculation of costs. Especially for solving the decision tasks related to optimization of output assortment, it is necessary to show separately costs influenced by changes in volume of production (variable costs) and costs not influenced by changes in volume of production (fixed costs) (Kupkovič, 2002). The basic structure of these, the so called, variable (incomplete) costs calculation is presented as follows:

Sale price (of the output)
- Temporary price allowance (discounts, seasonal prices)
= Adjusted price
- Variable costs (of the output)
= Contribution margin of the output (*CM*)

Costing methods, which result from a specific cost group and fail to take into account all cost items, belong to non-absorbent costing methods. This calculation can be specified as the calculation of incomplete (variable) costs. In this case we do not determine profit on individual products sales but profit of the whole enterprise.

Calculation can be presented as follows:

Total revenues

$$TR = \sum_{k=1}^{q} p_k q_k \qquad (1)$$

- Total variable costs

$$TVC = \sum_{k=1}^{q} TVC_k q_k \qquad (2)$$

Total Contribution margin

$$CM = \sum_{k=1}^{q} CM_k q_k = \sum_{k=1}^{q} q_k \cdot (p_k - PVC_k) \qquad (3)$$

- Fixed costs — *FC*
= Company profit / Loss — Profit/Loss

Total contribution margin is the difference between total revenues (*TR*) and total variable costs (*TVC*) or it is defined by the sum of contribution margins (*CM*) of individual products. They are determined separately as

subtraction of the sale price (p) and variable costs level (VC) for individual products from q - quantity of production.

3 DEVELOPMENT OF COSTING SYSTEM IN THE PRODUCTION OF COMPONENTS FOR WOOD-WORKING MACHINES
3. IZRADA SUSTAVA TROŠKOVA U PROIZVODNJI DIJELOVA STROJEVA ZA OBRADU DRVA

In determining the costs, the company uses the calculation pattern methodology of a comprehensive cost accounting system. The calculation pattern has the following structure:

Direct material
+ External co-operations
= Direct costs of production
+ Costs of production 1 (base value 1a × costing rate1a)
+ Costs of production 2 (base value 2a × costing rate 2a)
+ Manufacturing overhead (MO)
= Total cost from operating departments
= Costs of production **(*PC*)**
+ Administrative overhead costs (AOC)
+ Supplying overhead costs (SOC)
+ Sales overhead costs (SOC)
= Total costs (*TC*)
+ Profit, (- Loss)
= Sale price (*SP*)

The above costing methodology allows the identification of indirect overhead costs origin per cost bearer (order) by form of individual contributions from operating cost centres and departments. It regards individual overhead costs that are divided according to operations performed on products (costing units). The sum of these costs gives total cost of operating departments.

These contributions are obtained by summing the base value and costing rate. The basis for estimating the contributions of operating cost departments per cost bearer are technologic processes per cost bearer, that is technical-economic norms of standard hours (Sh) consumption of the operating department in manufacturing operation of a certain amount of cost bearers (1 piece, production plan, etc.). The equation for calculating the overhead costs margin is:

$$\text{Margin of manufacturing overhaed} = \frac{\text{manufacturing overhead volume } (MOV)}{\text{total cost from operating departments}} \quad (4)$$

External co-operations items include all costs related to product manufacture. They present operations performed on products outside the enterprise because the enterprise cannot provide them or because it lacks the required technology and such operations are part of technological process, e.g. product grinding.

Administrative overhead costs include all accrued primary and secondary costs related to managing and administration as well as organisation and general maintenance of production or non-production activities, which are budgeted and accounted in administrative cost centres. They cannot be estimated directly per cost bearer but by load charge:

$$\text{Margin of administrative overhaed} = \frac{\text{administrative overhead volume } (AOV)}{\text{total cost from operating departments}} \quad (5)$$

Supply overhead costs include all accrued primary and secondary costs related to purchase, budgeted and accounted in purchase and store of material cost centres which cannot be estimated directly per cost bearer. These are costs related to purchasing of material and its transport; storage, budgeted by means of load charge.

$$\text{Margin of supply overhaed} = \frac{\text{supply overhead volume } (SOV)}{\text{direct costs of production departments}} \quad (6)$$

Sales overhead costs include all accrued primary and secondary costs related to sales, budgeted and accounted in sales cost centres that cannot be estimated directly per cost bearer. These are costs related to storage, manipulation, sales and dispatching of final products and semi-finished products. The equation for the calculation of load charge is as follows:

$$\text{Margin of sales overhaed} = \frac{\text{sales overhead volume}}{\text{direct material + total cost from operating departments} + MOV + AOV + SOV} \quad (7)$$

In this paper we have focused on costing of four elementary products in the company concerned. A short summary of data necessary for making the calculations is presented in Table 1. Margins necessary for the calculation of overhead costs of individual cost centres according to the above equations (4, 5, 6, 7) are the following:

– Margin of manufacturing overhead = 17.260 %,
– Margin of administrative overhead = 26.726 %,
– Margin of supply overhead = 8.764 %,
– Margin of sales overhead = 2.984 %.

By observing the calculation pattern of the company concerned, it is possible to present the calculation of total costs of selected products (Table 2).

In the event of allocation of production costs to individual centres (departments), the centre utilization in standard hours becomes the base value. For example in gear rack production, the second operation is realized by the turning semi-automatic lathe. The machine standard hours in production of the same product are 4. 38 Sh and based on planned 2 736 pieces, the base value is 0. 0016 Sh/piece.

The rate of the workstation concerned amounts to 6 €/Sh. It means that for one gear rack it is necessary to

Table 1 Calculation of total costs of elementary products
Tablica 1. Ukupni obračun troškova osnovnih proizvoda

Item of calculation pattern *stavka u strukturi troškova*	**The chosen components of wood working machines** *odabrani dijelovi strojeva za obradu drva*				**Total costs** *ukupni troškovi*
	Gear rack (2 736 pieces) *okvir zupčanika (2 736 dijelova)*	**Pin with clip anchor (2 400 pieces)** *klip sa spojnicom (2 400 dijelova)*	**Gearbox (170 pieces)** *kućište zupčanika (170 dijelova)*	**Motor (450 pieces)** *motor (450 dijelova)*	
Direct material *direktni materijal*	128 774,4 €	16 560 €	15 640 €	30 075 €	191 049,4 €
External co-operations *direktne usluge*	0 €	0 €	0 €	330 €	330 €
Costs of production *troškovi proizvodnje*	56 267,7 €	7 960 €	14 619 €	19 818 €	98 664,7 €
Manufacturing overhead *dodatni troškovi proizvodnje*	9 597 €	1 373,6 €	2 523,2 €	3 420 €	16 913,8 €
Administrative overhead *administrativni troškovi*	14 860 €	2 127.2 €	3 907 €	5 296.5 €	26 190.7 €
Supply overhead *troškovi nabave*	11 286 €	1 451.2 €	1 370.7 €	2 664.7 €	16 772.6 €
Sales overhead *troškovi prodaje*	6 568.2 €	879.2 €	1 135.6 €	1 837.5 €	10 420.5 €
Total costs *ukupni troškovi*	227 353.3 €	30 351.2 €	39 195.5 €	63 441.7 €	360 341.7 €

Table 2 Calculation of total costs of production of gear racks and pin with clip anchor components
Tablica 2. Ukupni obračun troškova izrade okvira zupčanika i klipa sa spojnicom zupčanika

Calculation item *stavka kalkulacije*	**Gear rack** *okvir zupčanika*	**Pin with clip anchor** *klip sa spojnicom*		
Direct material / *direktni materijal*		47.06 €		6.90 €
External co-operations / *direktne usluge*		0		0
Other direct costs *ostali direktni troškovi*		0		0
Direct production costs *direktni troškovi proizvodnje*		47.06 €		6.90 €
Costs of production (costing rate × base value) *troškovi proizvodnje (stopa troška × osnovna vrijednost)*	circular hydr. saw / *kružna pila* = 4.73 · 0.0866	0.41	semi-automatic welding machine / *poluautomatski stroj za zavarivanje = 8.06 · 0.0794*	0.64
	semiautomatic lathe / *poluautomatska tokarilica* = 6 · 0.0016	0.01	degreasing machine / *stroj za odmašćivanje = 4.1 · 0.0166*	0.07
	blast cleaning machine / *stroj za čišćenje* = 6.16 · 0.0766	0.47	paint shop / *radionica za bojenje* = 8.3 · 0.0563	0.46
	hydraulic press / *hidraulična preša* = 5.76 · 0.0866	0.50	oil conservation / *čuvanje ulja* = 6.03 · 0.0043	0.03
	console vertical milling machine / *konzolna vertikalna glodalica* = 4.66 · 0.23	1.07	band-saw / *tračna pila* = 3.2 · 0.05	0.16
	vertical milling machine / *vertikalna glodalica* = 7.26 · 0.11	0.80	locksmith works / *bravarski poslovi* = 3 · 0.0017	0.01
	console vertical milling machine / *konzolna vertikalna glodalica* = 4.66 · 0.21	0.98	centre drilling machine / *stroj za bušenje* = 6.36 · 0.0683	0.43

Continued table 2 / nastavak tablice 2.

Calculation item *stavka kalkulacije*	**Gear rack** *okvir zupčanika*	**Pin with clip anchor** *klip sa spojnicom*		
	locksmith works / *bravarski poslovi* = 3 · 0.0617	0.18	semiautomatic lathe / *poluautomatska tokarilica* = 6 · 0.2067	1.24
	parts washing / *ispiranje dijelova* = 5.76 · 0.0350	0.20	parts washing / *ispiranje dijelova* = 6.16 · 0.0134	0.08
	machine centre / *obradni centar* = 5.83 · 0.8683	5.06	locksmith works / *bravarski poslovi* = 6.03 · 0.0183	0.11
	parts washing / *ispiranje dijelova* = 5.76 · 0.0350	0.20	table sander / *brusilica* = 8 · 0.01	0.08
	table-type miller / *stolna glodalica* = 4.5 · 0.3433	1.54	** …….	
	parts washing / *ispiranje dijelova* = 5.76 · 0.0350	0.20		
	locksmith works / *bravarski poslovi* = 3 · 0.1367	0.41		
	slotting machine / *stroj za izradu utora* = 5.66 · 1.0266	5.81		
	parts washing / i*spiranje dijelova* = 5.76 · 0.0350	0.20		
	**			
	** Total / *ukupno*	20.32 €	**Total / *ukupno*	3.31€
Manufacturing overhead costs *dodatni proizvodni troškovi 17.26%*		3.51 €		0.57 €
Contributions from operating cost departments *dodatni operativni troškovi odjela*		23.83 €		3.88 €
Manufacturing costs *troškovi proizvodnje*		70.89 €		10.78 €
Administrative overhead costs / *dodatni administrativni troškovi 26.726%*		5.43 €		0.89 €
Supplying overhead costs *dodatni troškovi nabave 8.764%*		4.12 €		0.60 €
Sales overhead costs *dodatni troškovi prodaje 2.984%*		2.40 €		0.37 €
Total costs / *ukupni troškovi*		82.84 €		12.64 €
Profit (loss) / *dobit (gubitak)*		+ 24.96 €		+4.06 €
Sale price without VAT *prodajna cijena (bez PDV-a)*		107.80 €		16.70 €

** Due to paper size it is not possible to mention all items affecting the operating cost (centres) departments. They are given by technological sequence of manufacturing process of individual products.
*** Zbog ograničenog opsega ovog rada nije moguće navesti sve stavke koje utječu na operativni trošak (centra) odjela. Stavke su navedene tehnološkim slijedom proizvodnje pojedinih proizvoda.*

calculate the item cost of 1 cent. We have a similar situation in the case of other workstations.

Similarly, it is possible to determine total costs of other components of wood-working machines. We mention here only the selected items of calculation pattern and sale prices for gearbox and motor components:

Total costs	Sale price	Profit/ Loss
Gearbox:	230.5 €	191.6 € - 38.09 €
Motor:	141.0 €	220.0 € + 79.00 €

4 PROPOSAL OF COSTING SYSTEM OF INCOMPLETE -VARIABLE COSTS
4. PRIJEDLOG SUSTAVA NEPOTPUNIH TROŠKOVA – VARIJABILNI TROŠKOVI

When developing a costing system of incomplete costs it was necessary to use the results of the established costing system of total costs calculation applied in the company concerned. The first step was to propose costs classification of fixed and variable costs. In this

case we used a combination of empirical method and variator method (Potkány, 2003):

a) Variator method
a) Metoda varijatora

The change of production volume influences directly costs development. Individual types of costs or costing items or total production costs behave differently. When searching optimal production volume we have to know the costs development and determine the dependence size of costs change on production volume change. To estimate this dependence we can use a reaction coefficient (c_r) derived as follows:

$$c_r = P_{cC} / P_{cP} \quad (8)$$

P_{cC} – *costs change percentage.*
P_{cP} – *performance (production) change percentage.*

If $c_r = 0$ the searched type of costs is considered to be fixed, if c_r gains another value the cost is variable - proportional or non-proportional. Values of costs change percentage and performance change percentage can be estimated as follows:

$$P_{cC} = [((C_1 / C_0) \text{ x } 100) - 100 + ((C_2 / C_1) \text{ x } 100) - -100 + ...] / (n+1) \quad (9)$$

$$P_{cP} = [((R_1 / R_0) \text{ x } 100) - 100 + ((R_2 / R_1) \text{ x } 100) - -100 + ...] / (n+1) \quad (10)$$

Where: C_1 (R_1) – costs (returns). in the first period e.g. month of January).
C_2 (R_2) – costs (returns). in the second period (e.g. month of February).
C_0 (R_0) – costs (returns). in the base period (e.g. month of December).
n – number of periods that follow (e.g. months).

b) Empirical method
b) Iskustvena metoda

This is one of the most frequently applied methods for the calculation of fixed and variable costs. The term classification analysis is often used. Costs dependence on production volume is measured by qualified estimation. This estimation is based on the data about centres economy. Calculation accuracy depends on the level of experts' knowledge of individual cost items. As we have to reallocate approximately 80 cost items in the company concerned, we hereby present only the list and percentages of individual items of variable costs. These items are:
- connecting material (100%),
- other direct material (100%),
- material for reparations (2 %),
- protective aids (2%),
- gas (20%),
- postage (4%),
- forgings and pressings (100%),
- consumption of overhead material (20%),
- reparations of production equipment (50%),
- consumption of small tangible property (21%),
- workers' wages. (4 %),
- other services (7 %),
- castings (100%),
- tools (49 %),
- fuelling (2 %),
- energy (49%),
- fare (100 %),
- heat (3%).

After the above presented allocation, we obtained the costing formula adjustment which can become an important tool of production-sales programme optimization. It is essential to know the variable part of costs that should be definitely covered by price and on the basis of their subtraction and contribution margin value it is possible to optimise the production programme. Retrograde form of calculation has the following structure:

Sale price after adjusting
- Direct material
- External co-operations
- Other direct costs
- Costs of production 1 (variable part)
  Base value 1a × costing rate1a
- Costs of production 2 (variable part)
  Base value 2a × costing rate 2a
  .....
  Base value n × costing rate n
- Costs of operation (variable part)
- Administrative expenses (variable part)
- Supply overhead (variable part)
- Sales overhead (variable part)

= Contribution to fixed costs and profit generation (*CM*)

Summary data necessary for making the calculation of variable costs of previous outputs are presented in Table 3.

Margins necessary for the calculation of overhead variable costs of individual centres according to the above equations (4, 5, 6 and 7) are the following:
– Margin of manufacturing overhead = 0.8282 %.
– Margin of administrative overhead = 0.3395 %.
– Margin of supply overhead = 1.0493 %.
– Margin of sales overhead = 0.095 %.

To determine the value of the contribution margin, it was necessary to assign only part of direct variable costs to the product, and especially production costs of individual workstations, as well as the resulting items of individual overheads. The summary of all types of costs related to the workstation concerned resulted in total variable costs that were inevitable to keep the ratio with the total workstation load. In this way it is possible to estimate the variable part of costing of individual workstations (machines). Similarly the value of margins of individual overheads could also be determined. The result of this methodical procedure is presented in Table 4.

Similarly it is possible to continue with the calculation of variable costing for gearbox and motor components of wood working machines. In order to stay within the limits of this paper size, only the values of

Table 3 Cost structure of variable costing of wood–working machine components
Tablica 3. Struktura varijabilnih troškova dijelova strojeva za obradu drva

Item of costing formula *stavka u izrazu troška*	**Chosen components of wood working machines** *odabrani dijelovi strojeva za obradu drva*				**Total costs** *ukupni troškovi*
	Gear rack (2 736 pieces) *okvir zupčanika (2 736 dijelova)*	**Pin with clip anchor (2 400 pieces)** *klip sa spojnicom (2 400 dijelova)*	**Gearbox (170 pieces)** *kućište zupčanika (170 dijelova)*	**Motor (450 pieces)** *motor (450 dijelova)*	
Direct material *direktni materijal*	128 774.4 €	16 560 €	15 640 €	30 075 €	191 049.4 €
External co-operations *direktne usluge*	0 €	0 €	0 €	330 €	330 €
Costs of production *troškovi proizvodnje*	12 336.6 €	1 324 €	3 124.4 €	3 333.3 €	20 118.3 €
Manufacturing overhead *dodatni troškovi proizvodnje*	102.1 €	11.2 €	25.8 €	294.3 €	433.4 €
Administrative overhead *dodatni administrativni troškovi*	41.9 €	4.8 €	10.6 €	11.3 €	68.6 €
Supply overhead *dodatni troškovi nabave*	1 351.6 €	173.6 €	164.1 €	319 €	2 008.3 €
Sales overhead *dodatni troškovi prodaje*	135.9 €	16.8 €	18.0 €	32.4 €	203.1 €
Variable costs *varijabilni troškovi*	142 742.5 €	18 090.4 €	18 982.9 €	34 395.3 €	34 395.3 €

the contribution margins will be presented here. Like the valuable products they show positive values. However it is very important to realize that the higher the contribution margin value, the higher is the product contribution to settlement of fixed costs and profit generation:

– Contribution margin (Motor) 144.15 €
– Contribution margin (Gearbox) 79.90 €
– Contribution margin (Gear rack) 55. 64 €
– Contribution margin (Pin with clip anchor) 9.10 €

5 MODEL OF DECISION-MAKING FOR PLANNING PRODUCTION-SALES PROGRAMME OF LIMITED CAPACITY

5. MODEL ODLUČIVANJA O PLANIRANJU PROIZVODNO-PRODAJNOG PROGRAMA S OGRANIČENJEM KAPACITETA

In the text bellow, we will try to show specifically (on one of many types of decision making tasks) the significance of assessment of contribution margin as a criterion value of decision-making process in the case of incomplete costs calculation. This is the decision making task for planning the production-sales programme of limited capacity.

In our case the production capacity is limited by the so called *critical place of production* – the key machine used in production of all chosen products. It is a *semiautomatic lathe* whose capacity is limited to approximately 504 standard hours (Sh). Based on already known indicators of individual product amounts, their consumption norms in a specific place of production and contribution margin values, we can develop an optimal production-sales programme (Table 5). The calculation of criterion value in a critical place of production – *contribution margin/standard hour (CM/Sh)* is a very important information:

Gear rack: 55. 64 € / 0. 0016 Sh = 34 775 €/Sh.
Gearbox: 79. 90 € / 0. 1352 Sh = 591. 0 €/Sh.
Motor: 144. 15 € / 0. 8083 Sh = 178. 3 €/Sh.
Pin with clip anchor: 9. 10 € / 0. 2067 Sh = 44. 0 €/Sh.

The contribution margin values per standard hour in a specific place of production show relatively high values in absolute numbers. This is caused by the fact that we did not express the time demands (labour content) of individual products by the sum of all technological operations but we have rather expressed them for the key machine. This is a model situation that has to be completed with the whole product portfolio in practice (in our case this means 250 types of products).

Calculations are considered to be important tools of economic efficiency management in the area of determination of costs, their control, assessment and consequential costs and verification of profit level of individual company performances (Potkány, 2004). This is also a very important tool for project evaluation of financial and economic efficiency (Freimann and Kampf, 2005). In the area of enterprise economics, assessment directions and key moments of its strategies, investment decision-making is considered one of the main factors of development and it plays a significant role in fulfilment of entrepreneur's goals (Drábek and Jelačić, 2007).

Table 4 Calculation of variable costs of the components gear rack and pin with clip anchor
Tablica 4. Kalkulacija varijabilnog troška dijelova okvira zupčanika i dijelova klipa sa spojnicom

Calculation item *elementi kalkulacije*	**Gear rack** *okvir zupčanika*		**Pin with clip anchor** *klip sa spojnicom*	
Sale price / *prodajna cijena*		107.80 €		16.70 €
Direct material *direktni materijal*		-47.06 €		-6.90 €
External co-operations *vanjska suradnja*		0		0
Costs of production (costing rate × base value) *troškovi proizvodnje (stopa troška × osnovna vrijednost)*	circular hydr. saw / *kružna pila* = 0.76 · 0.0867	0.07	semi-automatic welding machine / *poluautomatski stroj za zavarivanje* = 0.26 · 0.0794	0.02
	semiautomatic lathe / *poluautomatska tokarilica* = 0.8 · 0.016	0.001	degreasing machine / *stroj za odmašćivanje* = 0.83 · 0.0166	0.01
	blast cleaning machine / *stroj za čišćenje* = 0.86 · 0.0766	0.06	paint shop / *radionica za bojenje* = 0.7 · 0.0563	0.04
	hydraulic press / *hidraulična preša* = 0.66 · 0.0866	0.05	oil conservation / *čuvanje ulja* = 1.0 · 0.0043	0.005
	console vertical milling machine *konzolna vertikalna glodalica* = 0.93 · 0.23	0.21	band-saw / *tračna pila* = 0.46 · 0.05	0.02
	vertical milling machine *konzolna vertikalna glodalica* = 1.9 · 0.11	0.20	locksmith works / *bravarski poslovi* = 0.8 · 0.0017	0.01
	console vertical milling machine *konzolna vertikalna glodalica* = 0.93 · 0.21	0.19	centre drilling machine *stroj za bušenje* = 0.86 · 0.0683	0.06
	locksmith works *bravarski poslovi* = 0.6 · 0.0617	0.03	semiautomatic lathe / *poluautomatska tokarilica = 0.8 · 0.2067*	0.17
	parts washing / *ispiranje dijelova* = 5.76 · 0.0350	0.20	parts washing / *ispiranje dijelova* = 1.16 · 0.0134	0.24
	machine centre */obradni centar* = 1.330 · 0.8683	1.15	locksmith works / *bravarski poslovi* = 1.1 · 0.0183	0.02
	parts washing / *ispiranje dijelova* = 0.73*0.0350	0.03	table sander / *brusilica* = 1.23 · 0.01	0.01
	table-type miller / *stolna glodalica* = 0.93 · 0.3433	0.32	** …….	
	parts washing / *ispiranje dijelova* = 0.73 · 0.0350	0.03		
	locksmith works / *bravarski poslovi* = 0.6 · 0.1367	0.08		
	slotting machine / *stroj za izradu utora* = 1.63 · 1.0266	1.67		
	parts washing / *ispiranje dijelova* = 0.73 · 0.0350	0.02		
	locksmith works / *bravarski poslovi* = 0.6 · 0.1367	0.08		
	**			
	** Total / *ukupno* 4.51 €		**Total / *ukupno* 0.61 €	
Manufacturing overhead *dodatni troškovi proizvodnje* 0.8282%		-0.04 €		-0.004 €

Continued table 4 / nastavak tablice 4.

Calculation item *elementi kalkulacije*	**Gear rack** *okvir zupčanika*	**Pin with clip anchor** *klip sa spojnicom*
Administrative overhead *dodatni administrativni troškovi* 0.3395 %	- 0.01 €	-0.002 €
Supply overhead / *dodatni troškovi nabave* 1.0493 %	-0.49 €	-0.072 €
Sales overhead */ dodatni troškovi prodaje* 0.095%	-0.05 €	-0.007 €
Contribution margin *kontribucijska marža*	55.64 €	9.105 €

** Due to paper size it is not possible to mention all items affecting the operating cost (centres) departments. They are given by technological sequence of manufacturing process of individual products.
** *Zbog ograničenog opsega ovog rada nije moguće navesti sve stavke koje utječu na operativni trošak (centra) odjela. Stavke su navedene tehnološkim slijedom proizvodnje pojedinih proizvoda.*

5 CONCLUSION
5. ZAKLJUČAK

The main goal of this paper was the optimization of costing method for developing a production-sales programme of the selected engineering enterprise in the production of components for wood working machines.

The output of the costing system is the calculation that tries to allocate costs per costing unit in various ways. In most enterprises the costing system is usually understood as a part of information system resulting from accounting, budgeting, operational records and company statistics, using ineffective and false methods of costs allocated to individual performances.

The level of total costs determined by the full costing method is € 82.84 for gear rack, € 12.64 for pin with clip anchor, € 230.5 for gearbox and € 141 for motor. Information about this level of costs is not available for decision-making tasks.

In order to achieve the highest financial effect at respective critical place of production it is necessary to follow the results of calculation of incomplete variable costs, which can provide important information even about production programme planning. This calculation of incomplete (variable) costs can be specified as retrograde costing. In this case we do not determine profit on individual products sales but profit of the whole enterprise by the estimation of contribution margin. The level of contribution margin determined by retrograde costing is € 55.64 for gear rack, € 9.10 for pin with clip anchor, € 79.90 for gearbox and € 144.15 for motor.

If based on results of the calculation of total costs, the gearbox is excluded from the production programme, which showed a loss of € 38.09, the same products show a positive value of the contribution margin of € 79.90 in case of calculation of incomplete costs. It markedly contributes to the settlement of fixed costs. Predictability of fixed costs may be limited only by adding fixed costs as load charge into the calculation of total costs.

In our case the production capacity is limited by critical place of production – the key machine used for

Table 5 Plan of production-sales programme
Tablica 5. Planiranje proizvodno-prodajnog programa

Products sequenced according to priority *redosljed proizvoda prema prioritetima*	**Amount (pieces)** *količina (dijelovi)*	**Time demand in a critical place of production (Sh)** *vremenski zahtjevi u kritičnom razdoblju proizvodnje (Sh)*	**Cumulative demands (Sh)** *ukupni zahtjevi (Sh)*	**Contribution margin** *kontribucijska marža*
Gear rack / *okvir zupčanika*	2 736	4.40 Sh	4.4 Sh	153 010.0 €
Gearbox / *kučište zupčanika*	170	22.90 Sh	27.3 Sh	13 533.9 €
Motor / *motor*	450	363.70 Sh	391 Sh	64 847.7 €
Pin with clip anchor** *klip sa spojnicom* **	546	113.00 Sh	504 Sh	4 972 €
Contribution margin together / *zajednička kontribucijska marža*				236 363.6 €

** Considering the limited capacity of a specific place of production the remaining 1 854 pieces cannot be involved in production in a given time period. It is up to responsible workers to solve this situation (overtime work, second shift, change of date, cooperation, etc.)
** *S obzirom na ograničeni kapacitet proizvodnje, ostala 1 854 dijela ne mogu biti uključeni u proizvodnju u određenom vremenskom razdoblju. Rješenje tog problema ovisi o radnicima (prekovremeni rad, druga smjena, suradnja itd.)*

production of all chosen products. It is a semiautomatic lathe whose capacity is limited to approximately 504 standard hours. Contribution margin per standard hour is the optimal criterion value in a critical place of production By this parameter it is possible to optimize the production-sales programme in production of components for wood working machines.

Modern presentation of costing system is the result of a market orientated company with emphasis on the amount of sold products and the way of their sale as well as on respecting the target group of customers' requests. These pieces of information can be used in many areas of decision-making and managing related to restructuring of production programmes and estimating manufacturing processes, which affect the motivation and final productivity of the company's employees. The area of personal controlling has an important role in this field, which can contribute to increasing the company value (Zámečník and Zeman, 2004). This is the basis for the implementation of controlling system in company management (Šatanová, 2004).

The proposed system of company management can be used as the basis for a progressive trend of company management (Teplická, 2004).

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