

UTILITY OF THE METHOD T.H.M. (MACHINE - HOUR - RATE) PRODUCTION CENTURY PROCESS AUTOMATION

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Abstract:

The method T.H.M. (machine – hour – rate) gives greater accuracy in the factories or departments, where production is largely by machinery. In the specialty literature, the notion of price - the time - the car is defined as “a rate calculated by dividing the budgeted or estimated overhead or labour and overhead cost attributable to a machine or group of similar machines by the appropriate number of machine hours. The hours may be the number of hours for which the machine or group is expected to be operated, the number of hours which would relate to normal working for the factory, or full capacity”. In a highly mechanised cost centre, majority of the overhead expenses are incurred on account of using the machine, such as, depreciation, power, repairs and maintenance, insurance, etc. This method is currently offering the most equitable basis for absorption of overheads in machine intensive cost centres.

Keywords: machine hour rate, costing, production, cost centre, overhead costs

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1. Introduction

In recent decades great changes have taken place in technology, and the pace of innovation to products and services has increased. Technical progress has led to the extension of mechanization and automation of production processes, which generated increasing technical endowment entities and thus significantly increase the indirect costs and expenses specifically with the maintenance and operation of machines.

For these reasons it is necessary to use a method of calculation that highlights the machine or group of machines that are called production centers (responsibility center) or places that give rise to expenses. The sectorization production centers entity must take into account the possibility of sharing costs to calculate the unit cost per vehicle cost and the possibility to liability for costs incurred in each individual establishment. We quantify the activity in the center of production and costs of the activity can be identified directly on the carrier charges. Also each production center / responsibility center can be equipped with a system of performance measurement to inform the center manager and later manager of the level of achievement of objectives, resource consumption, but also on quality indicators.

Method to successfully meet the above requirements is known as price method - hour - car. Price method - hour - machine (THM) was treated as a stand alone method of calculation by North American economist Spencer A. Tucker, considered in many subsequent publications as its author exclusively. Abbreviation T.H.M. comes from the original translation in French: Taux – Heure – Machine.

2. Theoretical aspects:

The method involves carrying out the following preparatory work:

1. Determination of tariff - hour - machine: this means all costs incurred by an entity to make are functioning machine / equipment of a particular sector / instead of spending one hour without taking into account the costs of raw materials and expenses direct materials.

2. Establishing production centers or centers of activity: production centers are established manual and car production centers. Production centers are determined by inventory spot grouping at a center level cars aceeași parameters which serve the same purpose and is entered in situations location, known as the Nomenclature production

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centers (this does not require a reorganization physico-technical sense of bringing machine / manual operations in the same workshop / section, but provides a structure manufacturing process adapted calculation and management costs). A production center comprises one or more machines or handmade papers running same operation or group of operations. The name given to the production center is based on the name of technological operation performed (such as debit, turning, planing, etc.), and if more centers running the same operation is differentiated by numbers or by use of other features essential (eg, use machinery factory mark, product size etc.). In order to group the machines in production centers are taken into account the following criteria [Călin O., Cârstea Gh, 2002, p.287]: technological operation executed (its way); machine capacity (their performance); dimensional (length, area occupied, etc.); the number of people serving; installed power engines that operate machines; machine type and their age, in the period of service; value of the machinery; kinds of manufactured products; the number of exchanges in which they are used; the number of hours worked annually in machine (productive hours) etc.

3. Determine the annual number of scheduled hours of a production center - is determined either by estimation or documents using data from the previous year, at the annual planned production include preparation time center of work and productive operating time of equipment production center.

a. Estimating production scheduled hours shall be:

- calculate the number of working days of the year, as follows:
No. working days = 365 - no. Legal weekends (Sundays and statutory holidays) - other non-working days (holidays);
- calculate the annual number of hours by weighting the number of working days in a year 8 (if working within a single schema for 8 hours) 16 (if working in two shifts of 8 hours / shift) or 24 (if working three shifts of 8 hours / shift).

b. Year of the number of hours per year based on the documents shall be: centralize the workers' time sheets serving machines that production center, the hours of operation of the machine serviced by a single worker (where those machines are served for many workers). This number of hours is corrected under the influence of factors such as commissioning of equipment with high efficiency, modernization of equipment, changing the design of the products etc.

4. Determine the number of staff and production capacity of the center:

a. With the establishment directly productive workers flock each production center is set and hourly wage of each worker at the center, including Central hourly wage, benefits shall be established at each of the production workers during the labor disruption due to holidays, rest during work (lunch break) etc. It also will establish and indirect production workers have the equipment maintenance and repair tasks (handlers, receptionists, warehouseman, CTC controllers etc.).

Standard uniform number of workers is determined by the head of the organization of work. This actually may comprise one or more workers who normally work on a car or machine, making a productive operation. Where a worker serves two or more machines will be considered as employed at each machine a corresponding fraction (eg if the worker serves five machines simultaneously, it will count in the herd unit 5.1 standard workers. Similar to will count and indirectly productive workers who are permanently assigned to a particular operation of one or more production centers. Hourly wage per worker includes hourly salary plus related bonuses and other salary increases that will occur during scheduled.

Central zone production salary is calculated based on the hourly wage of the herd standard unit and the number of cars in the center of production. For example, at a production center consists of three machines, the number of workers standard unit consists

of a worker with an hourly wage of 8 lei, quarter hourly workers pay 10 lei and third workers an hourly wage of 12 lei. Hourly wage standard unit staff will be 14.50 USD [$1 \times 8 + 1/4 \times 10 + 1.3 \times 12$] and hourly wage of production center is 43.5 lei (14.50×3)

b. It determines the production capacity of the production center and programmed to correlate with

5. It prepares operating budget and allocate these costs on production sites - it serves the indirect costs of production planning, management and administration expenses or the costs of disposal, without this budget includes raw material consumption matting direct or direct labor costs (these items will be taken into account when calculating the unit cost). The operating budget is based on data recorded in the accounting year. When budgeting for the current year do take account of the variable, semi-variable and fixed these expenses and the different degrees of use of production capacity, achieving the operational budgets often flexible. Costs included in the operational budget of the production facilities is performed using the method of supplementing (with single or differential coefficient).

6. Determination of the charge-time-machine and the unit cost of the program (see the calculation in the example below)

3. Practical aspects

A unit producing fully mechanized and automated flow gives the following classification of production centers:

Name of production center	Central machines Number	Characteristic data			
		Machine value (V)	work surface (S)	Rating (P)	hours production schedule (Hpl)
CP1	2	60,000 lei	30 m ²	70 kw	6,100 ore
CP2	3	50,000 lei	10 m ²	16 kw	2,400 ore
CP3	1	40,000 lei	20 m ²	14 kw	4,500 ore
CP4	2	52,000 lei	5 m ²	5 kw	2,300 ore
CP5	2	38,000 lei	15 m ²	115 kw	6,700 ore
TOTAL		240,000 lei	80 m ²	220 kw	22,000 ore

Production center (CP)	Number. machines / center	Effectively standard workers / machine	hourly wage per worker (lei / hour)
CP1	2		
Worker		2	8.3
Help the worker		1/2	5
CP2	3		
Worker		2	7.1
Help the worker		1/3	8
CP3	1		
Worker		1	6.4
Help the worker		1	11
CP4	2		
Worker		2	12.3
Help the worker		1/2	6
CP5	2		
Worker		2	7
Help the worker		1	13

The unit performs two products A and B. For product companies carried 4,000 pieces, and the product B, 1,000 pieces. Individual processing time in each production center is shown in the table below:

Product	For processing individual				
	machines CP1	machines CP2	machines CP3	machines CP4	machines CP5
A	100	100	300	50	150
B	100	200	100	200	100

Unit cost of raw materials and direct materials for product A is 8,000lei / unit and product B of 1,000 lei / piece.

Using the method of calculation to determine THM and total unit cost of each product.

1. Determine staffing structure and production capacity for each production center:

a. Determine the hourly wage in the middle: $Sh_i = Nm_i \times \sum Sh/l_j \times n_j$

significance notations:

Sh – hourly wage in the middle of production

Nm – the number of machines in the center

Sh/l – hourly wage per worker

i – production center

j – the category of personal

n – the number of workers

$$Sh_{CP1} = 2 \times (8.3 \times 2 + 5 \times \frac{1}{2}) = 38.2 \text{ lei/oră}$$

$$Sh_{CP2} = 3 \times (7.1 \times 2 + 8 \times \frac{1}{3}) = 50.61 \text{ lei/oră}$$

$$Sh_{CP3} = 1 \times (6.4 \times 1 + 11 \times 1) = 17.40 \text{ lei/oră}$$

$$Sh_{CP4} = 2 \times (12.3 \times 2 + 6 \times \frac{1}{2}) = 55.20 \text{ lei/oră}$$

$$Sh_{CP5} = 2 \times (7 \times 2 + 13 \times 1) = 54 \text{ lei/oră}$$

b. Determine the maximum number of hours per year the center:

$$H \max_i = (Zc - Znl) \times r \times Nm_i$$

significance notations:

Zc - calendar days (one year is 365 days)

ZNL - weekends - Sundays, public holidays (it is considered that in a year there are 52 Sundays and 8 days statutory holidays)

Nm - the number of machines the center

r - the practice of machine is exchanged, ie 8:00 / exchange

$$H \max_{CP1} = (365 - 60) \times 8 \times 2 = 4,880 \text{ ore}$$

$$H \max_{CP2} = (365 - 60) \times 8 \times 3 = 7,320 \text{ ore}$$

$$H \max_{CP3} = (365 - 60) \times 8 \times 1 = 2,440 \text{ ore}$$

$$H \max_{CP4} = (365 - 60) \times 8 \times 2 = 4,880 \text{ ore}$$

$$H \max_{CP5} = (365 - 60) \times 8 \times 2 = 4,880 \text{ ore}$$

c. Determine the annual number of hours available in a center (Hd) - is calculated by subtracting the hours paid for planned interruptions (holidays, breaks and other interruptions during the program legal) and expresses its production capacity. The difference between the annual number of hours available on a production center and programmed in hours indicates the ability or lack of production capacity

Production center	Maximum annual hours (Hmax)	Time not worked the center	Hours available (Hd)
CP1	4,880	300	4,580
CP2	7,320	500	6,820
CP3	2,440	200	2,240
CP4	4,880	300	4,580
CP5	4,880	200	4,680
TOTAL	24,400	1,500	22,900

d. Determine production scheduled for each center, which is at the center of

manufacturing direct labor: $C_{Md_i} = Hpl_i \times Sh_i$

significance notations:

C_{Md} – direct labor costs related to the production center

$$C_{Md_{CP1}} = 6,100 \times 38.20 = 233,020 \text{ lei}$$

Hpl – scheduled production hours
 Sh – hourly wage the center of production

$$C_{Md_{CP2}} = 2,400 \times 50.61 = 121,464 \text{ lei}$$

$$C_{Md_{CP3}} = 4,500 \times 17.40 = 78,300 \text{ lei}$$

$$C_{Md_{CP4}} = 2,300 \times 55.20 = 126,960 \text{ lei}$$

$$C_{Md_{CP5}} = 6,700 \times 54.00 = 361,800 \text{ lei}$$

2. It prepares an operating budget - this includes all indirect manufacturing costs, excluding raw material costs and direct material costs. Underlying operational budgeting are costs incurred in the base year, correlated depending on the plan set for the year. These costs are divided into fixed costs and variable costs, in order to know their evolution under the action of various factors. Usually we use the flexible budgets.

Operating Budget

Group name and the types of costs	Total cost of the		Criterion for allocating
	fixed costs	variable costs	
Repair machinery and equipment	500	220	Value machine
Depreciation of machinery and installations		800	Value machine
Energy costs	600		Installed power
Fuel costs	220		Hours of operation
Salaries of management staff and protection costs related sectors	320	600	Direct labor
Repair buildings		30	Area
Depreciation buildings		200	Area
Lighting, heating, sewer		45	Area
Other manufacturing expenses		115	Hours of operation
Total manufacturing expenses common	1,640	2,010	
Teaching personnel salaries and expenses related protection		720	Direct labor
Displacements		30	Direct labor
Repair buildings		80	Area
Depreciation buildings		210	Area
Costs of energy and water		50	Area
Other operating expenses		160	Area
Total overheads	1,640	1,250	
TOTAL EXPENDITURE BUDGET	1,640	3,260	

$$K = \frac{CI}{\sum e_i}$$

Dispense production cost centers according to the allocation criteria set out: significance notations:

K - coefficient distribution of expenditures on production centers "i"

$\sum e_i$ - criteria based distribution amount

CI - expenses allocated to the production centers

The Parties share the expense is calculated as the product of the coefficient

incumbent previously calculated value based allocation criteria: $CI_{rep_i} = K \times e_i$

Current number	Assigned criteria	For allocating costs
1	The value of machinery	1,520
2	Productive area	775
3	Installed capacity	600
4	Direct labor	1,670
5	Hours of operation	335
Total budgeted costs		4,900

a. Costs 1,520 lei depending on the criterion value of the machinery:

$$K = \frac{1,520}{60,000 + 50,000 + 40,000 + 52,000 + 38,000} = 0.0063$$

$$CP1 : 60,000 \times 0.0063 = 378.00 \text{ lei}$$

$$CP2 : 50,000 \times 0.0063 = 315.00 \text{ lei}$$

$$CP3 : 40,000 \times 0.0063 = 252.00 \text{ lei}$$

$$CP4 : 52,000 \times 0.0063 = 327.60 \text{ lei}$$

$$CP5 : 38,000 \times 0.0063 = 247.40 \text{ lei (to be determined by the difference up to the$$

total amount of expenses allocated - review your cost calculation steps)

b. Costs 775 lei depending on the criterion of productive area:

$$K = \frac{775}{30 + 10 + 20 + 5 + 15} = 9.68$$

$$CP1 : 30 \times 9.68 = 290.4 \text{ lei}$$

$$CP2 : 10 \times 9.68 = 96.8 \text{ lei}$$

$$CP3 : 20 \times 9.68 = 193.6 \text{ lei}$$

$$CP4 : 5 \times 9.68 = 48.4 \text{ lei}$$

$$CP5 : 15 \times 9.68 = 145.8 \text{ lei}$$

c. Costs 600 lei depending on the criterion of installed capacity:

$$K = \frac{600}{70 + 16 + 14 + 5 + 115} = 2.72$$

$$CP1 : 70 \times 2.72 = 190.40 \text{ lei}$$

$$CP2 : 16 \times 2.72 = 43.52 \text{ lei}$$

$$CP3 : 14 \times 2.72 = 38.08 \text{ lei}$$

$$CP4 : 5 \times 2.72 = 13.6 \text{ lei}$$

$$CP5 : 115 \times 2.72 = 314.4 \text{ lei}$$

d. Costs 335 lei depending on the hours criterion:

$$K = \frac{335}{6,100 + 2,400 + 4,500 + 2,300 + 6,700} = 0.015$$

$$CP1 : 6,100 \times 0.015 = 91.5 \text{ lei}$$

$$CP2 : 2,400 \times 0.015 = 36 \text{ lei}$$

$$CP3 : 4,500 \times 0.015 = 67.5 \text{ lei}$$

$$CP4 : 2,300 \times 0.015 = 34.5 \text{ lei}$$

$$CP5 : 6,700 \times 0.015 = 100.5 \text{ lei}$$

e. Allocation of costs 1,670 lei by direct labor criterion (C_{Md}):

$$K = \frac{1,670}{233,020 + 121,464 + 78,300 + 126,960 + 361,800} = 0.0018$$

$$CP1 : 233,020 \times 0.0018 = 419.43 \text{ lei}$$

$$CP2 : 121,464 \times 0.0018 = 218.63 \text{ lei}$$

$$CP3 : 78,300 \times 0.0018 = 140.94 \text{ lei}$$

$$CP4 : 126,960 \times 0.0018 = 228.52 \text{ lei}$$

$$CP5 : 361,800 \times 0.0018 = 662.48 \text{ lei}$$

$$THM_i = \frac{C_{Md_i} + \sum Chr_{ji}}{Hpl_i}$$

3. Determine THM sites:

significance notations:

C_{Mdi} - direct labor cost

Chr - total cost of the operating budget allocated

Hpl - hours scheduled annual production

i – production center

j – „j” expense allocated to the production center and in relation to the criterion set

Production center	Hours scheduled annual production (Hpl_i)	Direct labor cost (C_{Md_i})	Total cost (Chr_{ji})	$THM_i = \frac{C_{Md_i} + \sum Chr_{ji}}{Hpl_i}$
CP1	6,100	233,020	<u>1,369.73</u> 378 290.40 190.40 91.50 419.43	38.42
CP2	2,400	121,464	<u>709.95</u> 315 96.80 43.52 36 218,63	50.90
CP3	4,500	78,300	<u>692.12</u> 252 193.60 38.08 67.50 140.94	17.55
CP4	2,300	126,960	<u>652.62</u> 327.60 48.40 13.60 34.50 228.52	55.48
CP5	6,700	361,800	<u>1,475.58</u> 247.40 145.80 314.40 105.50 662.48	54.22
TOTAL	22,000	921,544	4,900	

4. Product cost calculation:

Cost structure in the design method T.H.M. include:

- the cost of processing returns on items;
- Direct cost of raw materials and related product.

Unit cost of the product is determined as follows: $cu_j = \sum THM_i \times t_{ji} + cu_{mpmd_j}$

significance notations:

cu_j – unit cost per unit of product j;

THM_i – the cost of running time and production center;

t_{ji} – during the processing unit of product j's center;

cu_{mpmd} – unit cost of raw materials and direct;

The total cost of the product will be: $C_j = q_j \times (\sum THM_i \times t_{ji}) + q_j \times cu_{mpmd_j}$

Entire production cost can be determined by the relation:

$$C = \sum q_j \times (\sum THM_i \times t_{ji}) + \sum q_j \times cu_{mpmd_j}$$

significance notations:

C_j – Total cost of product j;

q_j – the amount realized from product j;

Production center	Product A			Product B		
	THM_i	t_{ji}	$THM_i \times t_{ji}$	THM_i	t_{ji}	$THM_i \times t_{ji}$
CP1	38.42	100	3.842	38.42	100	3,842
CP2	50.90	100	5.090	50.90	200	10,180
CP3	17.55	300	5.265	17.55	100	1,755
CP4	55.48	50	2.774	55.48	200	11,096
CP5	54.22	150	8.133	54.22	100	5,422
TOTAL	$\sum THM_i \times t_{ji} = 25,104$			$\sum THM_i \times t_{ji} = 32,295$		

Calculate the unit cost of the product: $cu_j = \sum THM_i \times t_{ji} + cu_{mpmd_j}$

$$cu_A = 25,104 + 8,000 = 33,104 \text{ lei}$$

$$cu_B = 32,295 + 5,000 = 37,295 \text{ lei}$$

The total cost of the product: $C_j = q_j \times (\sum THM_i \times t_{ji}) + q_j \times cu_{mpmd_j}$

$$C_A = 4,000 \times 25,104 + 4,000 \times 8,000 = 132,416,000 \text{ lei}$$

$$C_B = 1,000 \times 32,295 + 1,000 \times 5,000 = 37,295,000 \text{ lei}$$

Calculate the cost of the entire production: $C = \sum q_j \times (\sum THM_i \times t_{ji}) + \sum q_j \times cu_{mpmd_j}$

$$C = 4,000 \times 25,104 + 1,000 \times 32,295 + 4,000 \times 8,000 + 1,000 \times 5,000 = 169,711,000 \text{ lei}$$

4. Conclusions

Application of the method THM, given the particular process technology that extends places spending (responsibility centers) to the group of cars or even a large capacity machines or production lines. This boundary or entity sectorization production centers enables rational distribution expenses cost carrier to calculate the unit cost and the possibility to liability for costs incurred in each individual establishment.

Advantages and disadvantages of this method are:

a. T.H.M The advantages of:

- production centers created expresses on the one hand the technical and productive potential of an entity on the other side allowing the calculation of economic responsibility centers;
- provides a better utilization of the productive capacity of the entity by referencing the available annual hours scheduled production centers;
- avoid wastage through rational use of labor (service standards are revised machinery and recalculate the corresponding indicators) and eliminating / reducing interruptions in the production process;
- allocation of productive expenditure is made in relation to the processing time, which is considered a more equitable sharing criteria, based on the achievement of program production and utilization of machines.

b. Disadvantages method T.H.M. are:

- the scope of the method is limited to entities with type equipment manufacturing machine tools that perform various products or performing certain tasks. Method

successfully folds the small showing a few products and materials processing to the client;

- it is extremely laborious if performed a large number of products in a large number of production facilities and product is based on the realization cups complex technologies;
- considered as secondary factor consumption of raw materials, consumables and direct elements, and this factor should not be neglected in comparison with the cost of proceses main factor that focus method.

Considering the advantages and disadvantages exposed, use practice this method as long as the hatches sectorization production / cost centers is not conventional, but based on the technical and organizational structure of production sites and rational organization of production and work.

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