Calculation of comparative rates of machine

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Factors influencing the choice of machine tool

For the selected operation is necessary to select the most appropriate machine tool, whose choice affects especially those following factors:

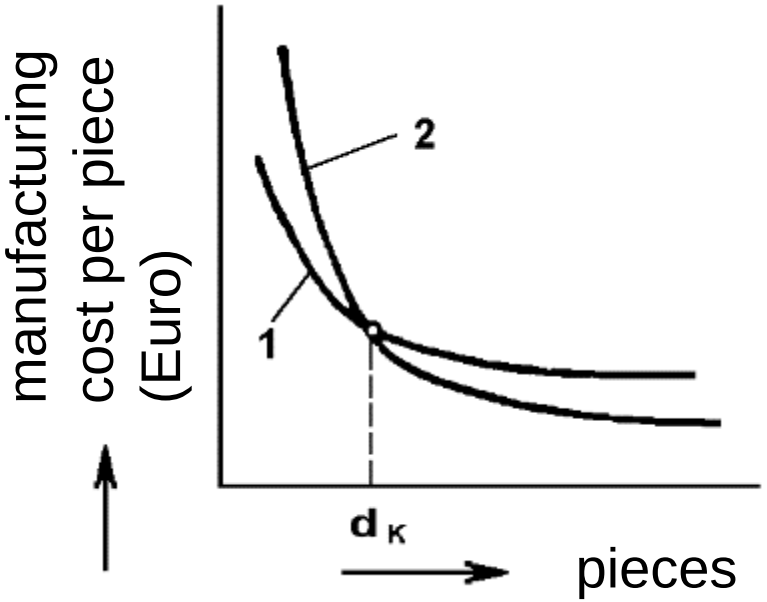
- the type of machining (turning, milling, drilling, etc.),
- the number of machined parts,
- the working space of machine,
- range of cutting conditions,
- actual performance of the machine tool,
- accuracy and rigidity of machine tool,
- degree of complexity and difficulty of the of the machine tool,
- the degree of utilization of the working time of the machine tool (the utilization time)
- the degree of utilization of production possibilities of the machine tool,
- the price of the machine tool,
- specific conditions of a given component or of the machine tool.

Factors influencing the choice of machine tool

In a large series and mass production is typically must take particular account of the work cycle and performance of the of the machine tool during the operation.

If we have to choose a suitable machine tool for a specific production order, we must take particular account of productivity and efficiency of production, which will be implemented at machine tool.

Determining the limit dose



Additional parameters for deciding when buying machine:

CNC lathes and turning centers	
Parameter	***Affects***
Material of workpiece	Type, size, design and equipment of machine, especially the type of chip extractor, filtration level, pressure coolant
Stock shape	The size, design, automation, mechanization machines
The size, shape and complexity of the workpiece, geometric tolerances, surface integrity	Type of machine-vertical / horizontal, the number of axes, machine size, equipment with toolholders
Size of the dose	Level of automation equipment assistive devices and sensors to enhance the capability of the manufacturing process

Machining centres

Parameter	***Affects***
Material of workpiece	The type, design and equipment machine, fastener, tool selection, chip evacuation, cooling method in the cutting, the level of coolant filtration, coolant pressure, coolant temperature regulation
Stock shape	Number of clamping, design of workholding device
The size, shape and complexity of the workpiece, geometric tolerances, surface integrity	The type of center-vertical / horizontal, the number of axes, pallet size / table machining technology, stack size of tools, selecting and adjusting tools
Method and multiplicity of clamping	Clamping mechanization, cleaning product, rinse workspace control setup, probe and offset the coordinate system
Size of the dose	The level of automation, production strategy, monitoring equipment and assistive devices and sensors to enhance the capability of the manufacturing process

Choosing the correct machine tool is a very complex task. If you create a clear vision of the ideal machine for your production in terms of the size of the workpiece, the size of the dose, method of machining, precision automation, integration into enterprise management system, energy consumption, the demands on operation, maintenance and other criteria, can proceed to their own choice according to manufacturer, equipment and price.

Task:

Calculate the comparative rate and time of payment machine, if given:

- machine price,
- costs of implementing machine,
- dimensions for machine,
- power machine,
- number of shifts,
- piece time,
- wage and wage overheads,
- amortization period,
- interest rate,
- the cost of maintenance and repairs,
- price for the rental area,
- cost of energy,
- number of working days per year.

The calculation procedure:

Formula for calculation of comparative rate machines:

$$S_S = \left(1 + F_O + F_{UR} + F_{UO} + F_P + F_E\right) \cdot \frac{\left(C + N_P\right)}{T_R}$$

C cost of machine [Kč],

N_P costs of implementing machine (software, tools, installation) [Kč],

T_R machine effective time per year [hours], (for 8 working hours with 80 % use of time):

$$T_R = 8 \cdot P_D \cdot 0{,}8 \cdot s$$

P_D number of working days per year,
s number of shifts.

The calculation procedure:

Formula for calculation of comparative rate machines:

$$S_S = \left(1 + F_O + F_{UR} + F_{UO} + F_P + F_E\right) \cdot \frac{\left(C + N_P\right)}{T_R}$$

F_O factor of renovation ($F_O = \frac{1}{D_O}$), D_O lifetime for repayment [years],

F_{UR} factor of interest ($F_{UR} = \frac{U_M}{100}$), U_M interest rate [%],

F_{UO} factor of maintenance ($F_{UO} = \frac{N_U}{100}$), N_U cost of maintenance [%],

F_P factor for the rental area:

$$F_P = \frac{a \cdot b \cdot C_p}{C + N_P}$$

a, b dimensions for machine [m],

C_P price for the rental area 1 m^2 / year,

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The calculation procedure:

Formula for calculation of comparative rate machines:

$$S_S = \left(1 + F_O + F_{UR} + F_{UO} + F_P + F_E\right) \cdot \frac{\left(C + N_P\right)}{T_R}$$

F_E factor for energy consumption:

$$F_E = \frac{P \cdot C_E \cdot T_R}{C + N_P} \cdot k_{pr} \cdot k$$

P	power machine [kW],	C_E	cost of energy [Kč / kWh],
$k_{pr} = 0,2$	power coefficient,	$k_v = 0,5$	work on machine coefficient.

The calculation procedure:

K_S number of pieces produced per year :

$$K_S = \frac{T_R \cdot 60}{t_K}$$

t_K piece time [min].

The calculation procedure:

Calculation of repayment time (comparing two machines):

		Machine I conventional	Machine II – CNC
piece time	[hours]	t_K^I	t_K^{II}
comparative rate	[Kč/hour]	S_S^I	S_S^{II}
wage	[Kč/hour]	M^I	M^{II}
wage overheads	[Kč/hour]	R_M^I	R_M^{II}
service costs	[Kč/hour]	$S_O^I = M^I + R_M^I$	$S_O^{II} = M^{II} + R_M^{II}$
machine total rate	[Kč/hour]	$S_{SC}^I = S_S^I + S_O^I$	$S_{SC}^{II} = S_S^{II} + S_O^{II}$
costs for 1 piece machining	[Kč/piece]	$N^I = t_K^I \cdot S_{SC}^I$	$N^{II} = t_K^{II} \cdot S_{SC}^{II}$
economic benefit for 1 year	[Kč/year]	$U = \left(N^I - N^{II}\right) \cdot K_S^I$	
repayment time	[years]	$T_U = \dfrac{C^{II} + N_P^{II}}{U}$	