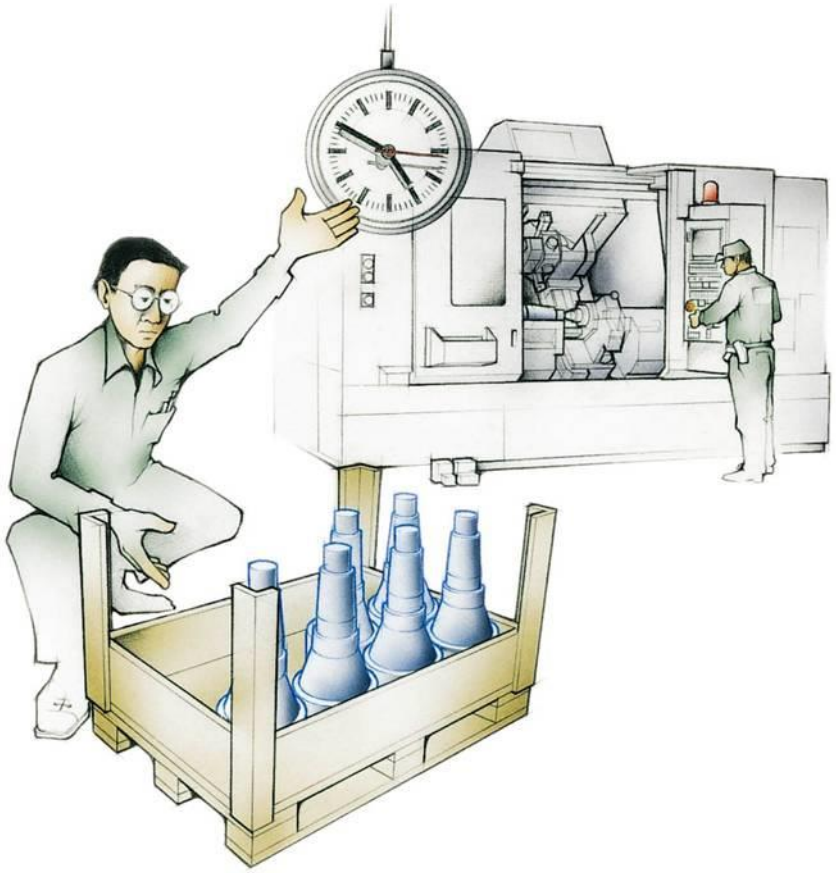
Doing more machining in the same production time

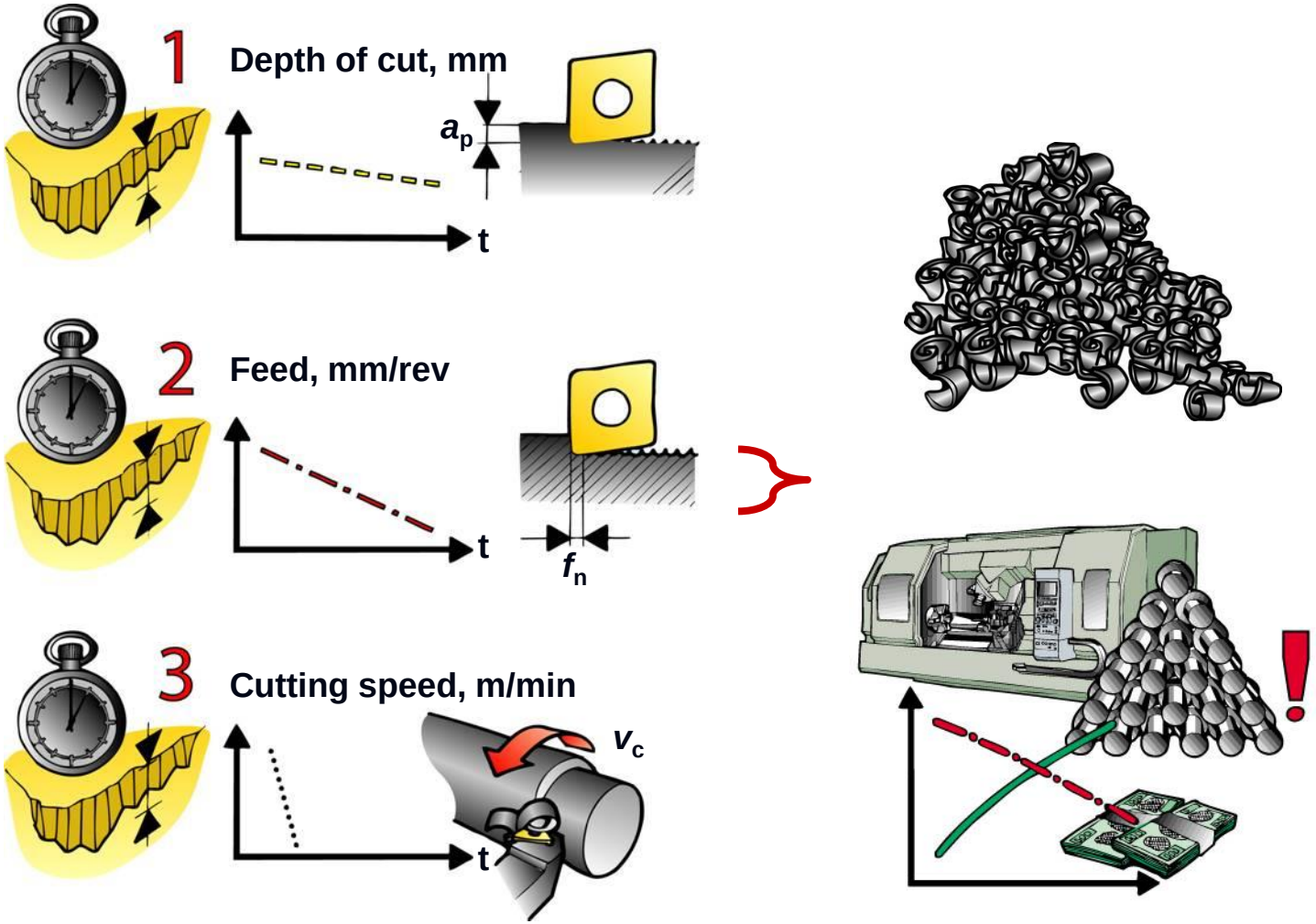


- **Productivity**

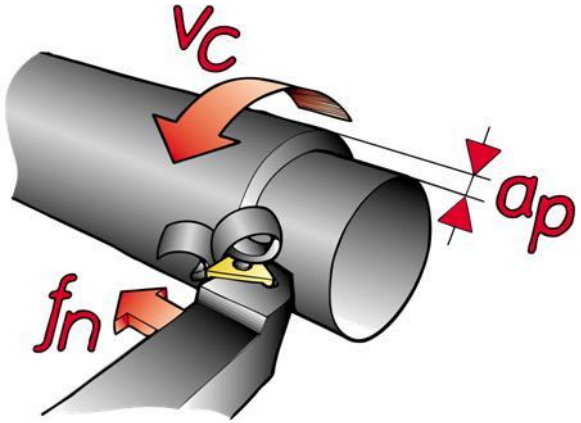
  The value of output produced divided by the value of input or resources

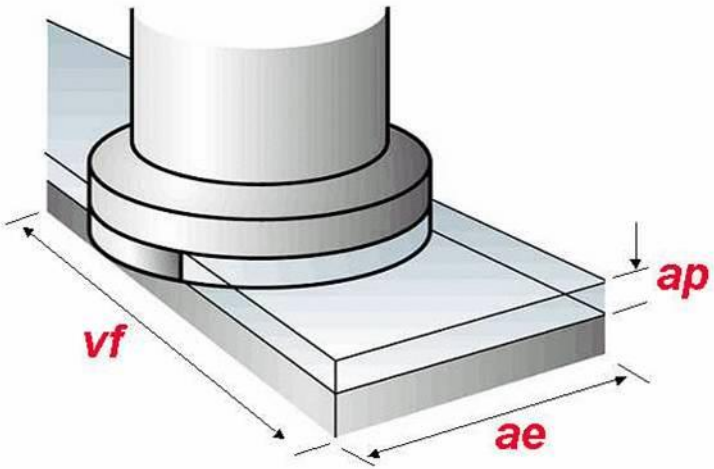
  = Output / Input

Maximizing productivity



Maximizing productivity





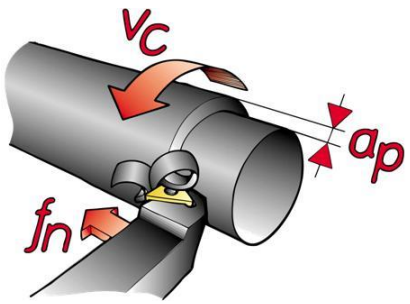
$$Q = a_p \times f_n \times v_c$$

$$Q = a_p \times a_e \times v_f$$

Maximizing productivity – example

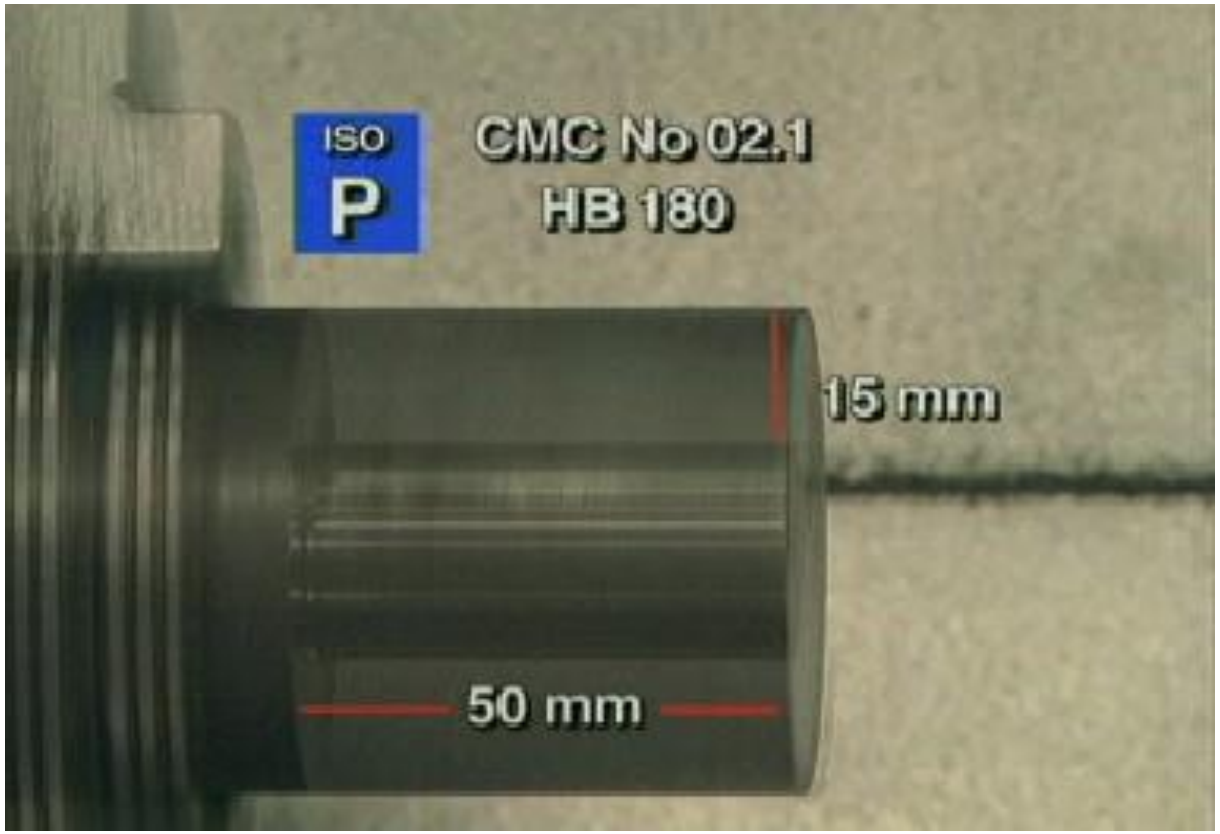
Insert: CNMG 120408-PM 4225
Material: ISO P 02.1 (low alloyed steel)

a_p	3.0	3.0	3.0
f_n	0.15	0.3	0.5
v_c	425	345	275
	↓	↓	↓
Q	**191**	**310**	**412 mm³/min**



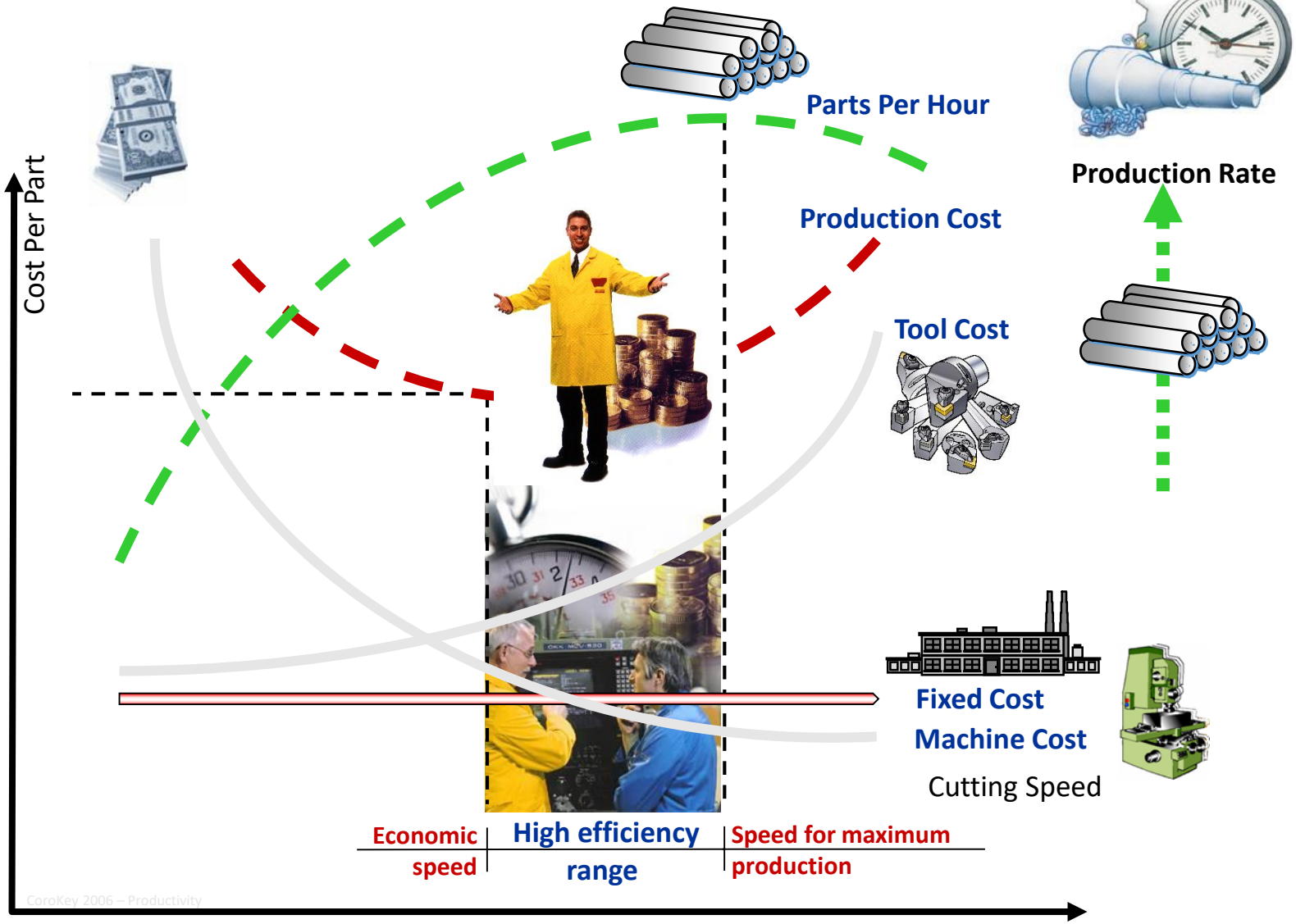
Maximizing productivity – example

Using a trigon insert, versus a C-style double sided and single sided inserts

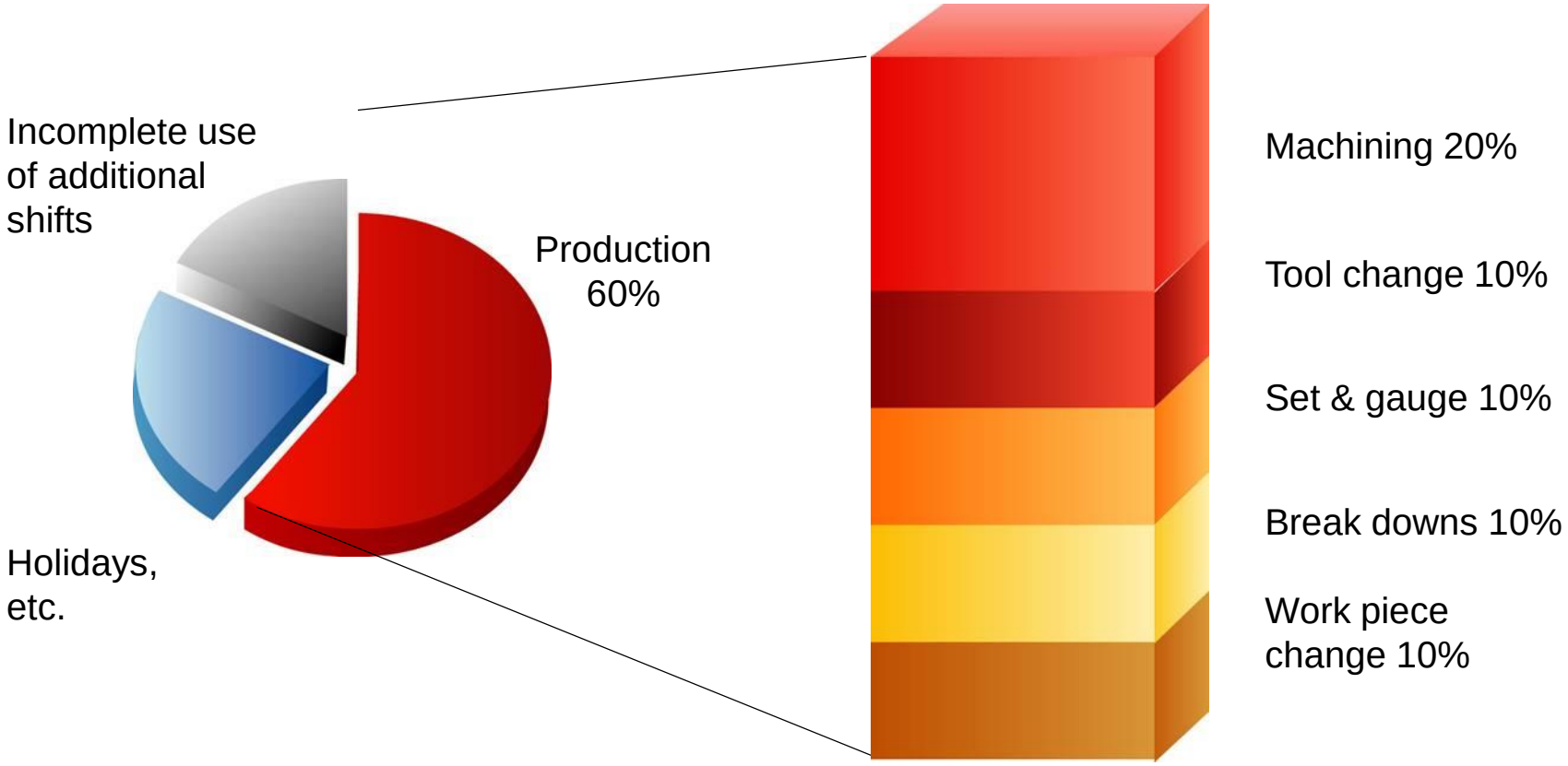


Machining economy

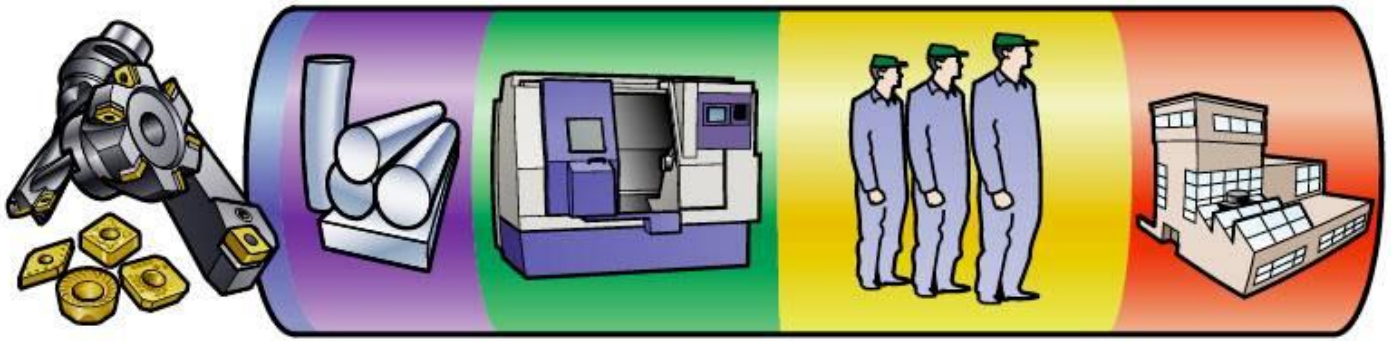
- Cutting data and cost



Machine tool utilization



Machining economy



- **Variable costs**

  Costs incurred only during production:
  - cutting tools, consumables (3%)
  - workpiece materials 17%

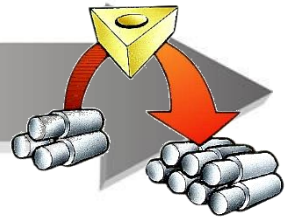
- **Fixed costs**

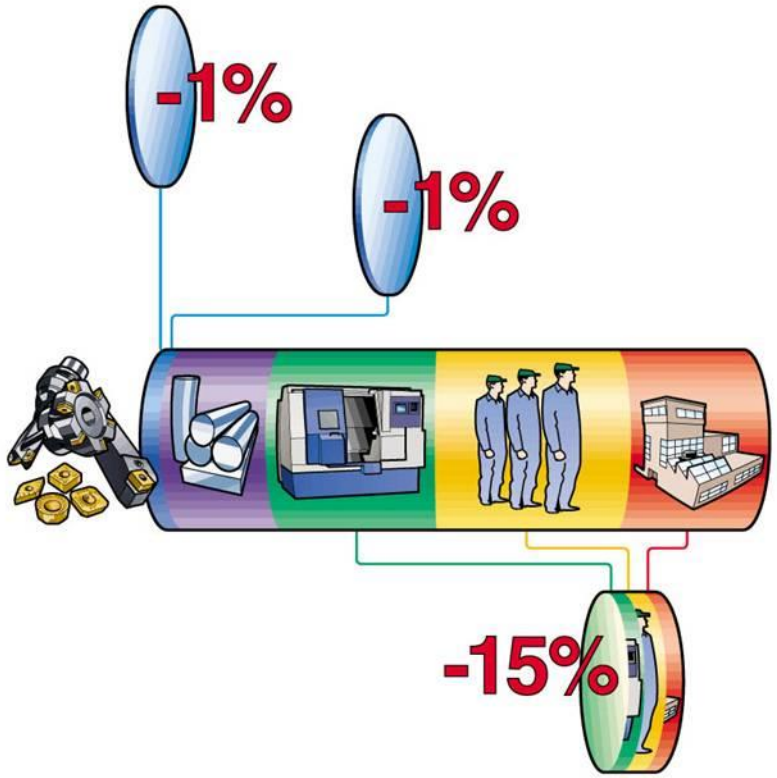
  Costs which exist even when not in production:
  - machine and tool holders (27%)
  - labour (31%)
  - buildings, administration etc. (22%)

Machining economy

– cost, tool life or productivity

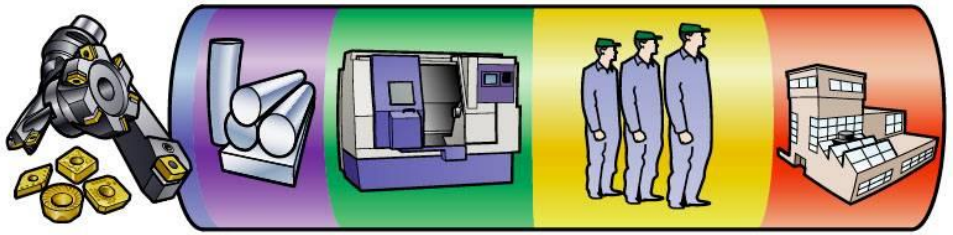
- Decreased cost:
  30% decrease in price only reduces total cost per component by **1%**
- **Increased tool life:**
  50% increase in tool life only reduces total cost per component by **1%**
- **Increased cutting data:**
  20% increase in cutting data reduces total cost per component by **15%**





Machining economy example

Shop spends $10,000
to make 1000 parts
Cost is $10.00 per part



	Today	Lower price	Tool life	Increase Cutting data
		30%	**50%**	**20%**
Variable				
- Tooling	$ .30	$ .21	$ .20	$ .45
- Material	$1.70	$1.70	$1.70	$1.70
Fixed				
- Machinery	$2.70	$2.70	$2.70	$2.16
- Labour	$3.10	$3.10	$3.10	$2.48
- Building	$2.20	$2.20	$2.20	$1.76
Cost per part	**$10.00**	**$9.91**	**$9.90**	**$8.55**
Savings		**1%**	**1%**	**15%**

* In addition to the 15% decrease in cost, there is also 20% additional capacity

Base for cutting data recommendations

- Tool life
  - All cutting data is based on on 15 min tool life
  - 15 min tool life = Factor 1.0
  - Use correction factor for other values according to the table

Higher metal removeal

If you want to change the cutting speed to obtain higher metal removal rates the new cutting speed values can be calculated from the following table.

Tool life (Mins.)	10	15	20	25	30	45	60
Correction factor	1,11	1,0	0,93	0,88	0,84	0,75	0,70

Example: If the recommended cutting speed (vc) = 225 m/min. A tool life of 10 minutes gives you 225 x 1,11 ≈ 250 m/min

- Hardness
  - All cutting data are based on the reference materials and the respective hardness
  - E.g ISO P HB 180 = Factor 1.0
  - Use correction factors for other values according to the table

ISO/ ANSI	CMC[1]	HB[2]	Reduced hardness -60	-40	-20	0	Increased hardness +20	+40	+60	+80	+100
P	02.1	HB[2] 180	1,44	1,25	1,11	1,0	0,91	0,84	0,77	0,72	0,67
M	05.21	HB[2] 180	1,42	1,24	1,11	1,0	0,91	0,84	0,78	0,73	0,68
K	08.2	HB[2] 220	1,21	1,13	1,06	1,0	0,95	0,90	0,86	0,82	0,79
	09.2	HB[2] 250	1,33	1,21	1,09	1,0	0,91	0,84	0,75	0,70	0,65
N	30.21	HB[2] 75			1,05	1,0	0,95				
S	20.22	HB[2] 350			1,12	1,0	0,89				
H	04.1	HRC[3] 60			1,07	1,0	0.97				

Example for calculating hardness factor and cutting speed compensation

- Steel material ISO P 02.1
  - Reference hardness HB= 180
  - 15 min tool life = Factor 1.0
  - Use correction factor for other values according to the table

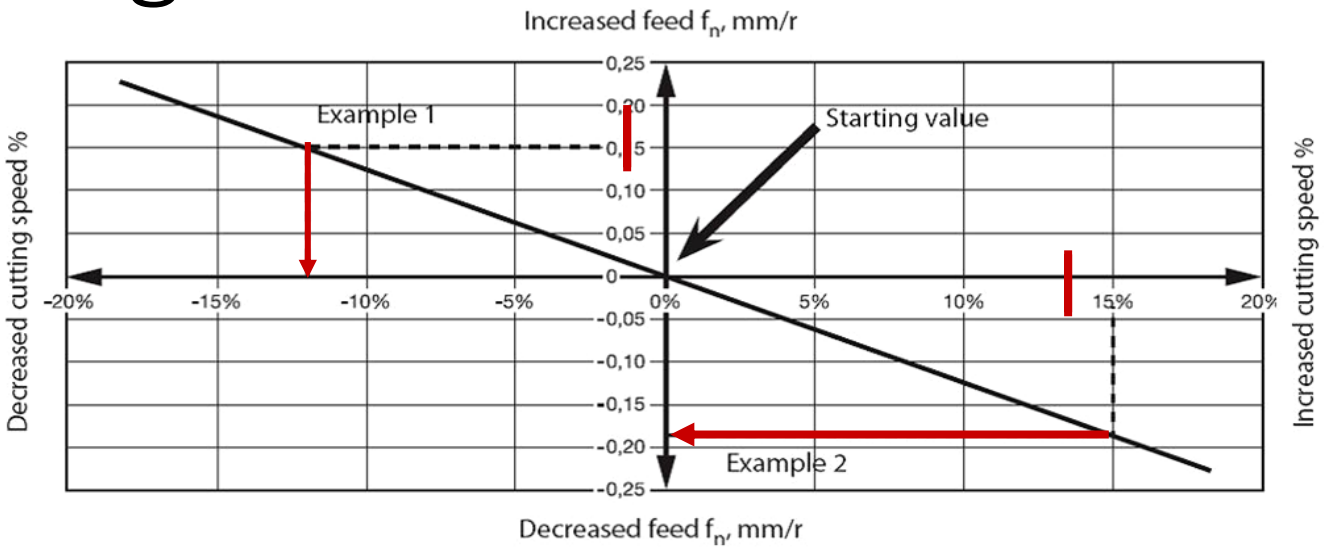
ISO/ ANSI	CMC[1]	HB[2]	Reduced hardness -60	-40	-20	0	Increased hardness +20	+40	+60	+80	+100
P	02.1	HB[2] 180	1,44	1,25	1,11	1,0	0,91	0,84	0,77	0,72	0,67
M	05.21	HB[2] 180	1,42	1,24	1,11	1,0	0,91	0,84	0,78	0,73	0,68
K	08.2	HB[2] 220	1,21	1,13	1,06	1,0	0,95	0,90	0,86	0,82	0,79
	09.2	HB[2] 250	1,33	1,21	1,09	1,0	0,91	0,84	0,75	0,70	0,65
N	30.21	HB[2] 75			1,05	1,0	0,95				
S	20.22	HB[2] 350			1,12	1,0	0,89				
H	04.1	HRC[3] 60			1,07	1,0	0.97				

- Customer workpiece material
  - DIN 42CrNiMo4
  - Tensile strength 900N/mm2
  - 900N7mm2 = HB 266
    values according to the table

Tensile strength N/mm²	Vickers HV	Brinell HB	Rockwell HRC	HRB
255	80	76.0	–	–
270	85	80.7	–	41.0
285	90	85.5	–	48.0
305	95	90.2	–	52.0
320	100	95.0	–	56.2
350	110	105	–	62.3
385	120	114	–	66.7
415	130	124	–	71.2
450	140	133	–	75.0
480	150	143	–	78.7
510	160	152	–	81.7
545	170	162	–	85.0
575	180	171	–	87.5
610	190	181	–	89.5
640	200	190	–	91.5
660	205	195	–	92.5
675	210	199	–	93.5
690	215	204	–	94.0
705	220	209	–	95.0
720	225	214	–	96.0
740	230	219	–	96.7
770	240	228	20.3	98.1
800	250	238	22.2	99.5
820	255	242	23.1	–
835	260	247	24.0	(101)
850	265	252	24.8	–
865	270	257	25.6	(102)
900	280	266	27.1	–
930	290	276	28.5	(105)
950	295	280	29.2	–
965	300	285	29.8	–
995	310	295	31.0	–

- Calculating hardness factor
  - HB 266-180 = +86
  - Cutting speed factor v_c = 0.70
  - Reduce the cutting speed by 70%

Cutting speed and feed data compensation for turning



- How to calculate cutting data compensations
  - The cutting data is based on 15 min tool life
- Example 1
  - Increase from e.g fn 0.3 mm/rev to 0.45 mm/rev = +0.15 mm/r
  - Decrease the cutting speed with 12% from the given cutting speed value
- Example 2
  - Increase the cutting speed with +15% e.g from 345 m/min to 400 m/min
  - Decrease the feed with 0.18 mm/r from the given feed value

How can you improve your productivity

Things to consider

- Identify the material and hardness HB or tensile strenght N/mm2
- Choose the correct geometry
- Choose the correct grade
- Use the given cutting data values or compensate the cutting data values according to your needs
- Correctly applied, our tools can increase productivity by at least 20%