Productivity measures

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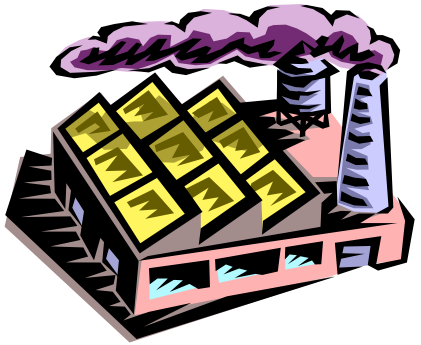
$$\text{Productivity} = \frac{\text{Production volume (expressed in a certain unit of measurement)}}{\text{Level of use of a certain production factor}}$$

Material Productivity



Machine productivity

Workforce productivity

Productivity measures

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Productivity measurements are, generally, expressed by indicators of efficiency such as:

P = Output / Input

These can be measured with reference to:

- a single machine,
- a group of machines,
- stages of the production process or
- the entire production system

(see later “Hamlet’s question”)

Productivity

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- Partial measures*: output / single input
  - Output/energy , output/machine hour, output/labor
- Multi-factor measures: output / multi input
  - Multi-factor: output/(energy + machine cost), output/(labor + capital)
- Total measure : output / all inputs
- In general, Productivity = output / input

Productivity measures

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To make a diagnosis is, generally, not so useful to aggregate the productivity measures.

More useful indications derive from the decomposition of productivity measurements (P) in:

- Utilisation (U) and
- Efficiency (η)

of productive factors.

The output of the process is always the good (compliant) production that is stocked measured against “standard hours” (i.e. the hours that according to standard are necessary to produce a specific object, including the setup time).

The input changes according to the productive factors considered (machine, material or workforce)

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- Workforce Utilisation

$$U = \frac{\text{ACTUAL PRODUCTION TIME}}{\text{PAID HOURS}}$$

$$U = \frac{T - TMo - TMm - TSc - TO - TG - TM - TPr}{T}$$

$$U = \frac{TPb + TPs + TS}{T}$$

Productivity measures

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- Machine Utilisation

$$U = \frac{\text{ACTUAL PRODUCTION TIME}}{\text{OPENING CALENDAR TIME}}$$

$$U = \frac{T - TMo - TMm - TSc - TO - TG - TM - TPr}{T}$$

$$U = \frac{TPb + TPs + TS}{T}$$

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- Efficiency

$$\eta = \frac{\text{Actual Production in std. hours}}{\text{ACTUAL PRODUCTION TIME}}$$

$$\eta = \frac{\text{STD H. “STOCKED”}}{\text{ACTUAL PRODUCTION TIME}}$$

$$\eta = \frac{\sum \left[\left(\overline{TPb_i} + \overline{TPs_i} \right) + \overline{TS} \right]}{\sum \left[\left(TPb_i + TPs_i \right) + TS \right]}$$

The concept of standard time is fundamental.

Productivity measures

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Factor	***PRODUCTIVITY***	***UTILISATION***	***EFFICIENCY***
WF	$\frac{\text{produced volume}}{\text{paid hours}}$	$\frac{\text{actual worked h.}}{\text{paid h.}}$	$\frac{\text{vol. in h. std.}}{\text{actual worked h.}}$
MAC	$\frac{\text{produced volume}}{\text{installed cap.}}$	$\frac{\text{act. prod h.}}{\text{opening h.}}$	$\frac{\text{vol. in h. std.}}{\text{actual prod. h.}}$
MAT*	$\frac{\text{produced volume}}{\text{mater. used}}$	$\frac{\text{theor. consum.}}{\text{actual consum.}}$	$\frac{\text{vol. in material}}{\text{theor. consum.}}$

PRODUCTIVITY = UTILISATION x EFFICIENCY

Utilisation
exercise

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T = 750 h	
TPb1 (eff) = 260 h	TPb2 (eff) = 407 h
TPs1 (eff) = 8 h	TPs2 (eff) = 3 h
TG = 12 h	TPr = 7 h
TM = 9 h	TS (eff) = 21 h
TMm = 4 h	TMo = 14 h
TO = 5 h	TSc = 0 h

Efficiency
exercise

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QB1 = 200.000 pcs	QB2 = 240.000 pcs
QS1 = 4.800 pcs	QS2 = 1.200 pcs
RS1 = 800 pcs/h	RS2 = 600 pcs/h
TPb1 (eff) = 260 h	TPb2 (eff) = 407 h
TPs1 (eff) = 8 h	TPs2 (eff) = 3 h
TS (eff) = 21 h	TS (std) = 20 h

RS = standard production rate (pcs/h)

Efficiency
exercise

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QB1 = 200.000 pcs	QB2 = 240.000 pcs
QS1 = 4.800 pcs	QS2 = 1.200 pcs
RS1 = 800 pcs/h	RS2 = 600 pcs/h
TPb1 = 250 h	TPb2 = 400 h
TPs1 = 6 h	TPs2 = 2 h
TS (std) = 20 h	