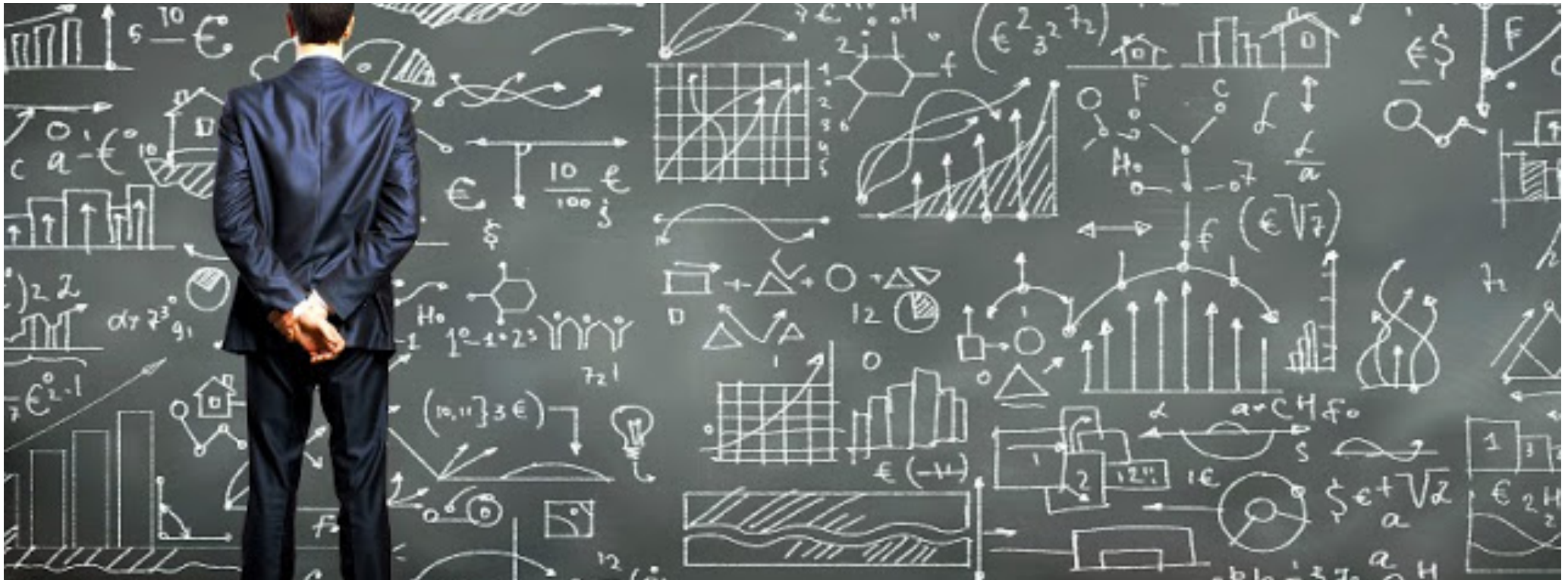
OPERATIONAL PRODUCTIVITY MEASURES

Measuring efficiency in physical terms



PARTIAL OPERATIONAL PRODUCTIVITY

$$\frac{100\ \text{km}}{3.5\ \text{liter}} \qquad \frac{67.2\ \text{miles}}{1\ \text{gallon}}$$

OPERATIONAL PRODUCTIVITY

$$\frac{\text{\# items sold}}{\text{square meters}} \qquad \frac{\text{hectoliters of wine}}{\text{hectares of vineyard}} \qquad \frac{\text{1 liter of wine}}{\text{kg grapes}}$$

$$\frac{\text{square meters “served”}}{\text{\# Full Time Equivalents}} \qquad \frac{\text{\# salable chairs}}{\text{1 day of production}}$$

$$\frac{\text{\# of products}}{\text{hours of labor}} \qquad \frac{\text{\# of dossiers}}{\text{\# of clerks}} \qquad \frac{\text{\# of km}}{\text{\# of day}} \qquad \frac{\text{\# of km sold}}{\text{\# of km travelled}}$$

HOW TO MEASURE RETAIL PERFORMANCE?

1. Number of Customers (Customer Traffic)
2. Effectivity (Retail Conversion Rate)
3. Average Sale (Average purchase value)
4. Items per purchase (Size of an average shopping cart)
5. Gross margin (Sales profit before costs)

SOURCE: https://erply.com/how-to-measure-retail-performance-5-essential-metrics/

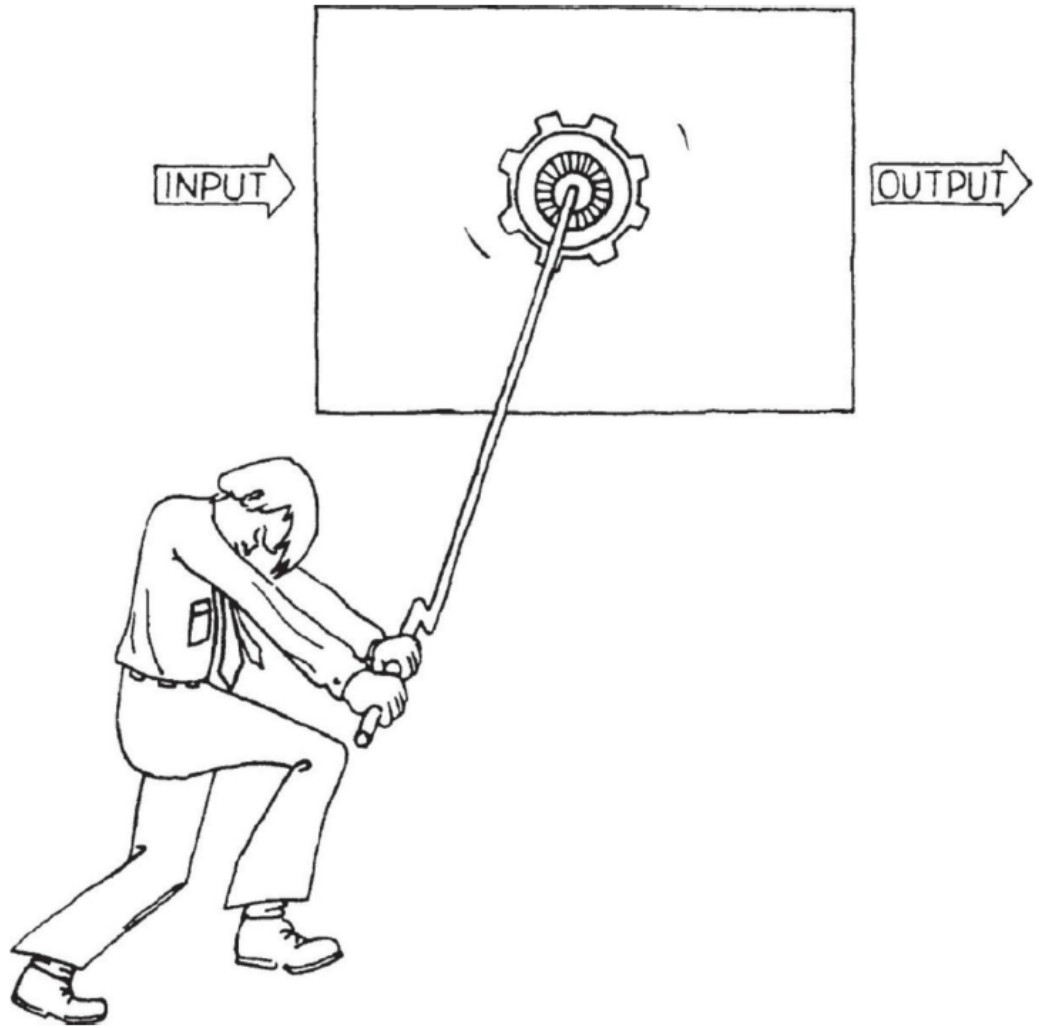
HOW TO LINK THE MEASURES TOGETHER

1. Number of Customers (Customer Traffic)
2. Effectivity (Retail Conversion Rate)
3. Average Sale (Average purchase value)
4. Items per purchase (Size of an average shopping cart)
5. Gross margin (Sales profit before costs)

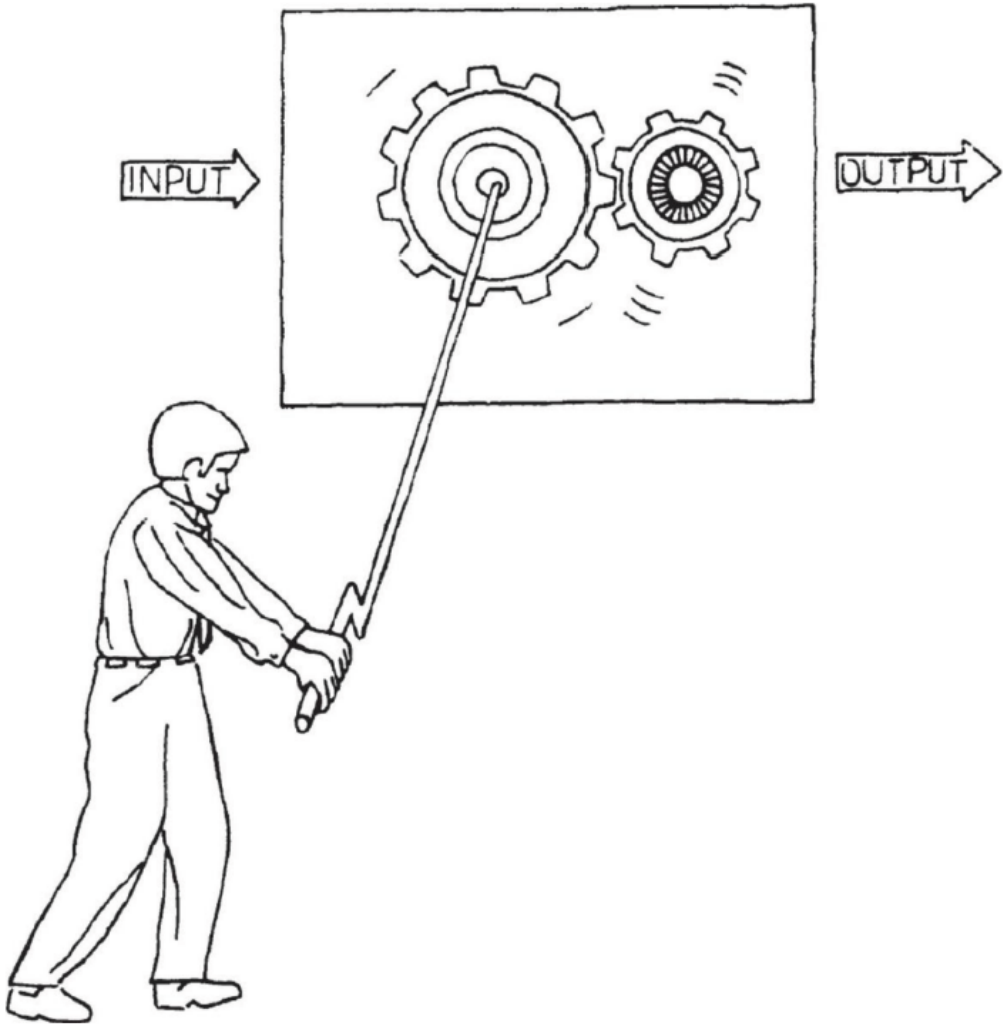
$$\frac{\#\text{ Visitors}}{\#\text{ Square meters}} * \frac{\#\text{ Transactions}}{\#\text{ Visitors}} * \frac{\#\text{ Items sold}}{\#\text{ Transactions}} * \left\{ \frac{\text{Sales revenue}}{\#\text{ Items sold}} - \frac{\text{COGS}}{\#\text{ Items sold}} \right\}$$

Partial operational productivity measures

WORKING FASTER (HARDER ?)



WORKING SMARTER



WORKING HARDER OR SMARTER

«The workings of our black box can furnish us with the simplest and most useful definition of productivity. The productivity of any function occurring within it is the output divided by the labor required to generate the output. Thus, one way to increase productivity is to do whatever we are now doing, but faster. This could be done by reorganizing the work area or just by working harder. Here we've not changed what work we do, we've just instituted ways to do it faster—getting more activities per employee-hour to go on inside the black box. Because the output of the black box is proportional to the activity that occurs within it, we will get more output per hour.

There is a second way to improve productivity. We can change the nature of the work performed: what we do, not how fast we do it. We want to increase the ratio of output to activity, thereby increasing output even if the activity per employee-hour remains the same. As the slogan has it, we want to "work smarter, not harder"».

Excerpt from: Andrew S. Grove. "High output management"

WHICH IS THE BEST?

CAB DRIVER FURIO

$$\frac{\text{100 km travelled}}{\text{8 liters}}$$

CAB DRIVER NEVIO

$$\frac{\text{150 km travelled}}{\text{12 liters}}$$

WHICH IS THE BEST?

CAB DRIVER FURIO

$$\frac{\text{50 km sold}}{\text{8 liters}}$$

CAB DRIVER NEVIO

$$\frac{\text{50 km sold}}{\text{12 liters}}$$

WHICH IS THE BEST?

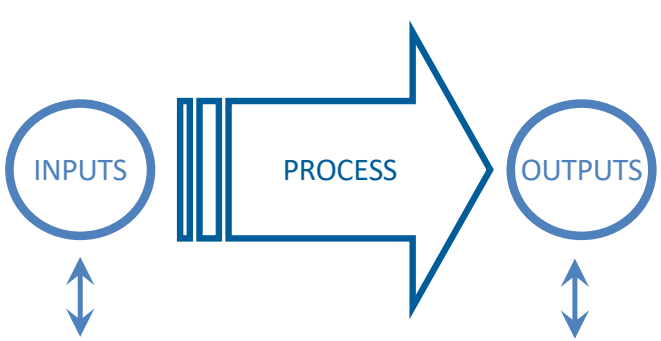
CAB DRIVER FURIO

$$\frac{50 \text{ km sold}}{8 \text{ liters}} = \frac{50 \text{ km sold}}{100 \text{ km travelled}} \times \frac{100 \text{ km travelled}}{8 \text{ liters}}$$

CAB DRIVER NEVIO

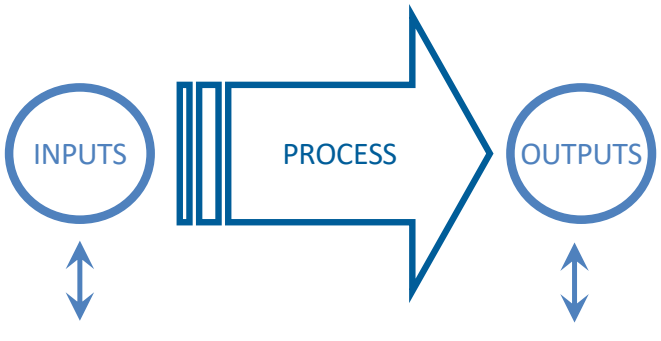
$$\frac{50 \text{ km sold}}{12 \text{ liters}} = \frac{50 \text{ km sold}}{150 \text{ km travelled}} \times \frac{150 \text{ km travelled}}{12 \text{ liters}}$$

TWO DIFFERENT PERSPECTIVE



Level of **resources consumed** to produce the output

Total output made in the period



Level of the **resources sacrificed to sell**

Output sold in the period

input and output compared must be coherent, in the sense that they must refer to the same entity (outputs made or outputs sold)

TWO DIFFERENT PERSPECTIVE: A VERY SIMPLE EXAMPLE

Let's imagine that in order to produce one unit of Product "K" we need 0,5 units of Resource "L" and that we have the following relationships between products obtained and sold:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
Made	850	730	620	670	630	600	**4100**
Sold	790	690	700	650	650	620	**4100**

Focus on outputs SOLD:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
(A) Output sold	790	690	700	650	650	620	**4100**
(B) Input used to make the whole production	395	345	350	325	325	310	**2050**
(C) Operational productivity = A/B	2,00	2,00	2,00	2,00	2,00	2,00	**2,00**

Focus on outputs MADE:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
(A) Output made	850	730	620	670	630	600	**4100**
(B) Input used to make the portion of product sold	425	365	310	335	315	300	**2050**
(C) Operational productivity = A/B	2,00	2,00	2,00	2,00	2,00	2,00	**2,00**

TWO DIFFERENT PERSPECTIVE: A MORE COMPLEX EXAMPLE

Let's imagine that in order to produce one unit of Product "K" we need 0,4 units of Resource "G" and that we have the following relationships between outputs obtained, sold and removed from inventory because obsolete:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
Made	600	570	610	650	620	550	**3600**
Sold	540	595	629	614	598	584	**3560**
Removed					28	12	**40**

Focus on outputs SOLD:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
(A) Outputs sold	540	595	629	614	598	584	**3560**
(B) Inputs used to make the outputs that have been sold	216	238	252	246	239	234	**1424**
(C) Inputs used to make the outputs that have been removed					11,20	4,80	**16**
(D) Operational productivity = A/(B+C)	2,50	2,50	2,50	2,50	2,39	2,45	**2,47**

Focus on outputs MADE:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
(A) Outputs made	600	570	610	650	620	550	**3600**
(B) Outputs removed					28	12	**40**
(C) Inputs used to make the outputs	240	228	244	260	248	220	**1440**
(D) Operational productivity = (A-B)/C	2,50	2,50	2,50	2,50	2,39	2,45	**2,47**

IN THE LONG RUN

$$\frac{OUTPUT_{SOLD}}{INPUT_{USED}} = \frac{OUTPUT_{SOLD}}{OUTPUT_{MADE}} * \frac{OUTPUT_{MADE}}{INPUT_{USED}}$$

First example:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
(A) Output made	850	730	620	670	630	600	**4100**
(B) Input used to make the portion of product sold	425	365	310	335	315	300	**2050**
(C) Operational productivity = A/B	2,00	2,00	2,00	2,00	2,00	2,00	**2,00**

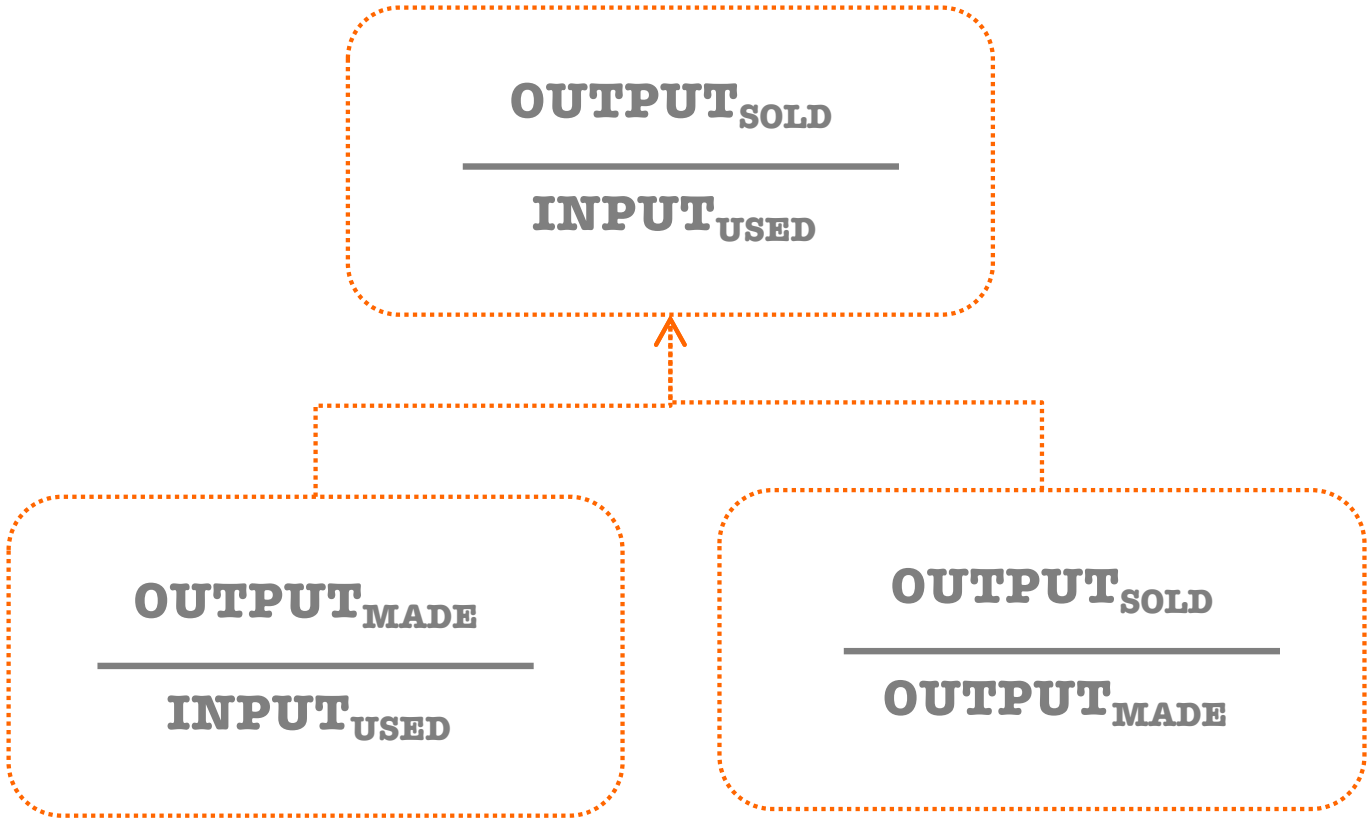
$$\frac{4{,}100 \text{ units}}{2{,}050 \text{ doses}} = \frac{4{,}100 \text{ units}}{4{,}100 \text{ units}} * \frac{4{,}100 \text{ units}}{2{,}050 \text{ doses}} = \mathbf{2{,}00}$$

Second example:

	20X0	20X1	20X2	20X3	20X4	20X5	Total
(A) Outputs made	600	570	610	650	620	550	**3600**
(B) Outputs removed					28	12	**40**
(C) Inputs used to make the outputs	240	228	244	260	248	220	**1440**
(D) Operational productivity = (A-B)/C	2,50	2,50	2,50	2,50	2,39	2,45	**2,47**

$$\frac{3{,}560 \text{ units}}{1{,}440 \text{ doses}} = \frac{3{,}560 \text{ units}}{3{,}600 \text{ units}} * \frac{3{,}600 \text{ units}}{1{,}440 \text{ doses}} = \mathbf{2{,}47}$$

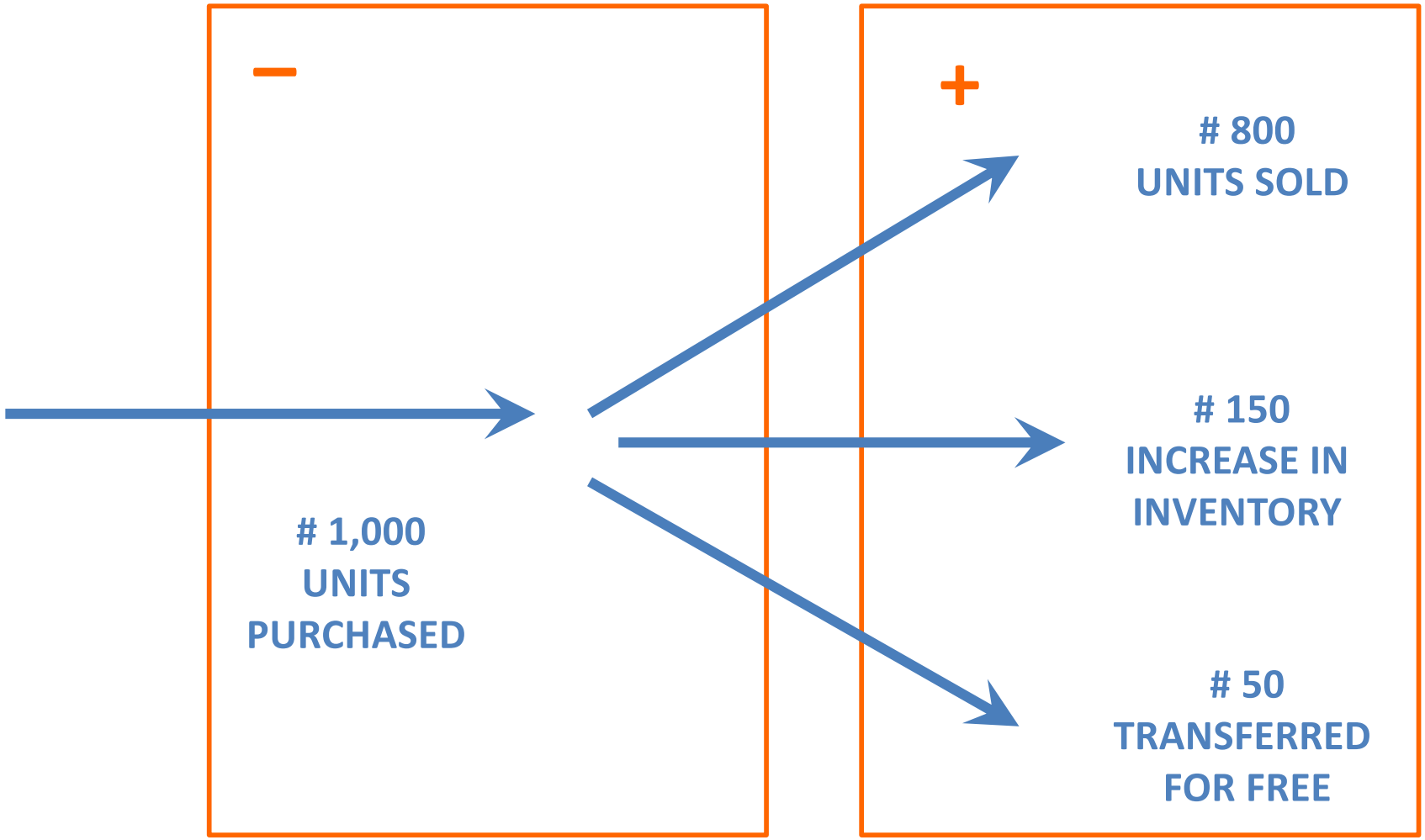
CAUSE AND EFFECT RELATIOSHIP



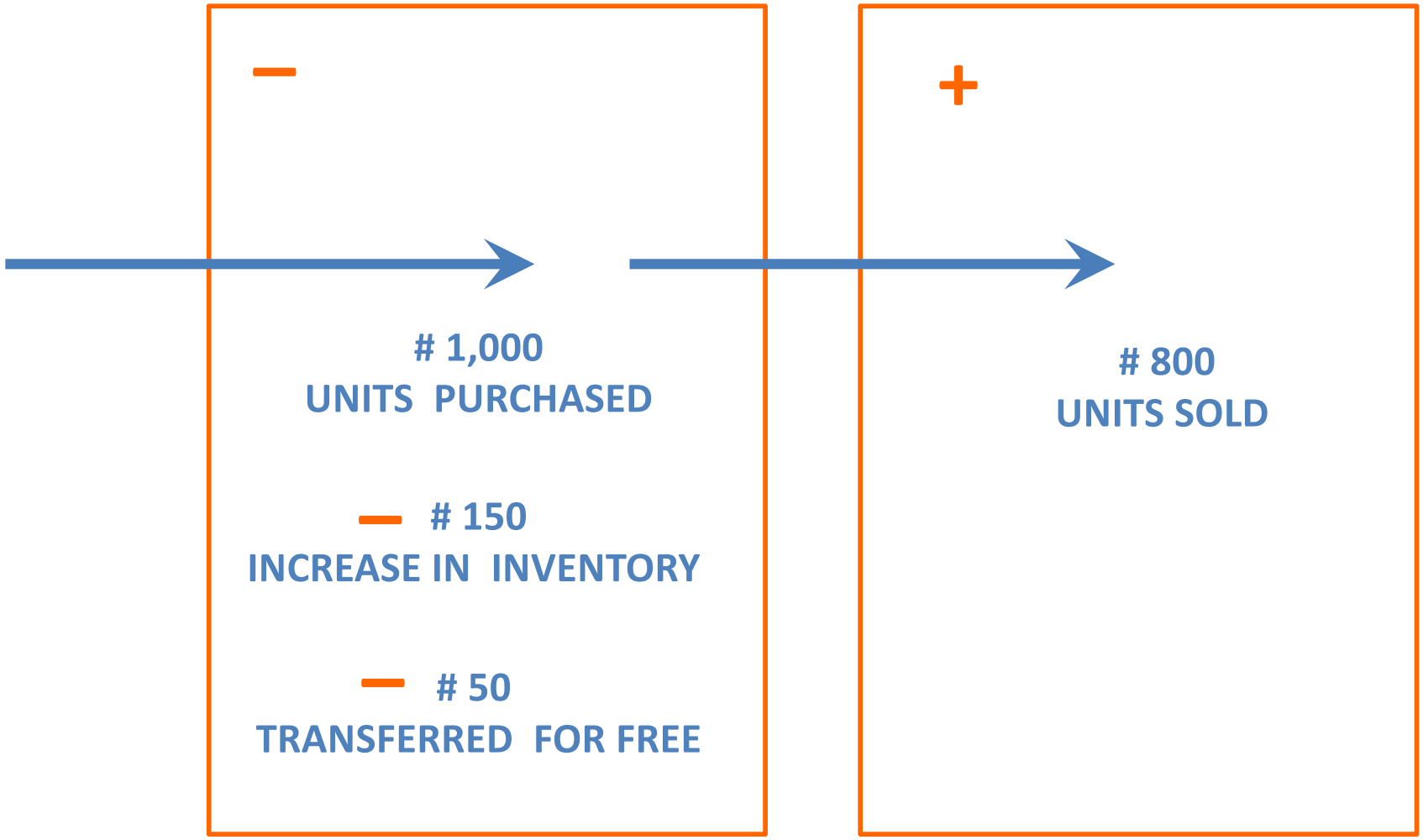
In the long run is necessarily less than or at most equal to 1!

This component if not correctly managed **can only destroy value**

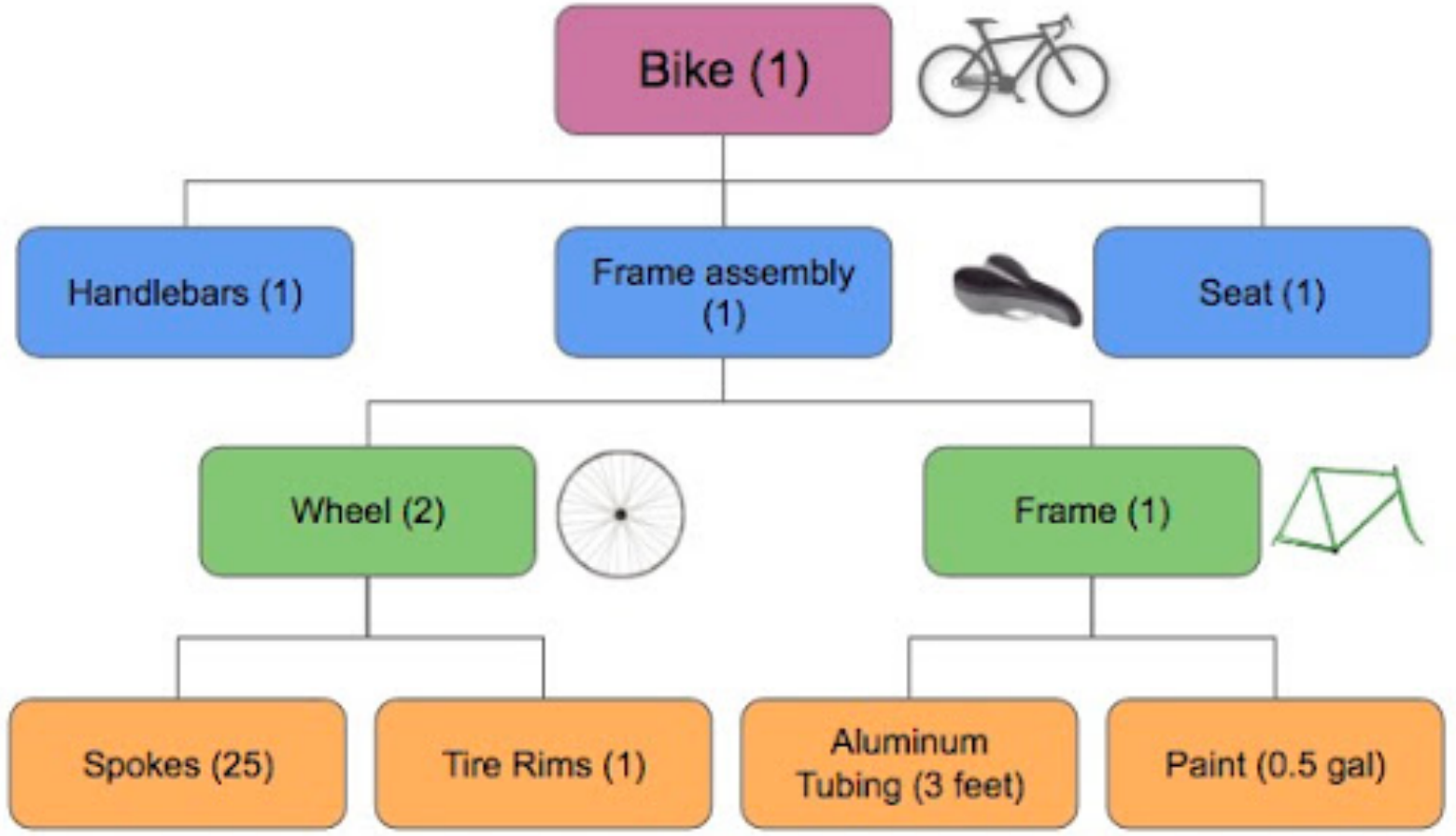
TOTAL OUTPUT INCOME STATEMENT (MERCHANDISING)



COGS INCOME STATEMENT (MERCHANDISING)



BILL OF MATERIALS



DIFFERENT STANDARDS

How many corks are needed to cork a bottle of wine?

$$\frac{1 \text{ CORK}}{1 \text{ BOTTLE}} = 1$$

$$\frac{21 \text{ CORKS}}{18 \text{ BOTTLES}} = 1.3125$$

IDEAL VS NORMAL STANDARD

Companies set standards at one of two levels: ideal or normal.

- Ideal standards represent optimum levels of performance under perfect operating conditions.
- Normal standards represent efficient levels of performance that are attainable under expected operating conditions.

Some managers believe ideal standards will stimulate workers to ever-increasing improvement. However, most managers believe that ideal standards lower the morale of the entire workforce because they are difficult, if not impossible, to meet. Very few companies use ideal standards.

Most companies that use standards set them at a normal level. Properly set, normal standards should be rigorous but attainable. Normal standards allow for rest periods, machine breakdowns, and other "normal" contingencies in the production process.

SPOILAGE, SCRAP AND REWORK

Spoilage refers to unacceptable units that are discarded or sold for disposal value.
Scrap is the material left over from the manufacture of the product; it has little or no value.
Rework units are units produced that must be reworked into good units that can be sold in regular channels.

"Level" of the problem

Normal: *occurs under normal operating conditions; it is uncontrollable in the short term and is considered a normal part of production and product cost.*
➜ the cost incurred is absorbed by the cost of good units produced.

Abnormal: *is in excess over the amount of normal spoilage expected under normal operating conditions.*
➜ the cost incurred is charged as a loss to operations in the period detected.

COMPARISON BETWEEN TWO OFFICES

10 clerks working 8 hours/day

8 clerks working 6 hours/day

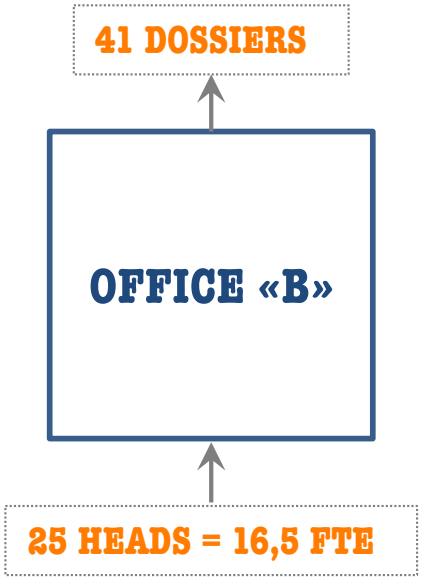
2 clerks working 4 hours/day

1 clerk working 8 hours/day

14 clerks working 6 hours/day

10 clerks working 4 hours/day

COMPARISON BETWEEN TWO OFFICES



10 clerks working 8 hours/day * 8/8 = 10 FTE

8 clerks working 6 hours/day * 6/8 =. 6 FTE

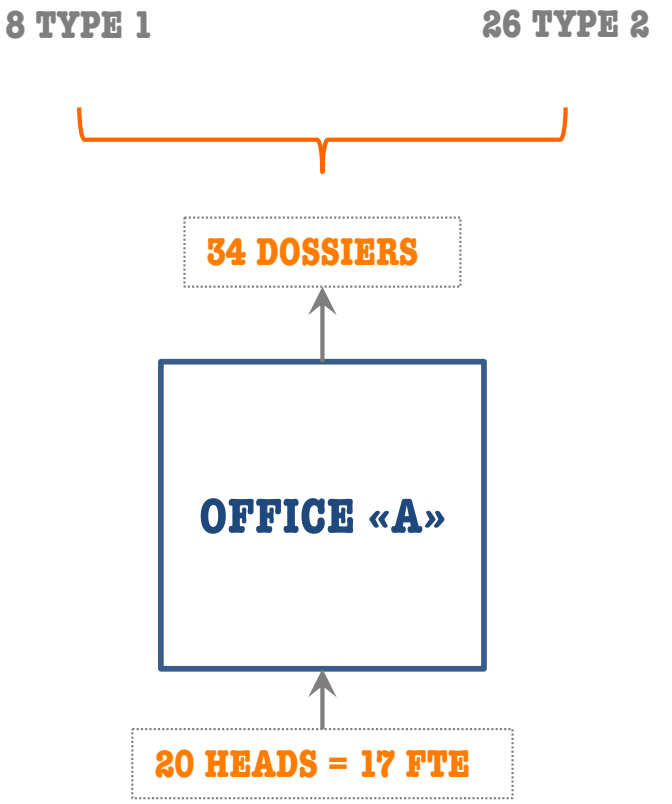
2 clerks working 4 hours/day * 4/8 = 1 FTE

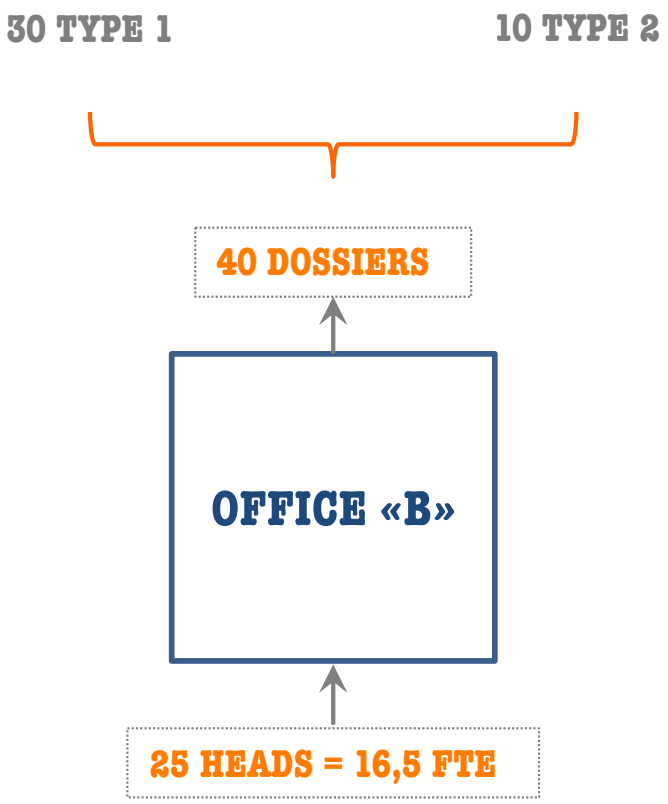
1 clerk working 8 hours/day * 8/8 = 1 FTE

14 clerks working 6 hours/day * 6/8 = 10,5 FTE

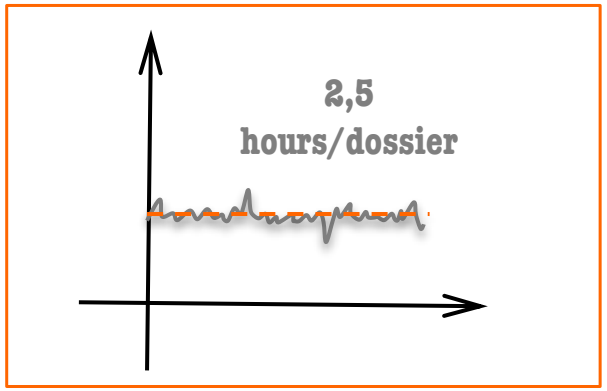
10 clerks working 4 hours/day * 4/8 = 5 FTE

DIFFERENT KINDS OF OUTPUTS

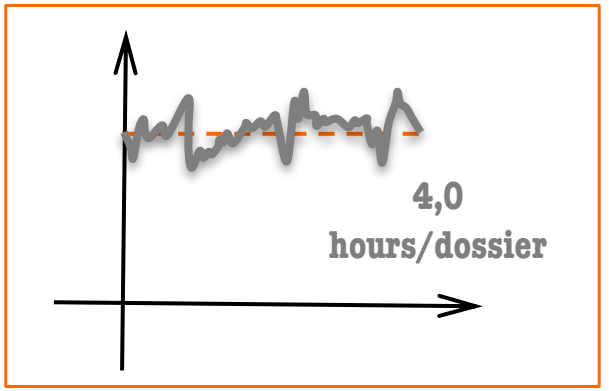




ESTABLISHING EQUIVALENCE



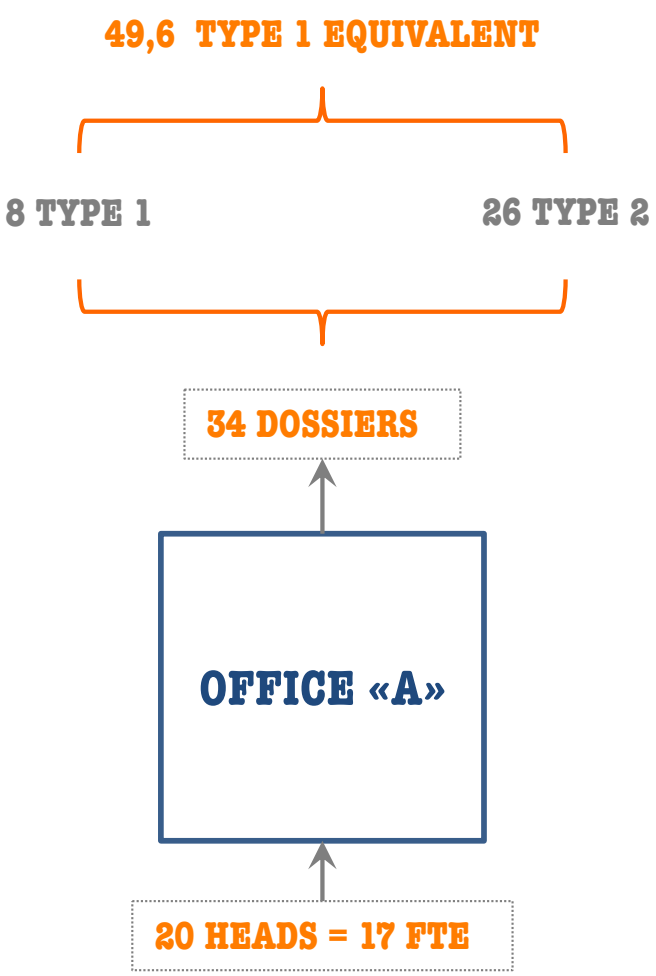
DOSSIER TYPE 1

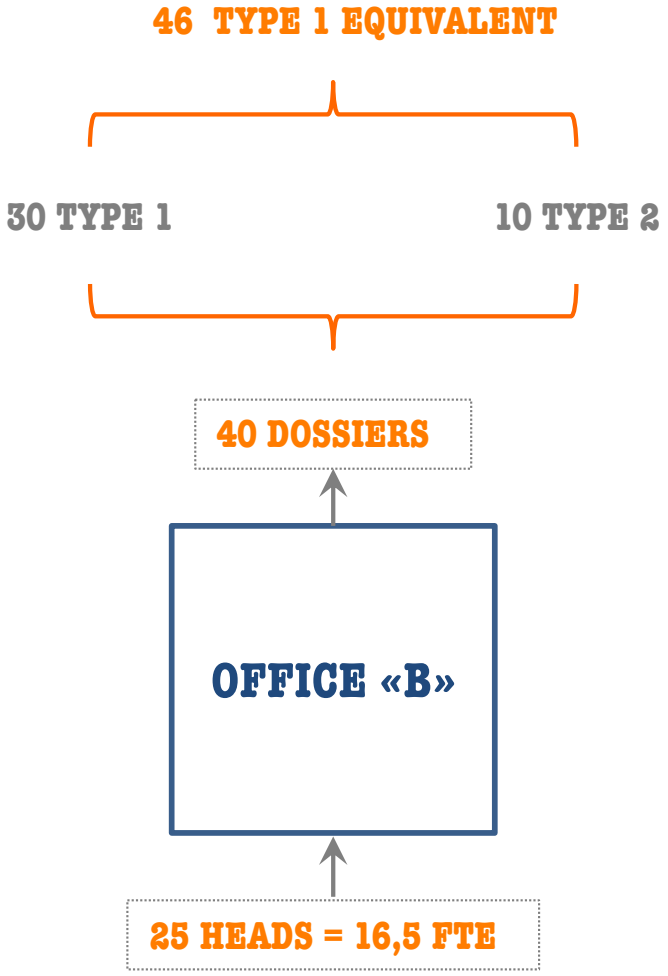


DOSSIER TYPE 2

$$\text{DOSSIER TYPE 2} = \frac{4}{2,5} * \text{DOSSIER TYPE 1}$$

DIFFERENT KINDS OF OUTPUTS





DIFFERENT WINE BOTTLE SIZES

AVERAGE SALES PRICE "PER BOTTLE"

The owner of Birre dal Mondo S.r.l., a company that sells beer imported from abroad, wishes to calculate the average unit selling price of a particular S.K.U. (Stock Keeping Unit) for the purpose of calculating the breakeven point.
The brand in question is sold in bottles of different sizes. The sales figures for the period under consideration are as follows:

- 330 cl format 14,580 bottles sold € 10,206.00
- 660 cl format 39,126 bottles sold € 43,038,60
- 1000 cl format 24,168 bottles sold € 36,252.00

Required:

The owner asks you to calculate the average sales price "per bottle". Can you help him out?

AVERAGE SALES PRICE "PER BOTTLE": SOLUTION

Format	Bottles Sold	Sales Revenue	Price per bottle	Conversion Rate	Equivalent bottles	
330	14,580	€ 10,206.00	€ 0,70	0,50	7,290	
660	39,126	€ 43,038.60	€ 1,10	1,00	39,126	
1000	24,165	€ 36,252.00	€ 1,50	1,52	36,614	
		€ 89.496,60			**83,030**	**€ 1,08**

PRICE AS “HOMOGENIZATION FACTOR”

$ 1,000

$ 2,000

$ 900

1 iPhone

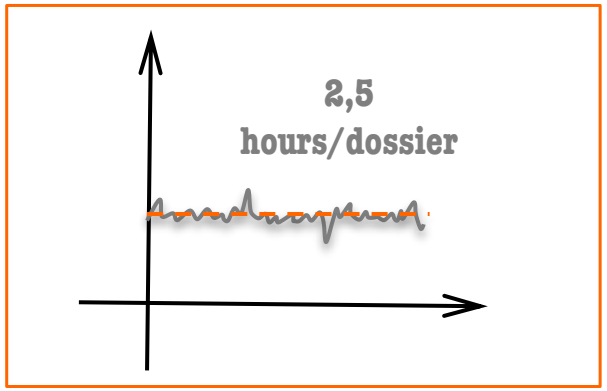
2 iPhone equivalent

0,9 iPhone equivalent

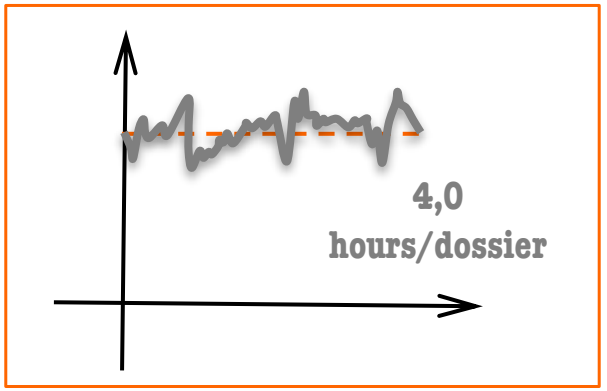
Break even point in units → Break even point in total dollars

QUANTITY OF DIRECT MATERIALS USED

HOURS OF DIRECT WORK USED



DOSSIER TYPE 1



DOSSIER TYPE 2

$$\text{DOSSIER TYPE 2} = \frac{4}{2{,}5} * \text{DOSSIER TYPE 1}$$

WORK IN PROCESS

Direct Materials	476.905
Direct Labour	366.850
Manufacturing Overheads	660.330
Total Manufacturing Costs	**1.504.085**

Finished Products	3.554
WIP # 2	2.300
WIP # 1	4.500

Required:

Determine the cost of one product.

EQUIVALENT UNIT OF PRODUCTION

	WIP #1	WIP #2	Finished Products	WIP #1	WIP #2	Finished Products
Direct Materials	75,00%	20,00%	5,00%	75,00%	95,00%	100,00%
Direct Labour	0,50	1,25	0,25	0,50	1,75	2,00
Manufacturing Overheads	1,00	4,50	0,50	1,00	5,50	6,00
Total Manufacturing Costs						

	WIP #1	WIP #2	Finished Products	WIP #1	WIP #2	Finished Products
Direct Materials	€ 48,75	€ 13,00	€ 3,25	48,75	61,75	65,00
Direct Labour	€ 12,50	€ 31,25	€ 6,25	€ 12,50	€ 43,75	€ 50,00
Manufacturing Overheads	€ 15,00	€ 67,50	€ 7,50	€ 15,00	€ 82,50	€ 90,00
Total Manufacturing Costs	**€ 76,25**	**€ 111,75**	**€ 17,00**	**€ 76,25**	**€ 188,00**	**€ 205,00**
				37,20%	**91,71%**	**100,00%**

EQUIVALENT UNIT OF PRODUCTION

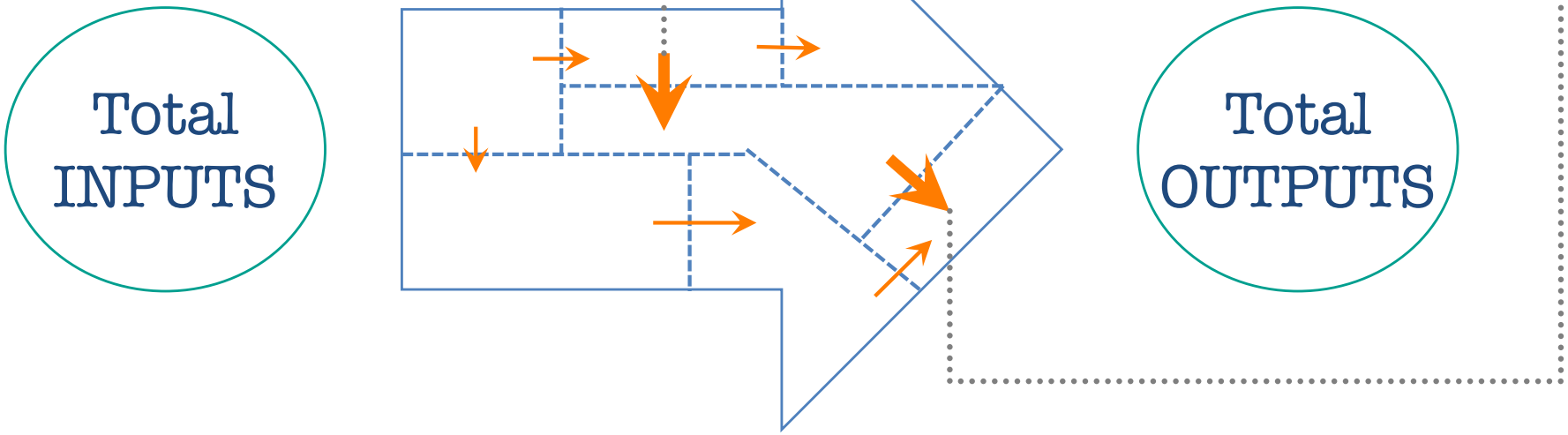
Direct Materials	476.905	7.337	€	65,00
Direct Labour	366.850	7.337	€	50,00
Manufacturing Overheads	660.330	7.337	€	90,00
Total Manufacturing Costs	**1.504.085**	7.337	€	205,00

Finished Products	3.554	100,00%	3.554
WIP # 2	2.300	91,71%	2.109
WIP # 1	4.500	37,20%	1.674
			7.337

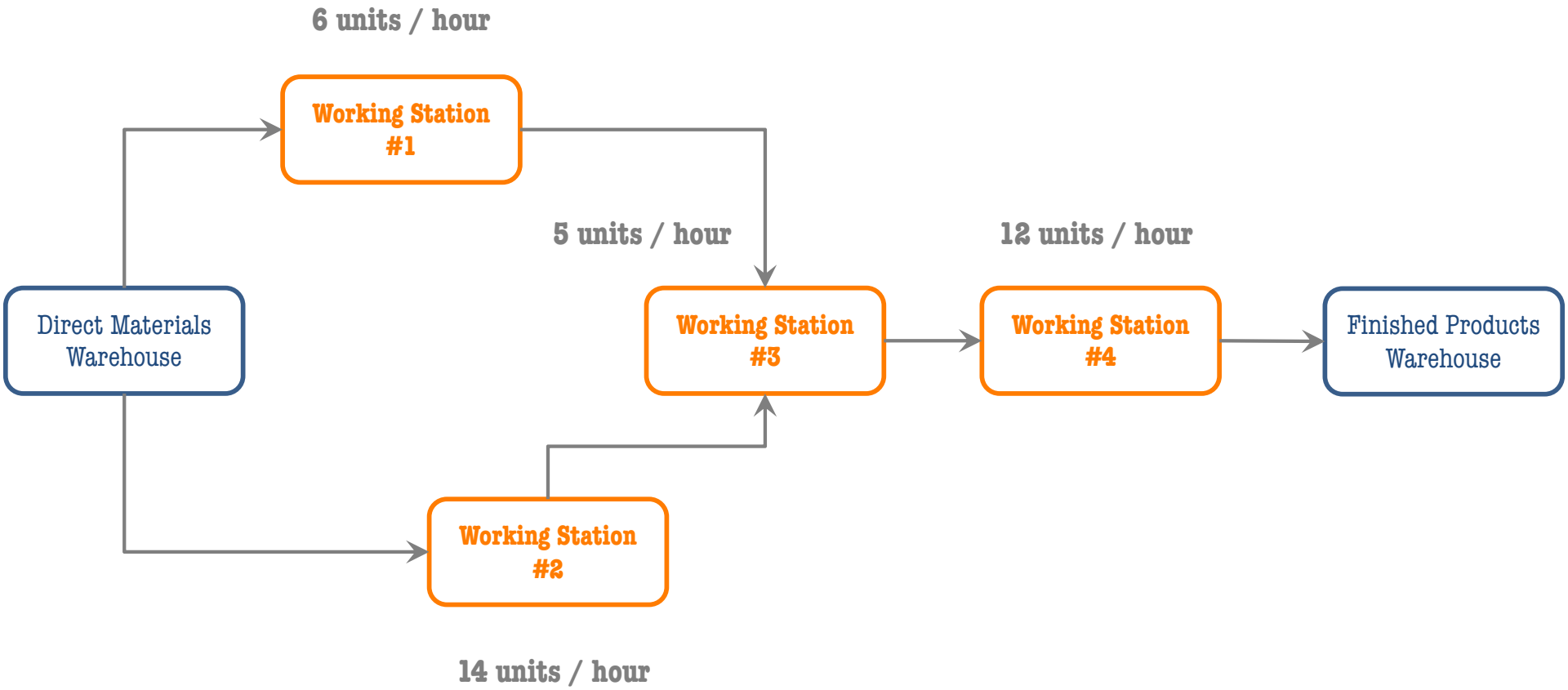
$$\text{Cost per unit} = \frac{1{,}504{,}085}{7{,}737} = 205$$

LOCAL EFFICIENCY

$$\text{Local Efficiency} = \frac{\text{Local Outputs}}{\text{Local Inputs}}$$



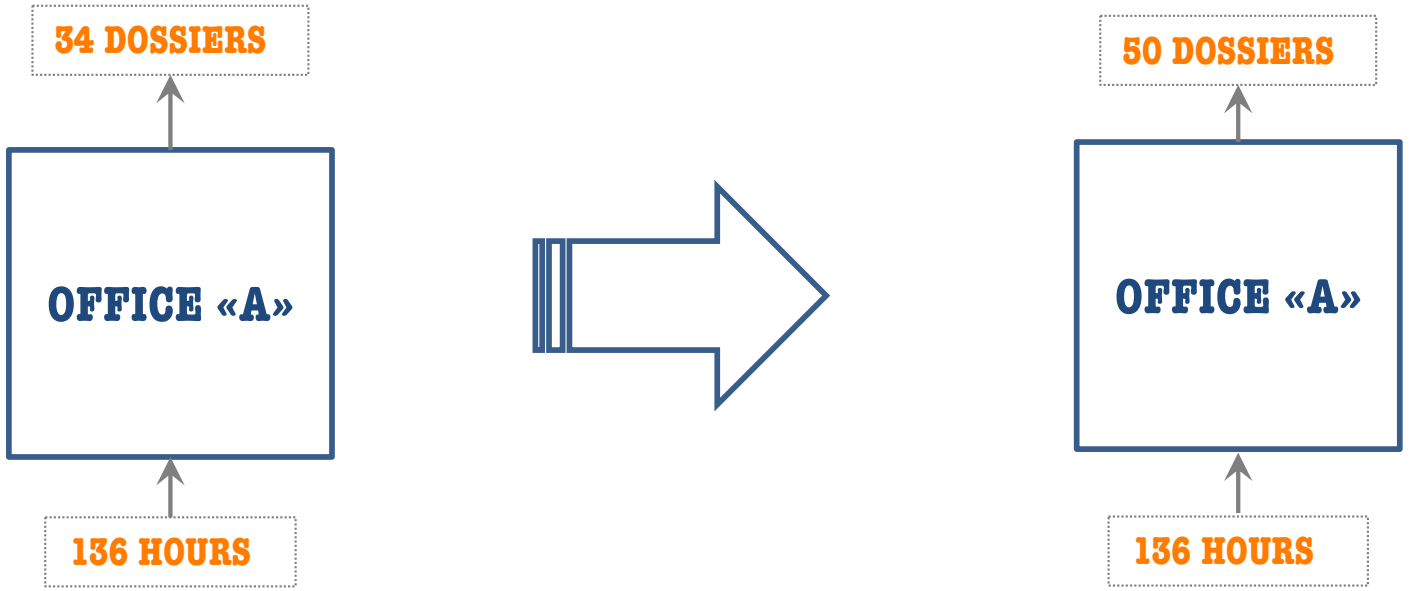
ANALYSIS OF A SIMPLE PROCESS



CAUTION IN INTERPRETING PARTIAL MEASURES

T_0

CAUTION IN INTERPRETING PARTIAL MEASURES



T_0

INVESTMENT IN TECHNOLOGY
workers are equipped with a new information system

T_1

It should always be remembered that any measure of partial productivity cannot isolate the relationships of formally considered inputs and outputs alone.

MEASURING CHANGES IN PRODUCTIVITY

«Actual productivity ratios by themselves convey little information about productive efficiency or whether the company has improving or declining productivity.

It is possible, however, to make a statement about increasing or decreasing productivity efficiency by measuring changes in productivity. To do so, the actual current productivity measures are compared with the productivity measures of a prior period.

This prior period is referred to as the base period **and** serves to set the benchmark or standard for measuring changes in productive efficiency. The prior period can be any period desired.

For strategic evaluations, the base period is usually chosen as an earlier year. For operational control, the base period tends to be close to the current period—such as the preceding batch of products or the preceding week».

Source: Don R. Hansen & Maryanne M. Mowen, "Cost Management. Accounting and Control", Fifth Edition, Chapter 15 *Productivity Measurement and Control,* Thomson South-Western, 2006

ADVANTAGES OF PARTIAL MEASURES

«Partial measures allow managers to focus on the use of a particular input.

Operating partial measures have the advantage of being easily interpreted by everyone within the organization. Consequently, partial operational measures are easy to use for assessing productivity performance of operating personnel. Laborers, for instance, can relate to units produced per hour or units produced per pound of material. Thus, partial operational measures provide feedback that operating personnel can relate to and understand—measures that deal with the specific inputs over which they have control.

The ability of operating personnel to understand and relate to the measures increases the likelihood that the measures will be accepted.

Source: Don R. Hansen & Maryanne M. Mowen, "Cost Management. Accounting and Control", Fifth Edition, Chapter 15 *Productivity Measurement and Control,* Thomson South-Western, 2006

DISADVANTAGES OF PARTIAL MEASURES

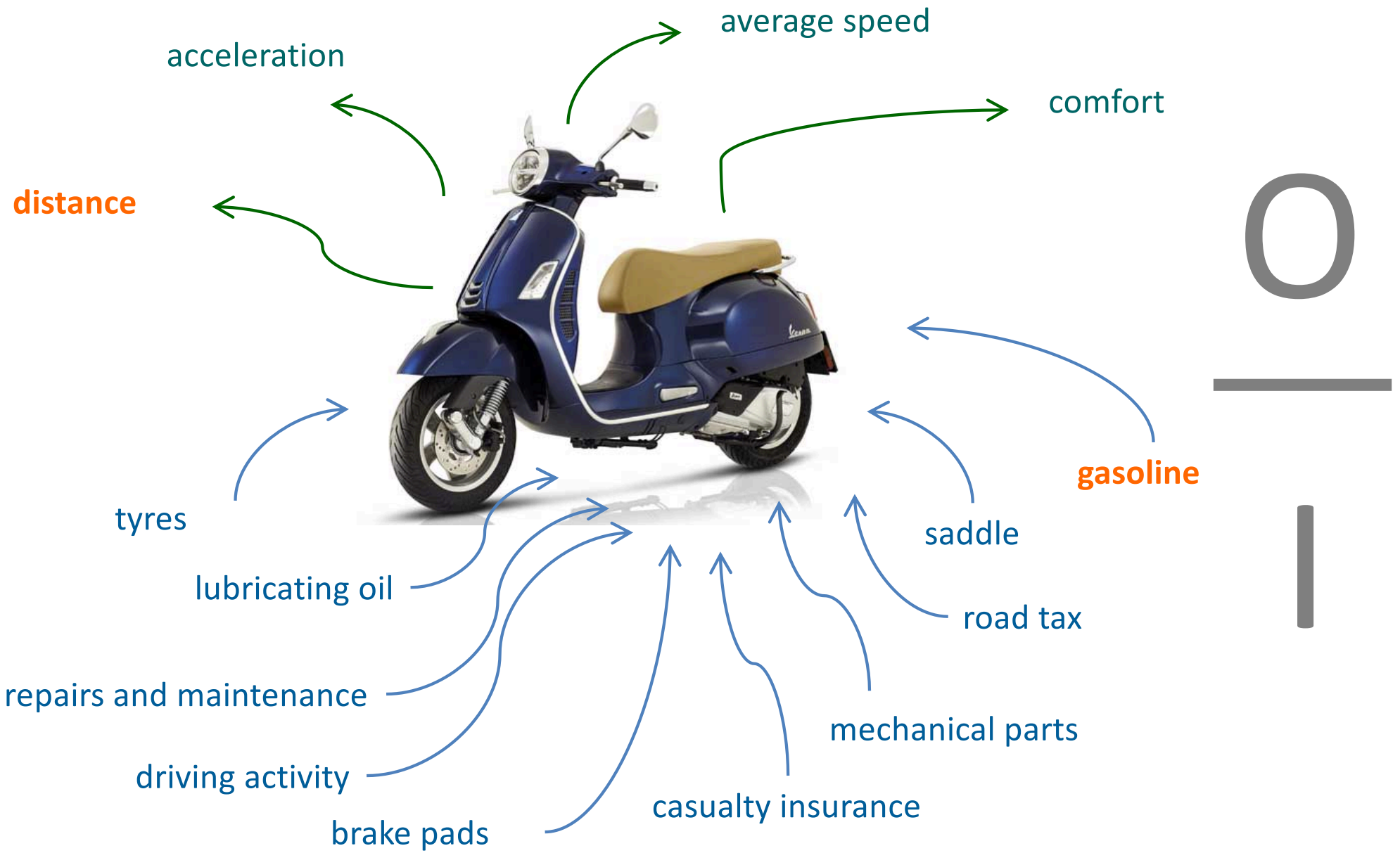
Partial measures, used in isolation, can be misleading.

A decline in the productivity of one input may be necessary to increase the productivity of another. Such a trade-off is desirable if overall costs decline, but the effect would be missed by using either partial measure.

For example, changing a process so that direct laborers take less time to assemble a product may increase scrap and waste while leaving total output unchanged. Labor productivity has increased, but productive use of materials has declined. If the increase in the cost of waste and scrap outweighs the savings of the decreased labor, then overall productivity has declined.

Source: Don R. Hansen & Maryanne M. Mowen, "Cost Management. Accounting and Control", Fifth Edition, Chapter 15 *Productivity Measurement and Control,* Thomson South-Western, 2006

DIFFERENT INPUTS AND DIFFERENT OUTPUTS



SOME CONSEQUENCES

Two important conclusions can be drawn from the analysis of disadvantages of partial productivity measures.

First, the possible existence of trade-offs mandates a total measure of productivity for assessing the merits of productivity decisions. Only by looking at the total productivity effect of all inputs can managers accurately draw any conclusions about overall productivity performance.

Second, because of the possibility of trade-offs, a total measure of productivity must assess the aggregate financial consequences and, therefore, should be a financial measure.

Source: Don R. Hansen & Maryanne M. Mowen, "Cost Management. Accounting and Control", Fifth Edition, Chapter 15 *Productivity Measurement and Control,* Thomson South-Western, 2006

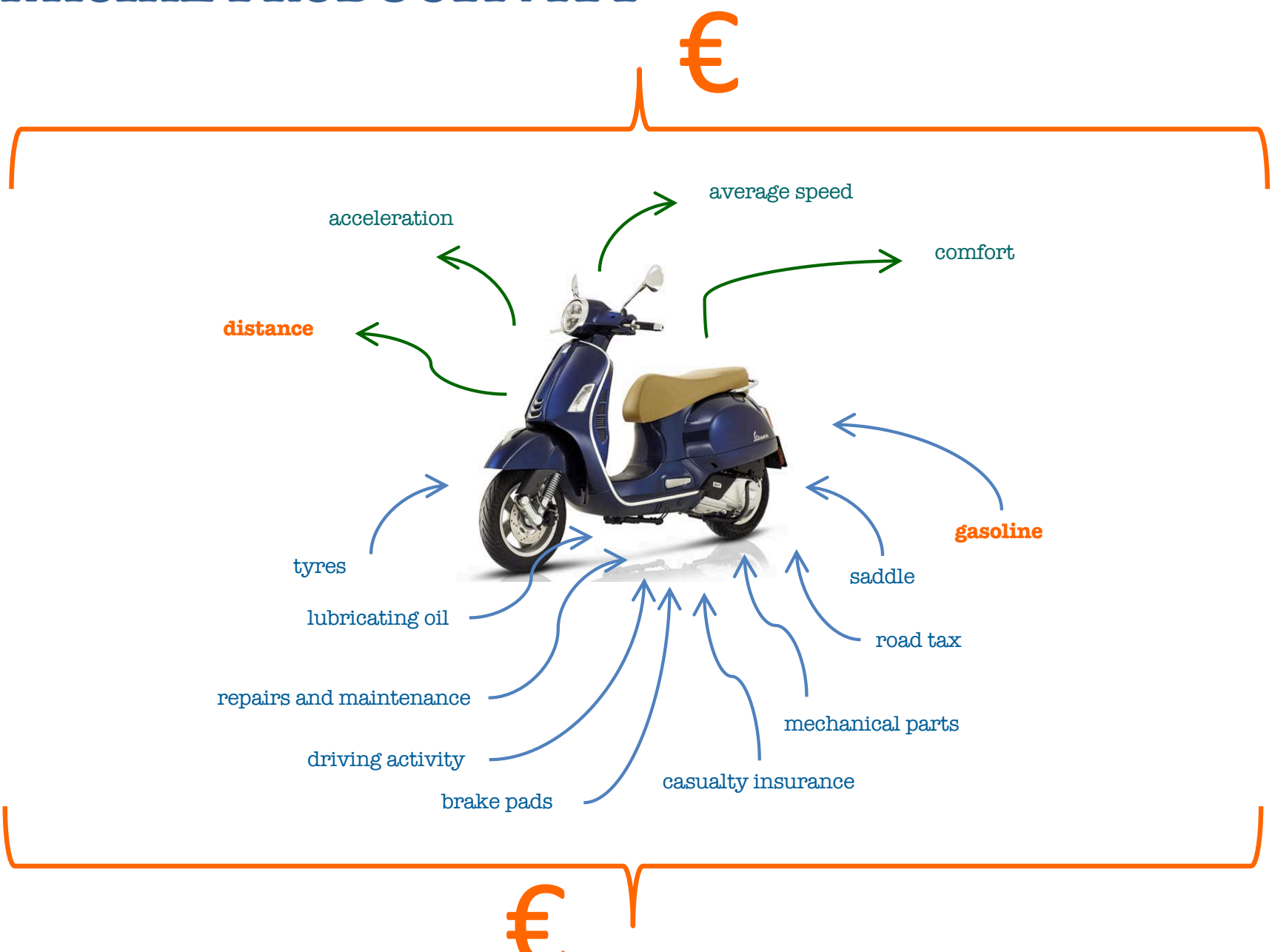
WHY IT IS DIFFICULT TO COMPUTE....

Total operational productivity measure:

$$\frac{\sum_{j=1}^{n} O_j^{Ph}}{\sum_{i=1}^{m} I_i^{Ph}}$$

There is a problem of heterogeneity both in the components of the numerator and in those that make up the denominator.

FINACIAL PRODUCTIVITY



SOME TAKEAWAY POINTS FROM MODULE # 5

- Efficiency measures provide information regarding the relationship between the sacrifice that has been made and the outcome that has been achieved. These measures summarize, therefore, the quality of the process carried out, allowing us to express a summary judgment on the correctness of the activities performed and the adequacy of the relationships between them.

- The efficiency of a process can be increased as much increasing the effort lavished (to work more fast) how much focusing the attention on the activities that guarantee the greater result for unit of effort profuse (to work in way more intelligent). This last action requires to focus the attention on the tasks with greater leverage (greater yield) .

- There are several measures of efficiency. A first set of metrics are measures of operational productivity. These metrics are constructed by contrasting outputs measured in physical terms (meters, litters, units, pieces, slices, cases, etc.) with inputs always measured with inputs always measured in physical terms (grams, pieces, hours, etc.).

SOME TAKEAWAY POINTS FROM MODULE # 5

- The most widely used measures of operational productivity are partial operational productivity ratios. These indicators are developed by selecting a particular type of output (which is placed at the numerator of the ratio) and a particular type of resource or class of resources that can be measured in the same way (whose measure appears at the denominator of the ratio).

- Partial operating productivity ratios are linked to so called “technical coefficients” which are constructed by placing the input measure at the numerator and the output measure at the denominator. Technical coefficients are, obviously, measures of inefficiency: if a technical coefficient increases, therefore, operational productivity decreases.

- Operational productivity measures are widely used in business because they provide information that is easily interpreted by workers. No special technical skills are required to decipher their meaning. In this respect, they are excellent measures for providing credible targets to those working at lower levels of the corporate hierarchy.