#6 Total Productivity Model

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Review : What is Productivity ?

Productivity is the quality or state of being productive.

Productivity is the measure of how specified resources are managed to accomplish timely objectives stated in terms of quality and quantity.

indicate

How well labor, capital, materials, and energy are used!

Why Labor Productivity?

- ✓ Easy to measure
- ✓ Easy to get the actual data
- ✓ One of the main cost in production system

Kelemahan 'Labor Productivity Measure'

- Ketidakselarasan pengaruh satu faktor input terhadap faktor input lainnya bila mengalami perubahan signifikan.
- Pengaruh faktor input lainnya dianggap tidak ada, sehingga berpotensi pada kesalahan pengambilan keputusan.

	Old Machine	New Machine
Production rate	100 parts/man-hour	120 parts/man-hour
Labor wage rate	$5/man-hour	$5/man-hour
Labor productivity	100/5 = 20 parts/$	120/5 = 24 parts/$
Labor productivity index	1	**24/20 = 1.2**
Machine rate (cost)	$40/man-hour	$60/man-hour
Machine productivity	100/40 = 2.5 parts/$	120/60 = 2 parts/$
Machine productivity index	1	**2/2.5 = 0.8**
Combined productivity of labor and machine	100 / (5+40) = 2.2 parts/$	120 / (5+60) = 1.85 parts/$
Combined productivity index	1	**1.85/2.22 = 0.83**

Total Productivity Model

- **The Total Productivity Model (TPM)** is based on a total productivity measure and a set of five partial productivity measures.

$$Total\ Productivity = \frac{total\ tangible\ output}{total\ tangible\ input}$$

Total tangible output = value of finished units produced
+ value of partial units produced
+ dividends from securities
+ interest from bonds
+ other income

Total tangible input = value of (human + material + capital + energy + other expense) inputs used

OUTPUT

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                    Outputs
                   (tangible)
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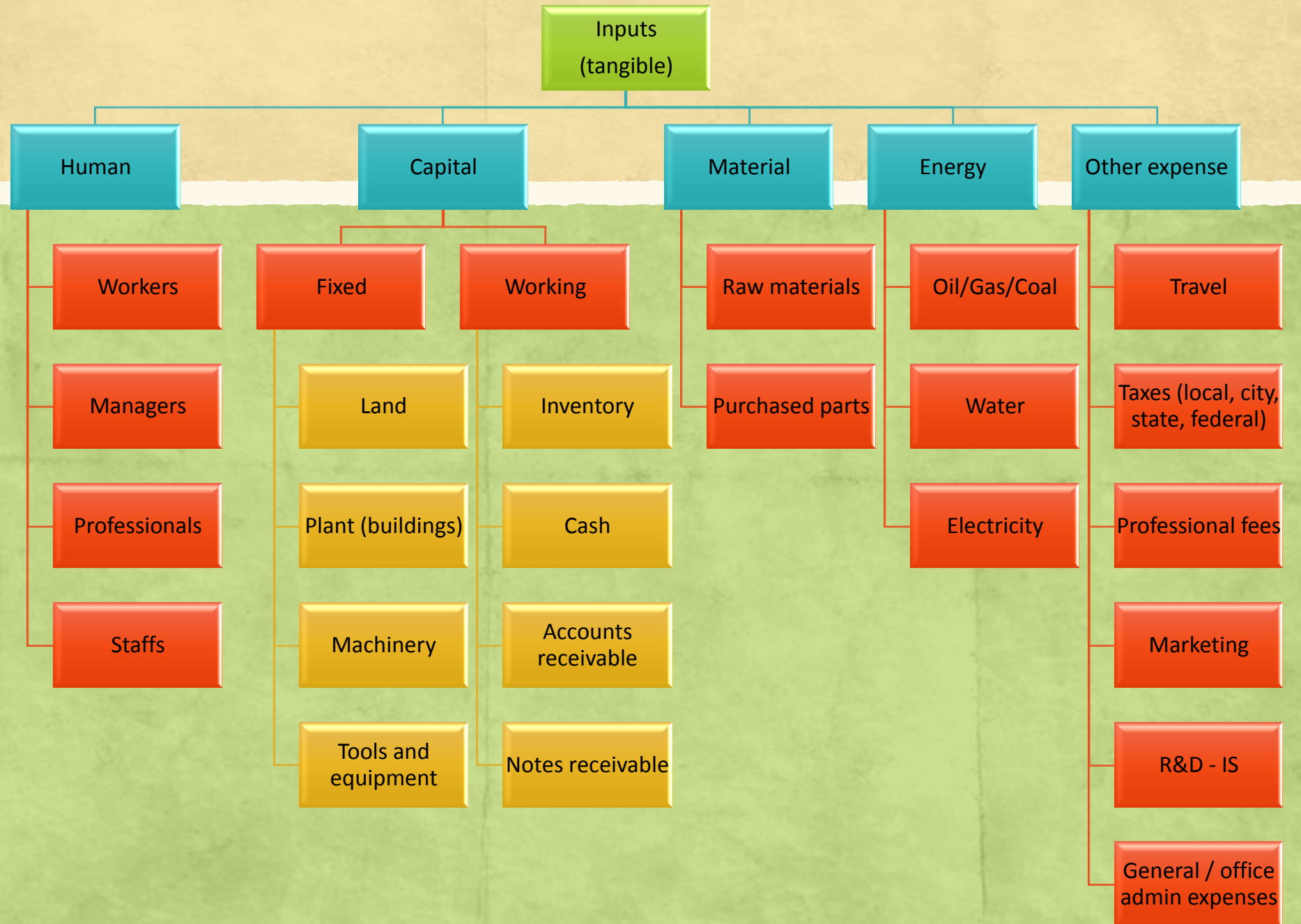| Finished units produced	Partial units produced	Dividends from securities	Interest from bonds	Other income

Finished units produced
- For sale
- For internal use

Partial units produced
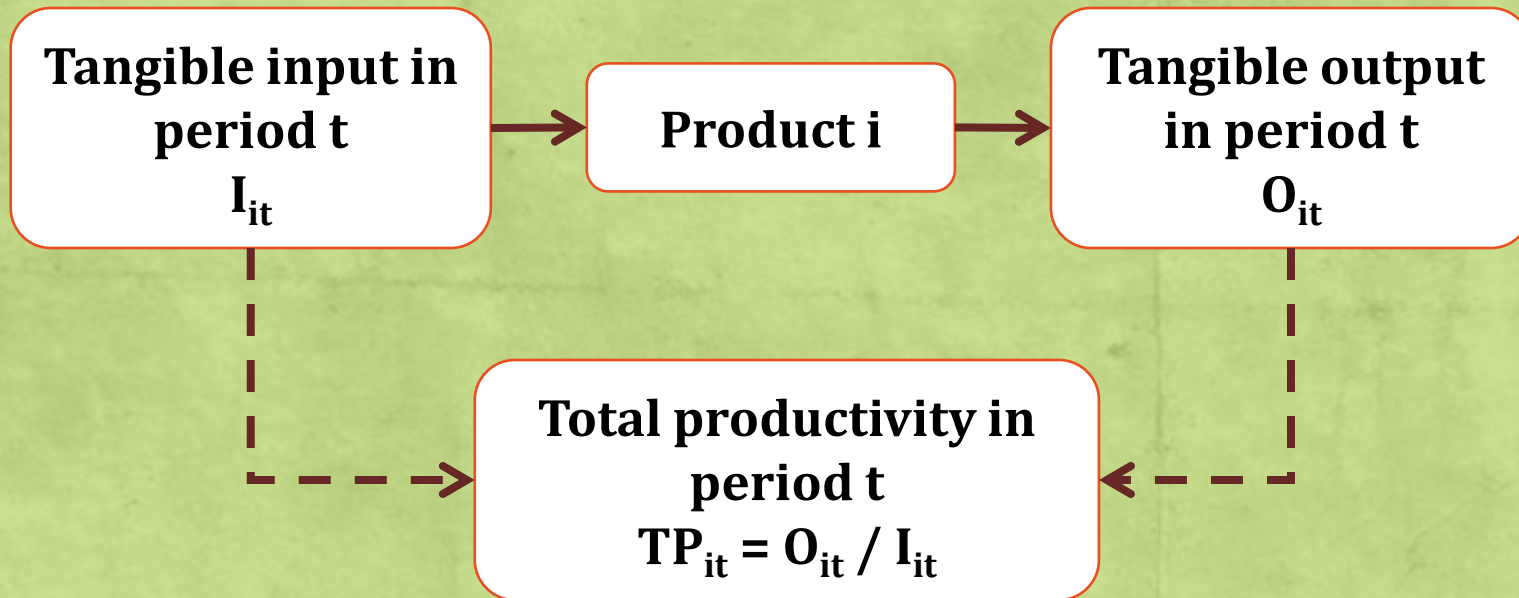- For sale
- For internal use
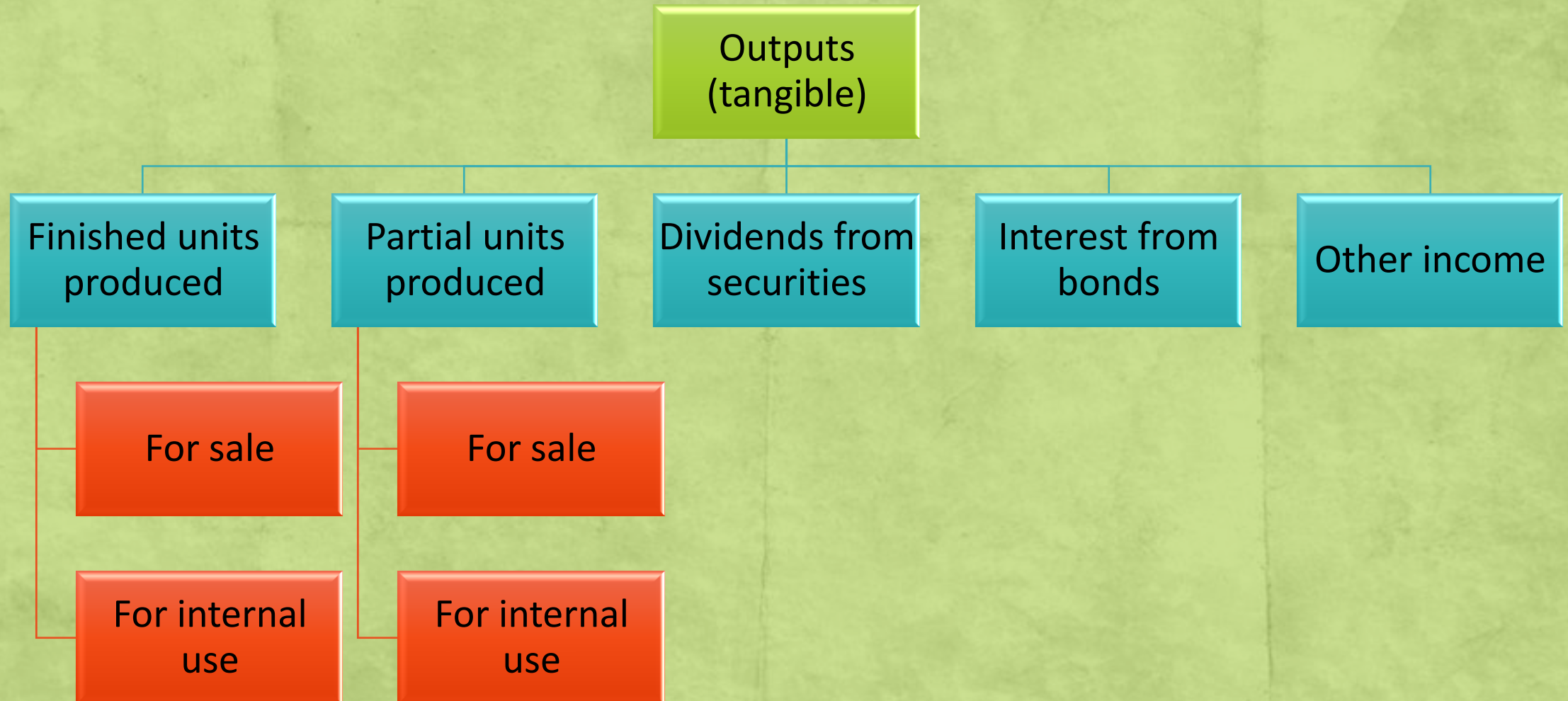
Advantages of TPM

- It provides both aggregate (firm-level) and detailed (operational unit-level) productivity indices

- It points out which operational units are profit making and which are not.

- It shows which particular input resources are being utilized inefficiently so that corrective action can be taken.

- It lends itself to mathematical treatment so that sensitivity analysis and model validation become relatively easier.

- It is integrated with the evaluation, planning, and improvement phases of the productivity cycle.

- It offers the advantages of management by exception by providing a means to more tightly to control the total productivity of major operational units, while providing a routine control for the less critical operational units.

- It provides valuable information to strategic planners in making decisions related to diversification and phase-outs of products or services.

Total Productivity Index for Product i Period t

Tangible input in period t
I_{it}

→ **Product i** →

Tangible output in period t
O_{it}

Total productivity in period t
$TP_{it} = O_{it} / I_{it}$

$$TP_{it} = \frac{O_{it}}{I_{it}} = \frac{O_{it}}{\sum_{j} I_{ijt}} = \frac{O_{it}}{I_{iHt} + I_{iMt} + I_{iCt} + I_{iEt} + I_{iXt}}$$

$\{j\} = \{H, M, C, E, X\}$

H = human input

M = material and purchased parts input

C = capital input

E = energy input

X = other expense input

Total Productivity Index for Firm Period t

Tangible input in period t
IF_{it}

Firm

Tangible output in period t
OF_{it}

Total productivity in period t
$TPF_{it} = OF_{it} \, / \, IF_{it}$

$OF_{it} = \Sigma \, O_{it}$

$IF_{it} = \Sigma \, I_{it}$

Firm

Product 1

Product 2
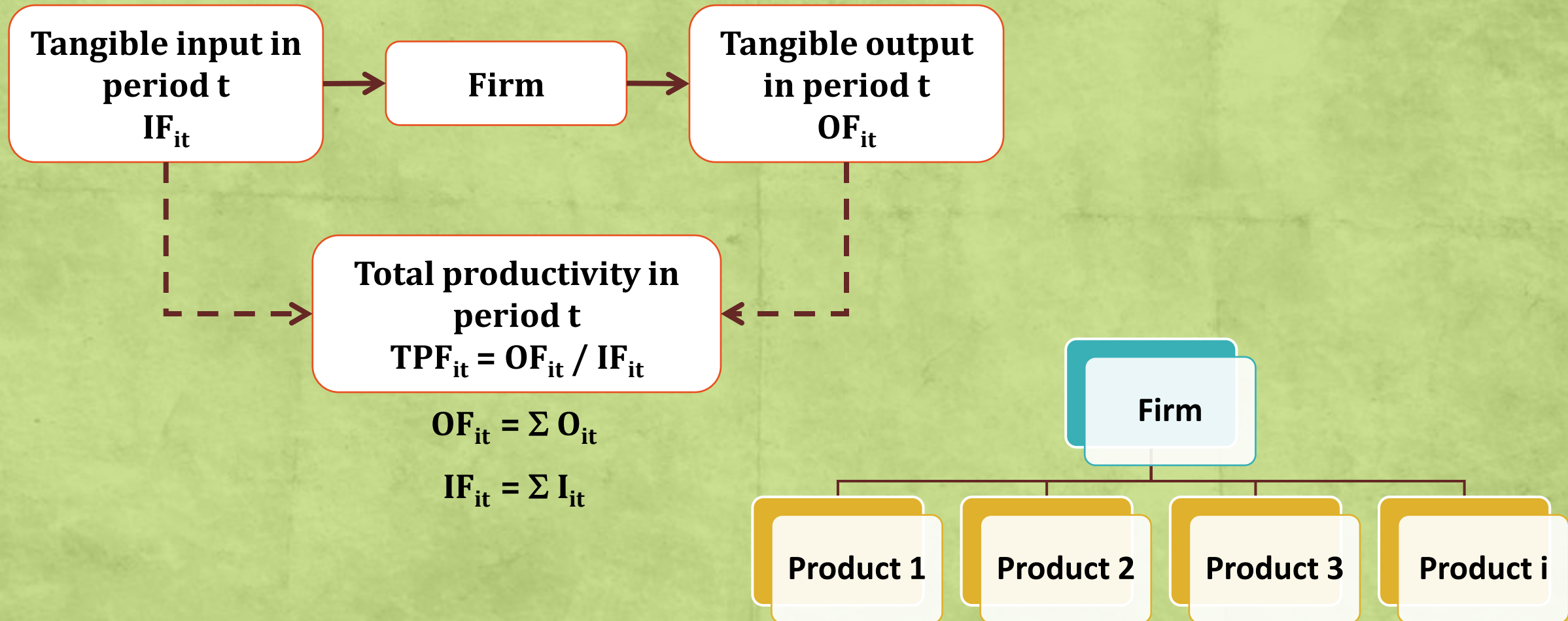
Product 3

Product i

Total Productivity of Product i in terms of Its Partial Productivities

$$TP_i = W_{ij} \times PP_{ij}, \text{for all } j$$

$$PP_{ij} = \frac{O_i}{I_{ij}}$$

$$W_{ij} = \frac{I_{ij}}{\sum\limits_{j} I_{ij}}$$

{j} = {H, M, C, E, X}

i = product type

W = weight corresponding to the input factor j

PP = partial productivity

TP = total productivity

Total Productivity of a Firm as a Function of Total Productivities of Individual Products

$$TPF = \sum_i W_i \cdot TP_i$$

$$TP_i = \frac{O_i}{I_i}$$

$$W_i = \frac{I_i}{IF}$$

$\{j\} = \{H, M, C, E, X\}$

i = product type

W = weight corresponding to the input factor i

TP = total productivity

TPF = total productivity firm

Total Productivity of a Firm as a Function of Partial Productivities

$$TPF = \sum_i W_{ij} \cdot PP_{ij} , \; for\, all\, j$$

$$PP_{ij} = \frac{O_i}{I_{ij}}$$

$$W_{ij} = \frac{I_{ij}}{\sum_j I_{ij}}$$

{j} = {H, M, C, E, X}

i = product type

W = weight corresponding to the input factor i

PP = partial productivity

TPF = total productivity firm

Profit vs Total Productivity

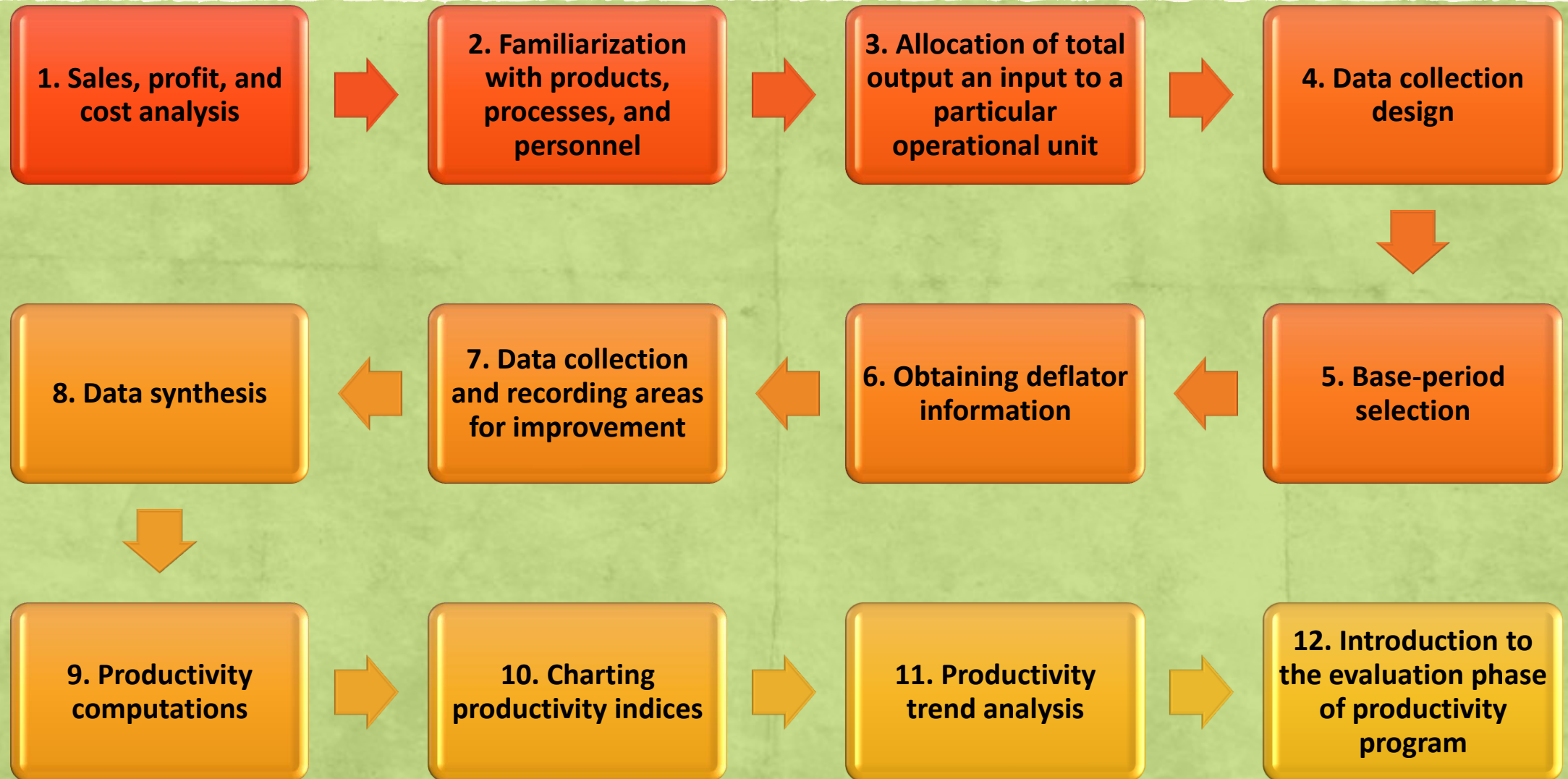$$P_i = (TP_i - 1)I_i + I_{iC,W}$$

Profit per product type

$$PF = (TPF - 1)IF + I_{C,W}$$

Profit firm

Steps in Implementing
The Total Productivity Model

1. Sales, profit, and cost analysis

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2. Familiarization with products, processes, and personnel

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3. Allocation of total output an input to a particular operational unit

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4. Data collection design

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8. Data synthesis

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7. Data collection and recording areas for improvement

←

6. Obtaining deflator information

←

5. Base-period selection

↓

9. Productivity computations

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10. Charting productivity indices

→

11. Productivity trend analysis

→

12. Introduction to the evaluation phase of productivity program

Homework

- Given the following data for two type of products.

- Calculate profit per product type and profit firm !

PRODUCT 1
Inputs :
- **Human $4000**
- **Material $5000**
- **Fixed Capital $1800**
- **Working Capital $200**
- **Energy $600**
- **Other expense $400**
Output $ 12,000

PRODUCT 2
Inputs :
- **Human $3500**
- **Material $4500**
- **Fixed Capital $2300**
- **Working Capital $400**
- **Energy $800**
- **Other expense $400**
Output $ 15,000

Have an enjoy study
and see you next week···

Thank you...