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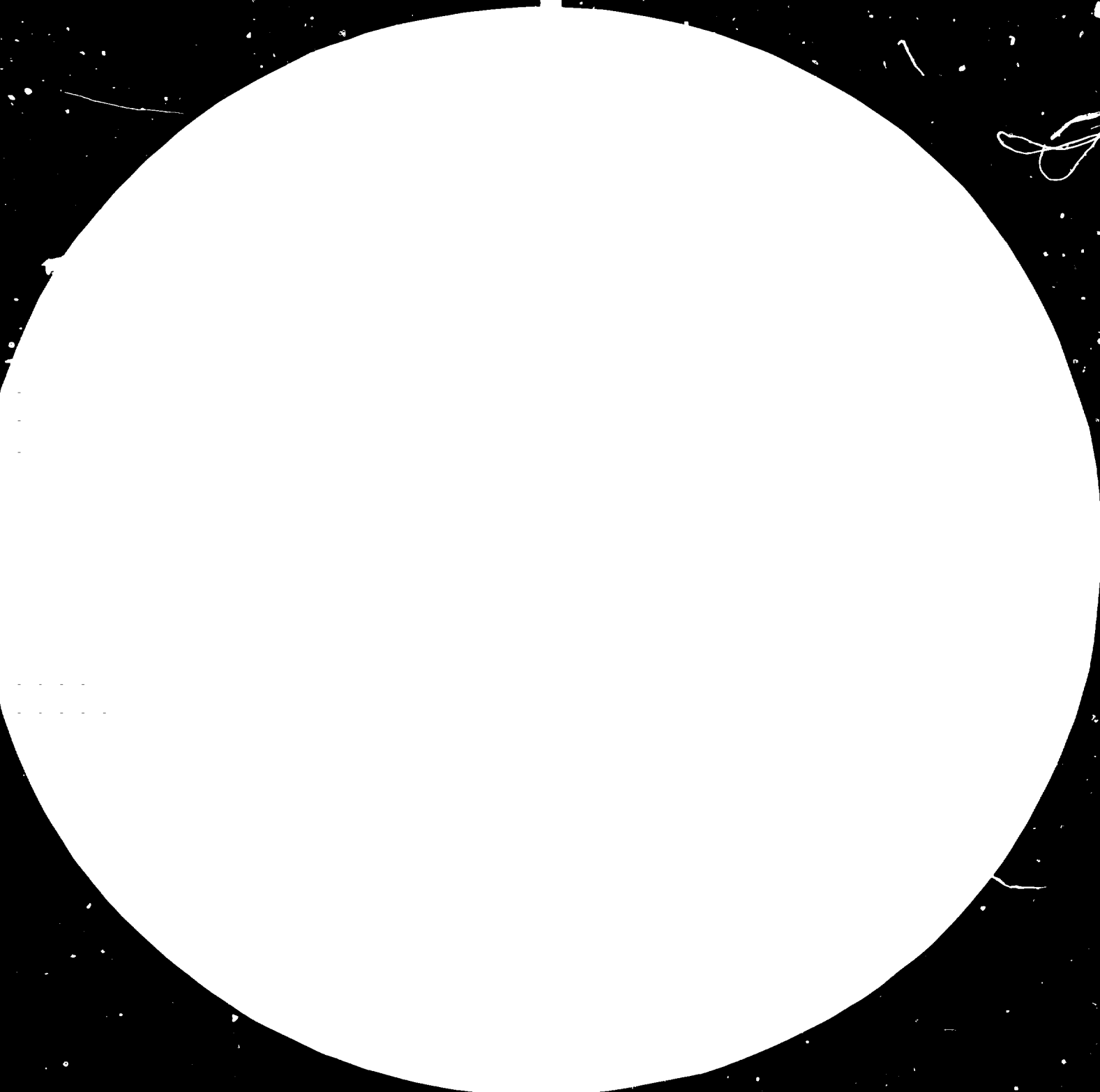

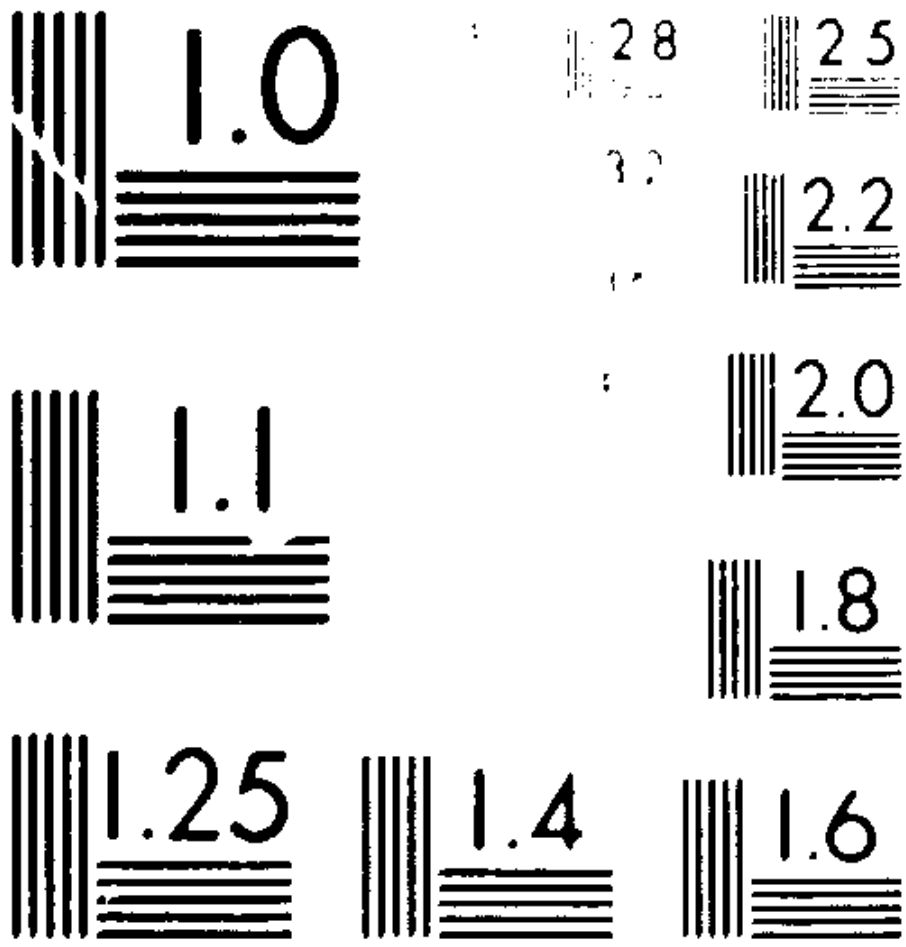
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PRODUCTION ECONOMICS*

by

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1. The production function

Production is the process by which goods are created. Production management deals with decision making related to production processes, so that the resulting goods are produced according to the specifications, in the amounts and by schedule demanded, and at minimum cost.

Production may also be defined as a transformation system, where factors of production (input) are transformed into products (output), as illustrated in figure 1.

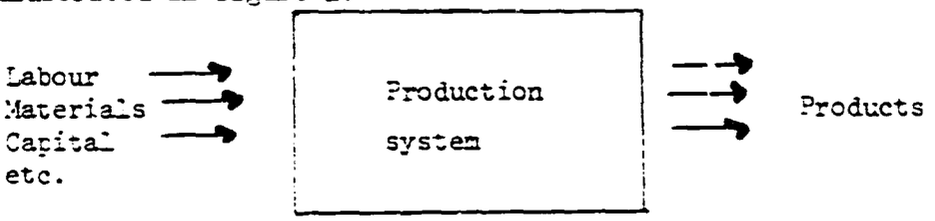

Figure 1. The production system.

2. Productivity and production economy

Production efficiency is generally measured in terms of productivity. It is possible to define the total productivity of a producing system as follows:

$$P_{tot} = \frac{O}{L + C + M + X}$$

where P_{tot} = total productivity

O = output in output units
L = labour input e.g. in man-hours
C = capital input e.g. in dollars
M = material input e.g. in kilograms
X = other inputs

Because it is difficult to sum up the input elements in the denominator, it is more convenient to speak of

$$\text{labour productivity} = \frac{O}{L} \quad \text{or}$$

$$\text{capital productivity} = \frac{O}{C} \quad \text{or}$$

$$\text{material productivity} = \frac{O}{M} \qquad \text{or}$$

$$\text{other productivities} = \frac{O}{X}$$

It is easy to see that the sum of the above mentioned components is more than P_{tot}.

The most common productivity concept is labour productivity.

It is important to distinguish between the concepts "productivity" and "production economy". Productivity tells us how effective the production is, but it does not tell how economically it takes place. Production economy (P.E.) may be defined as follows:

$$P.E. = \frac{\text{Output}}{\text{Costs of production}} \qquad \text{or alternatively}$$

$$P.E. = \frac{\text{Costs of production}}{\text{Output}}$$

Here the costs of production may be understood as total production costs, or as the cost of a single production factor, for instance labour. Productivity and production economy may be examined also on the national level. As far as that is concerned there are big differences between countries. Some examples will be shown here:

	Relative productivity	Relative labour cost of a produced unit
U.S.A.	124	72
Netherlands	116	87
F.R.G.	100	100
Switzerland	93	106
Austria	82	83
Sweden	79	127
France	78	83
Japan	76	91
U.K.	52	83
Italy	51	114

3. Profitability

The smaller the production costs of a given output are, the more economical the production is. Production costs alone do not, however, determine the total economic result or profitability of an enterprise. In order to calculate profitability we must also know all the costs, and the sales revenue (sales) of the products produced and sold.

3.1 Fixed and variable costs

It is often worthwhile to consider how costs vary with the volume produced. We think of cost items such as property taxes, indirect labour, and building depreciation as being non-variable, or fixed, and of items such as direct labour, materials and certain supplies used in the production process as being variable with volume. However, many cost items may be fixed only over short ranges of volume. Indirect labour is commonly in this class. The semi-variable nature of such cost elements can be important considerations prior to taking certain decisions.

3.2 Breakeven analysis

Breakeven analysis makes use of the fixed and variable nature of costs to indicate the range of volume necessary for profitable operation. If we could divide all costs into those that vary with volume and those that do not, we could compute an average total cost per unit for a given volume. Semi-variable costs can be reduced to a fixed component and a variable component. However, this concept of average unit cost is correct only at the one volume of computation since the fixed costs per unit would change as we averaged them over different volumes. Conceptually, then, it would be helpful to consider the fixed costs as a total pool of costs which must be covered by net revenue, over and above variable costs, before any profit whatever is made. This point or volume of sales where total net revenue after variable costs just equals the total pool of fixed costs is called the breakeven point, because it is the point in the progress of sales where the total revenue just covers the total cost, variable and fixed. Below this volume a loss is recorded, and above it a profit is recorded.

Figure 2 is a diagram of the structure of a simple breakeven chart.

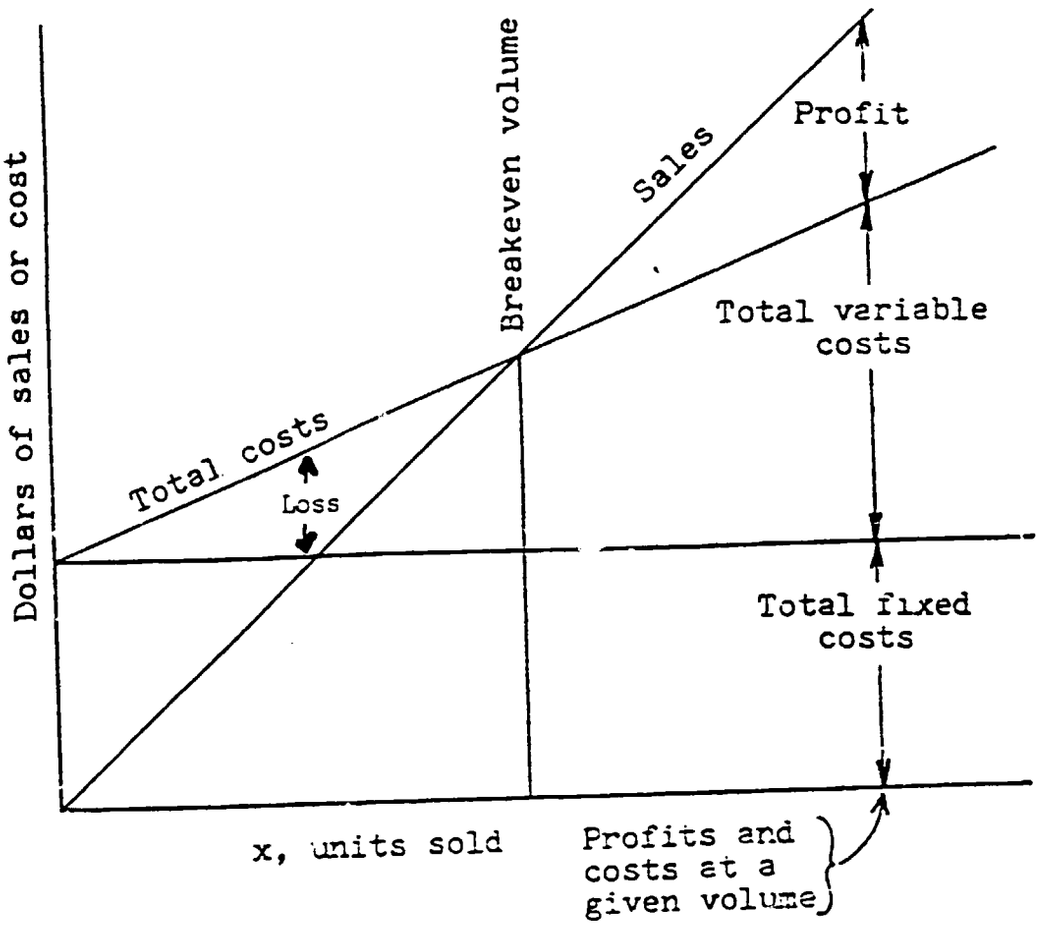

Figure 2. A simple breakeven chart.

3.3 Contribution

Contribution is the difference between sales and variable costs or the contribution to fixed costs and profit, that is

$C = S - V$ and

$S = F + V + P$

where C = contribution
S = sales
V = variable costs
F = fixed costs
P = profit

Since both S and V vary with volume, C varies with volume also.

The breakeven chart in figure 2 is constructed on a product basis, i.e. the volume is determined as units of a product sold. If the volume consists of several products it is necessary to use the value

as a measure of volume. Already in its simplest form the break-even chart is, however, a useful "tool" in analysing the effects of different managerial decisions on the breakeven point, contribution or profit.

4. Improving production economy

In general all the measures that improve productivity, improve production economy of the producing unit as well. The improvements in productivity and production economy influenced by labour and material reductions are easy to understand. The role of capital is perhaps not so clear. Let's elucidate the matter with following example, concerning a manufactureing firm X:

- annual sales US$ 10 million
- material costs/ annum US$ 6 million
- average inventory turnover 3 times
- average inventory level US$ 2 million (i.e. total US$ 6 million divided by three)

Assuming that the rate of interest is 10 per cent, we can calculate an annual loss of interest of US$ 200,000 for the capital bound in the average inventory. Let's suppose we increase the inventory turnover figure to 4 by better production planning and inventory control. Consequently the average inventory level will drop to US$ 1.5 million, and the loss of interest thus to US$ 150,000.

The increase of the inventory turnover from 3 to 4 has resulted in an annual saving of US$ 50,000 , and what is still more important, released US$ 500,000 which is a considerable amount of money (capital). That money can be used much more effectively, and thus the capital productivity can be increased.

The preceding case illustrates the significance of the material inventory level for capital productivity. We must, however, not forget that there is capital bound also in other inventory items, i.e. in goods-in-process, finished goods and supplies, and these also deserve a critical examination.

A considerable amount of capital is also tied up in the firm's fixed assets (property, plant and equipment). The capital productivity of these items cannot be increased so flexibly by decreasing the capital tied up. One has instead to try to keep the production volume (output) as high as possible.

As a summary aspects concerning capital productivity may be listed as follows:

- increasing turnover of inventories,
- improving layout of physical facilities,
- utilizing production capacity to the fullest possible extent,
- keeping through-times as short as possible.

We have so far dealt mainly with capital productivity improvement. We must not forget that productivity is a function of several variables. To examine their influence would be an interesting and challenging task, but not possible in a condensed presentation like this.