Productivity (and not efficiency)

The seminal book on lean, *The Machine that Changed the World*, spent many words, tables, and figures on the subject of productivity (as well as, of course, quality).

Why?

Productivity is one of the critical few measures that reflect the "leanness" of a process, value stream or enterprise. It captures how effectively an organization uses its resources, and it's usually a meaningful way to compare performance over time and between entities.

Productivity is the ratio between the outputs of goods or services and the inputs applied for the purpose of that output. There are two typical applications of this ratio – single-factor productivity and multi-factor productivity. Labor is often the single factor and is referred to as labor productivity. Another popular single factor is machine productivity.

Labor productivity captures the output per labor input. Outputs are often units, but can also be reflected in the dollar value of the labor. Multi-factor productivity, as the name implies, takes into account multiple inputs; typically labor and resources such as capital equipment, energy and material. The common unit of measurement for multi-factors is almost exclusively dollars.

Example productivity ratios include:

- units per labor hour
- units per person per hour
- units per labor dollar
- sales per person
- units per machine hour
- units per square foot
- sales per square foot
- total processing cost per unit

The number of different productivity measurement is limited only by the imagination. But, like anything, the measurement must be pragmatic and help drive the proper lean behavior with a focus on period over period improvement within the process, value stream and enterprise.

The formula and ABC Company example(s) follow:

$$P = \frac{O}{I}$$

Where:
P = productivity
O = output for the period, as expressed in units or dollars
I = inputs for the period, as expressed in units or dollars

Some of the ratios for labour productivity measurement are as follows:

$$\text{Workers' productivity} = \frac{\text{Workers' output expressed in standard hours}}{\text{Number of hours (man-hours) worked by the workers}}$$

$$\text{A Worker's or a group of worker's productivity} = \frac{\text{Number of units of output}}{\text{Number of days taken}}$$

$$\text{Another example of labour productivity} = \frac{\text{Number of toilets cleaned in a shift}}{\text{Number of cleaners}}$$

$$\text{A group of workers' productivity} = \frac{\text{Tonnes (or kg) of output}}{\text{Number of workers}}$$

$$\text{Labour productivity} = \frac{\text{Workers' Output expressed in Rupee Value}}{\text{Workers' Salaries and Wages in Rupees}}$$

Productivity, as measured above, represents the efficiency of the labour. These indices show how efficiently is the labour being utilised. As indicated earlier, these are the engineering indices of labour productivity. That is, labour productivity would be looked at the same way the machinery productivity is viewed.

Though there is nothing wrong conceptually with this viewpoint, it is a limited view. These are 'partial measures' of productivity. Further additions are required in order to get a complete picture of productivity. Before proceeding to a more comprehensive definition, let us look at the 'engineering' or 'efficiency' definition of productivity.

DIFFERENT INPUTS AND PRODUCTIVITY MEASURES

Input, which is the denominator in the ratio of Productivity, also can be viewed differently at different situations. Inputs are of varied types: human input, material input, machinery input, money input, technology input and time input. Not all can be combined together to be put in the denominator as one entity; for instance, the technology and time inputs. Sometimes, it is better not to combine any; Productivity can then be judged on each of the inputs. Certain inputs are critical and therefore, very important from the productivity point of view.

For instance, if electrical power is scarce and, so is vital, then productivity could be measured with respect to power as the input. This will be a useful measure for the management in comparing it with a benchmark and taking appropriate decision to improve the process with regard to the use of power.

$$\text{Productivity} = \frac{\text{Number of tonnes of Aluminium produced}}{\text{Number of units of power used for the production}}$$

r another ratio for Energy Productivity $= \dfrac{\text{Production value of the metal produced, Rs.}}{\text{Purchased Energy, Rs.}}$

r for a gas-fired thermal generation of power, where the gas is limited, expensive and, therefore, critical resource, the productivity of the generation of power would be

$$\text{Productivity} = \frac{\text{Number of units of power generated}}{\text{Number of Kg of gas used up for that generation}}$$

milarly, one may be interested in productivity as it relates to the input of materials. We can ve

aterials Productivity $= \dfrac{\text{Production Output (Value in Rs.)}}{\text{Raw materials + Packaging Materials + Supplies (all in Rs.)}}$

Even input measurement can sometimes give different pictures of productivity. For example, we n describe the input of labour or staff in terms of either the number of persons or the number hours/days spent by them or the amount of wages paid to them which can be allocated to the tput produced.

$$\text{Productivity} = \frac{\text{Number of units of output}}{\text{Number of persons employed to produce that output}}$$

MULTIFACTOR PRODUCTIVITY

It is right to say that the productivity measure should represent or reflect the overall capability and not focus on only one set of costs. The reason being that with the single factor productivity measures, it is easy to increase the productivity of one factor by replacing it with another. Labour, capital and materials are all potential substitutes for each other. Thus, in a company where the Just in Time system is improperly implemented, we may find that while the inventory turnover is high, the fixed assets turnover is low; thus, in the case of this company, the inventory is substituted by capital. Or, in another case, the company may decide to outsource heavily by cutting down on its production operations, selling off those machines and laying off some of its workers. In this case, the fixed assets turnover and labour productivity (sales to number of workers) will go up; but, materials productivity may quite likely fall because outsourcing mostly comes at a premium (higher cost). Hence, a multifactor view of productivity would be better.

The Total Factor Productivity (TFP) measure could be

$$\frac{\text{Production at standard price}}{\text{Labour + materials + overhead + k (capital invested)}}$$

where, labour, materials overhead and capital constitute all the input factors. 'k' is a fraction taking values below 1.0.

Example If 180 pieces are produced at a standard price of Rs 500 each, with a labour cost of Rs. 4,000, material cost of Rs. 20,000 and overhead of Rs. 12,000, the multifactor productivity would be

of days, in this case, would mean less productivity in the area of recovery which might affect

$$\text{Productivity} = \frac{\text{Quantity at standard price}}{\text{Labour cost + Material cost + Overhead}}$$

$$= \frac{180 \text{ units} \times \text{Rs. } 500 \text{ per unit}}{\text{Rs. } 4{,}000 + \text{Rs. } 20{,}000 + \text{Rs. } 12{,}000} = \frac{\text{Rs. } 90{,}000}{\text{Rs. } 36{,}000} = 2.5$$

While TFP is comprehensive, the partial measures of productivity definitely have their place. These are easy to comprehend and when performance is up for review, people can generally explain what happened easily. From the manager's or the supervisor's angle, it is simpler to tackle each factor of input separately.

The manager selects a measure or measures that capture something that he/she feels is important to the competitiveness of the company. It is not always necessary to have the stereo-type measures of productivity. For instance, in the service sector businesses, it is not always possible to judge the employees actions based upon the output. In the service industry, the quality of the service is sometimes much more important than the physical output. For example, a cook or chef of a hotel cannot be judged by the quantity of the food cooked, but by its taste i.e. quality. Quantity could only be a secondary consideration. Similarly, the productivity of a designer cannot be measured by the number of models completed. If a good design improves efficiencies all over, then the fact that it has been designed by two people instead of one does not mean the designers are half as productive or less productive.

PRODUCTIVITY IN INDIA

Importance of Productivity:

The main reason the productivity has an impact on economic growth is due to the fact productivity improves the profitability of business enterprises and the dynamic efficiency of the private enterprises and therefore increase the level of investment in the economy and therefore increase the potential output of the economy as a whole in the long term. That is it has the effect of moving the aggregate long term supply curve to the right. As well, it will enable the economy to grow with less inflation and therefore increase the economic growth rate. As well, as it increases sustainably the real income of the work force in general in the long-term it increases the consumption potential of consumers and therefore increase aggregate demand and through the multiplier effect produces consistent economic growth. In other words, government policies directed towards productivity improvement in most of the important sectors of the economy as well as efficiency of the public sector enables the economy to have sufficient resources and technology to tackle environmental issues effectively at a minimum cost. In addition productivity improvement also has the effect of attracting international capital to the economy and investment in the economy there by increasing the potential capacity to produce or lift the production possibility curve to the right.

Example:
ABC is trying to assess productivity between two property insurance claims processing centers. The claim types and complexity are essentially identical. The table below captures some of the relevant data for the prior period.

Claim Center	Claims Processed (Closed)	Claim Specialist Hours Worked	Average Claim Specialist Hourly Rate
A	3,283	9,521	$18
B	3,147	7,239	$21

Using the data above, ABC calculated the productivity of Claim Center A and B (P_A and P_B, respectively) for both hourly inputs and wage inputs.

Claims per claim specialist hour:

$$P_A = \frac{3,283\,\text{claims}}{9,521\,\text{hours}} = 0.34\,\text{claims per hour}$$

$$P_B = \frac{3,147\,\text{claims}}{7,239\,\text{hours}} = 0.43\,\text{claims per hour}$$

Claims per claim specialist labor dollar:

$$P_A = \frac{3,283\,\text{claims}}{9,521\,\text{hours} \times \$18} = 0.019\,\text{claims per labor \$}$$

$$P_A = \frac{3,147\,\text{claims}}{7,239\,\text{hours} \times \$21} = 0.021\,\text{claims per labor \$}$$

Now, this may be more meaningful to the users if the formula is "flipped." Using the inverse of the formula reflected above, we can calculate the claim specialist wage dollars per claim.

$$P = \frac{I}{O}$$

$$P_A = \frac{9,521\,\text{hours} \times \$18}{3,283\,\text{claims}} = \$52.20\,\text{per claim}$$

$$P_B = \frac{7,239\,\text{hours} \times \$21}{3,147\,\text{claims}} = \$48.31\,\text{per claim}$$

Some other things to think about:

- Understanding productivity is important. However, lean practitioners also distinguish between local and total (think "system") productivity. So, while a cell or department's productivity level is important, the total value stream is even more critical.
- Don't be fooled! Understand the difference between real and apparent productivity: