THE LEARNING CURVE

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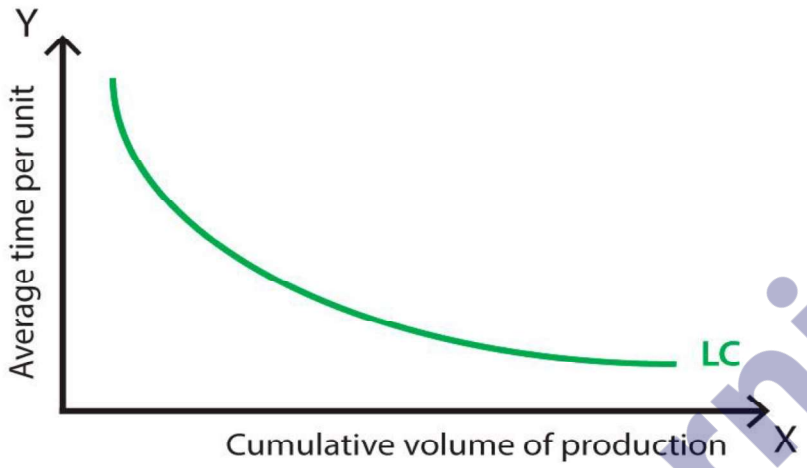
WHAT IS LEARNING CURVE?

- Learning curve theory is used to measure how, in some industries and some situations, the **incremental cost per unit** of output continues to ***fall*** for each extra unit produced due to the knowledge gained by the labor.
- Whenever an individual starts a **new job** which is fairly **repetitive in nature**, they are **not fast** enough since **lack of knowledge** about the job.
- However they gain the **confidence and knowledge** later on and become more **efficient** and quicker.
- Eventually, however, when they have acquired enough experience, there will be nothing more for them to learn, and so the **learning process will stop**.
- Learning curve theory applies to situations where the workforce as a whole improves in efficiency with experience. The learning effect or learning curve effect describes the speeding up of a job with repeated performance.

WHAT IS LEARNING CURVE?



WHERE DOES LEARNING CURVE THEORY APPLY?

Labour time should be expected to get shorter, with experience under following circumstances.

- Production is highly labor intensive.
- Complex and made in small quantities in special orders.
- Brand new products (learning process does not continue indefinitely)
- A repetitive task
- An incentive for staff to improve
- Low staff turnover

HISTORY OF LEARNING CURVE

- The first reported observation of the learning curve goes as far back as 1925 when aircraft manufacturers observed that the number of man hours taken to assemble planes decreased as more planes were produced.
- TP Wright (Theodore Paul Wright) subsequently established from his research of the aircraft industry in the 1920s and 1930s that the rate at which learning took place was not random at all and that it was actually possible to accurately predict how much labor time would be required to build planes in the future.
- During World War II, US government contractors then used the learning curve to predict cost and time for ship and plane construction. Gradually, private sector companies also adopted it after the war.

APPROACHES TO LEARNING CURVE PROBLEMS

- **Method 1. The tabular approach**
- **Method 2. The graphical approach**
- **Method 3. The algebraic approach**

THE TABULAR APPROACH

- The theory is that the cumulative average time per unit produced is assumed to fall by a constant percentage every time total output of the product doubles. Cumulative average time is the average time per unit for all units produced so far, back to and including the first unit made.
- ***The tabular approach is only effective in scenarios where output is doubling.***
- Under this approach, a table is set up to show
  - levels of output,
  - cumulative average time required per unit and
  - incremental time for additional units.
- The cumulative average time per unit produced is assumed to decrease by a constant percentage every time total output of the product doubles.

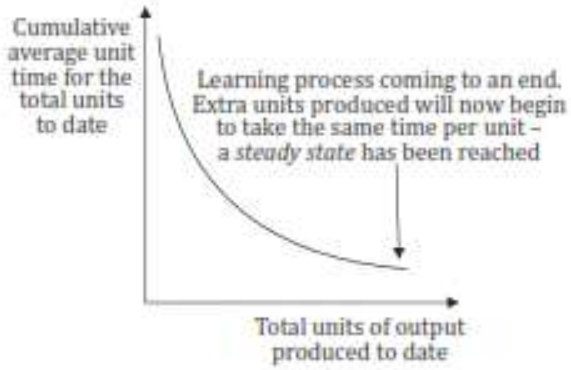
THE TABULAR APPROACH

- For instance, where an 80% learning effect occurs, the cumulative average time required per unit of output is reduced to 80% of the previous cumulative average time when output is doubled.

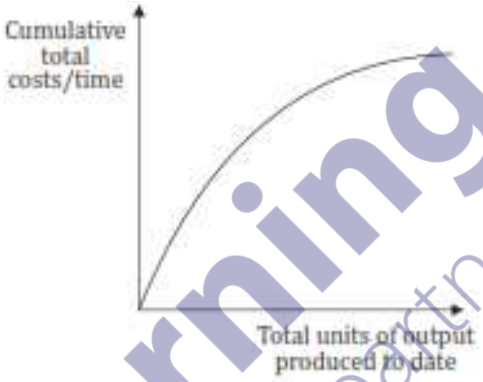
Cumulative No. of units	Cumulative ave. time per units, Hrs	Cumulative total time Hrs	Incremental no. units	Incremental total time hrs	Incremental ave. time hrs
1	100	100	0	0	
		100*1			
2	80	160	1	60	60
	100*80%	80*2		160-100	60/1
4	64	256	2	96	48
	80*80%	64*4		256-160	96/2
8	51.2	409.6	4	153.6	38.4
	64*80%	51.2*8		409.6-256	153.6/4

THE GRAPHICAL APPROACH

Unit time graph



Cumulative unit time graph



THE ALGEBRAIC APPROACH

- The formula for the learning curve is $\mathbf{y = ax^b}$, where b, the learning coefficient or learning index, is defined as ***(log of the learning rate/log of 2)***. The learning curve formula can be used to solve all learning curve scenarios.
- The formula for the learning curve is $\mathbf{y = ax^b}$

where

- **y is the cumulative average time per unit to produce x units**
- **x is the cumulative number of units**
- **a is the time taken for the first unit of output**
- **b is the index of learning (logLR/log2)**
- **LR is the learning rate as a decimal**

THE ALGEBRAIC APPROACH

- Example:
- When $y = ax^b$ in learning curve theory, the value of **b = log of the learning rate/log of 2. The learning rate is expressed as a proportion, so that for an 80%** learning curve, the learning rate is 0.8, and for a 90% learning curve it is 0.9, and so on.
- For an 80% learning curve, b = log 0.8/log 2.
- Using the button on your calculator marked 'log'

$$b = \frac{-0.0969}{0.3010} = -0.32193$$

LEARNING CURVE EFFECTS IN MANAGEMENT ACCOUNTING

Areas affected

- Direct labour time and costs.
- Variable overhead costs, if they vary with direct labour hours worked.

Areas not affected

- Material usage and cost
- Fixed overhead expenditure.

EXPERIENCE CURVE

- The learning curve effect can be applied more broadly than just to labour. There are also efficiency gains in other areas.

(a) As methods are standardized **material wastage and spoilage will decrease.**

(b) Machine costs may decrease as **better use is made of the equipment.**

(c) **Process redesign may take place. As understanding of the process** increases, improvements and short-cuts may be developed.

(d) Learning curve labour efficiency will have a knock-on effect on the **fixed cost per unit**.

LIMITATION IN LEARNING CURVE

- The learning curve phenomenon is not always present.
- It assumes stable conditions at work which will enable learning to take place.
- This is not always practicable, for example because of labour turnover.
- It must also assume a certain degree of motivation among employees.
- It might be difficult to obtain accurate data to decide what the learning curve is.
- Workers might not agree to a gradual reduction in production times per unit.
- Production techniques might change, or product design alterations might be made, so that it takes a long time for a 'standard' production method to emerge, to which a learning effect will apply.