CHAPTER II
COST CONCEPTS &
COST MEASUREMENT
AN INTRODUCTION TO COST CONCEPTS

If a manager asks a cost accountant: "What is the cost of this product?" The cost accountant should reply: "What are you going to do with the information?". The reason is that different decisions require different types of costs. It is said cost concepts are relevant only if they influence a decision, and cost data are relevant only if they are useful to a cost concept. Costs that may be accurate for one kind of decision, may be completely misleading for another.¹ For example, per unit product cost is useful for decisions on product profitability, but they are useless for cost control decisions. Moreover, the data accumulated to develop unit product costs can be assembled using either a direct cost concept or an absorption cost concept. Direct cost data are relevant for planning decisions that use product cost information, but absorption cost data

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are useful only for external reporting purpose. This suggests that in order to design an effective direct cost system the accountant should be aware of several cost concepts. Some of the cost concepts that are useful in developing a direct cost system are: traceable costs, common costs, and opportunity costs. A brief reference is as under:

**Traceable Costs**

A traceable cost is directly related to a unit of a product, a department or a sales territory. The material cost of a unit of product, the labour cost of a unit of product, and the variable overhead in a unit of product are all costs that are traceable to the unit of product. In fact, direct costs and traceable costs are interchangeable terms.

**Common Costs**

The cost of facilities or services employed in the

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output of two or more operations, commodities or services.\textsuperscript{1}

Common costs support a number of activities or organisation segments and are, therefore, often treated as period cost. For example, the monthly fixed costs of operating a production department are common to all units produced by that department during the month. A common cost does not change even when one of the activities it supports is discontinued. Suppose a common cost 'A' supports three activities namely Activity 1, Activity 2 and Activity 3. The Common cost 'A' will remain to support activities 1 and 2 if activity 3 is eliminated and they remain to support activities 2 and 3 if activity 1 is eliminated. However, the common cost 'A' is not inherently common because of the nature of the cost. These common costs are traceable costs if the three activities are viewed as one activity. Consequently, whether a cost is direct or common depends on

\textsuperscript{1} Eric L. Kohler in Dictionary for Accountants
the decision for which the cost is relevant. In the
preceeding example, the supervisor who is in charge of
activity 3 considers the costs supporting the three
activities to be common costs. However, the supervisor
in charge of all three activities considers the same costs
to be direct (or traceable) costs of his area of
responsibility. It may be construed that another factor
affecting the designation of a cost as common or traceable
is the perspective of the decision maker.

Opportunity Cost

Besides being concerned with the traceability of
costs, the accountant must recognise the concept of
opportunity cost. Opportunity cost is the marginal income
or contribution or economic resource that is given up or
forgone as a result of accepting one alternative instead
of another.¹ For example, assume that a manufacturer can

sell a semifinished product to an outside buyer for Rs. 1,000. He chooses however to keep it and finish it. The opportunity cost of the semifinished product is Rs. 1,000 because this is the amount of economic resources that the manufacturer gave up in order to finish the product. Note that no cash has changed hands. This is the unique feature of an opportunity cost. There is no exchange of economic resources because opportunity costs result from foregoing some action.

ANALYSIS OF COST BEHAVIOUR:

Information about cost behaviour relates to the relation of cost changes to changes in activity levels. Information about costs that change with changes in activity levels and those that do not is essential for sound planning decisions.¹ A manager selects a course by examining the costs of alternatives available to him. He must know what

levels of costs to expect for different activity levels if he is to develop a plan of action to meet his profit objective.\(^1\) Knowledge of cost behaviour pattern is also important for cost control decisions because costs can be controlled only if the accountant can compute the level of cost that the company should have incurred for the actual volume of work performed in a department during a specific time period.\(^2\) For example, the budgeted cost level in a production department for January is related both to the number of units produced during January and to the passage of one month. These budgeted costs can be computed if costs have been classified according to their variability in relation to output and to the passage of time.

In short knowledge of the relation of the individual costs and expenses to changes in the volume of activity is

1. Ibid.

the foundation for, (1) planning the amount of costs to be
incurred in future periods; (2) estimating profits for future
activities and (3) determining whether costs have been
adequately controlled by those responsible for their
incurrence.\(^1\) The relation between changes in a cost and
changes in the volume of activity result in a classification
of variable fixed and semi-variable costs.

Variable costs are those which will fluctuate in
close relation to a selected activity or volume measure.
Units sold, amount of sales units produced, labour hours and
labour costs are the more frequently used volume measures.
When volume increases the amount of variable cost will
increase proportionately. The raw material used in the
manufacture of a finished product is almost always a variable
cost. The expense for wrapping papers, twine, shopping bags
or other supplies will usually vary with the amount of sales

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activity in a retail store. Sales commission when based upon a percentage of sales, are another example of an expense which is completely variable.

Fixed costs are those which are related to passage of time and have only a minimal relationship with the volume of activity which has or is expected to be undertaken.¹ An annual lease expense which is incurred for building space will be fixed in amount regardless of the manufacturing or sales volume. Depreciation expense is usually fixed, as are many types of insurance, office salaries and property taxes are also examples of costs which are in most cases fixed and have little relationship to the volume of activity. Most fixed costs are programmed or committed costs. Given a long enough time period all fixed costs would appear variable and their fixed nature usually within a one year planning period,

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¹. Institute of Cost and Management Accountant Indirect Costs: a Direct Challenge to Productivity - Report based upon branch research investigations into the problem of rising indirect costs and their control. London 1963.
is the result of management decisions which have committed
to the company to incur the cost. Depreciation on equipment,
certain types of insurance coverage and salaries of key
personnel are examples of committed costs. Programmed costs
are the results of appropriation of decision and include
such costs as advertising and research and development. A
programmed cost can be any sum which management wishes, but
once it has been budgeted, it must be considered a fixed
cost for the period.¹

*Semi-variable costs* are those which change
when volume changes but not in exact proportion. In other
words, semivariable costs consist both a base amount that
remains constant in relation to activity changes and a
portion that varies directly with the changes in activity
changes in activity level. Salaries of sales clerks in

¹ Management Research Groups: The Control of Overhead
London, 1936.
retail stores are an example of this type of expense. When
the stores sales are expected to increase, as they are prior
to festivals, additional sales clerks employed, so that the
total salaries paid to sales clerks will move up or down
with the amount of sales. This change will not be in exact
proportion, however, for a minimum number of sales clerks
will be necessary at all times. Compensation for a salesman
who is paid a monthly salary plus a commission on his sales
is also a semivariable cost.

Semifixed costs consist of layers of fixed costs
which are added as specific levels of volume are attained.
They change in lump-sum amounts at certain levels of activity
instead of changing continuously over all levels of activity.
Many types of personnel costs can be put under this category.
Supervisory costs are frequently semifixed costs because each
supervisor is able to supervise a limited number of employees.
As production increases to the point at which each supervisor
is working at his limit, adding one more worker because of an increase in production requires one more supervisor.

From the above discussion one point is but very much apparent. Changes in activity and the passage of time are the two factors that determine the behaviour patterns of costs. Accordingly costs may broadly be classified into two categories:

One that varies directly with changes in activity are called variable costs and those that vary with the passage of time are called fixed costs. These costs are graphically illustrated in Exhibit II-I. The remaining two cost behaviour patterns shown in Exhibit II-I are only variations of variable and fixed cost behaviour patterns.

In developing procedures for planning and controlling the various types of costs, one should recognise that the behaviour patterns of the costs hold true only for the

relevant or normal range of activity. The "normal" range of activities normally consists of the range of activity within which a department expects to operate during the planned period. For example, the planned monthly production for a factory department may vary between 80% and 100% of one shift capacity. The relevant range over which the expenses will be analysed is this expected range of production.

VARIABLE COST DETERMINANTS:

No cost is inherently fixed or variable. Therefore fixed and variable costs are examined further to point out some of the factors that cause expenses to behave as fixed or variable. Variable costs are incurred to utilise existing capacity to produce and sell goods. Material cost is a good example of a variable cost because it varies


directly with changes in the level of production. However, such is not the case with expenses such as labour. Labour cost can be fixed or variable, or any combination of the two, depending on how management decides the expense should behave. If management decides to maintain a stable labour force with no overtime work, labour cost is a fixed expense; if a stable labour force is maintained with overtime worked as needed, labour cost is fixed up to a point. Beyond that point the cost behaves like a semivariable cost.

The time span affected by a decision also influences the variability of a cost. Costs that are fixed for monthly planning decisions may be variable costs for decisions spanning a two year planning period. For example, a bank finds that personnel costs in one of its branches are constant throughout each month, but the same cost vary with deposit

volume when a two year time period is considered. In this particular case personnel costs are fixed for short term planning and control decisions, but they are variable costs for long range planning decisions.

Organisation perspective, too, affects the variability of a cost. The supervisor of a production department considers the cost of heating or cooling his department to be a fixed cost because the cost is unaffected by changes in output of his department.\(^1\) In contrast, heating and cooling costs are variable costs from the viewpoint of the manager in charge of providing these services. Since his cost fluctuates with the amount of heating or cooling his department produces, he considers them to be variable costs.

In general, a cost is a variable cost of a department if the

\(^1\) Walker J.K. - Overhead as an Element of Investing Costs, by J.K. Walker and Gertside Mulcahy.
Toronto: Canadian Institute of Chartered Accountants, 1965.
cost changes because of a change in activity in that department.

A cost may be fixed from the total company viewpoint, but the same cost may be variable from a departmental perspective. Consider maintenance costs as an illustration of this situation. A company may support a fixed staff in its maintenance department regardless of the fluctuation in demand for maintenance services. At the same time the company may charge individual departments for the use of maintenance services in such a manner that maintenance cost is a variable cost to the using department. In this case, a cost that is fixed from the total organisation perspective is variable from an organisation segment viewpoint. Companies treat maintenance cost, or any other cost in this manner to try to reduce total cost. By making maintenance cost a variable cost to the using departments the company creates a decision environment in which departmental managers can influence
departmental maintenance costs in the short run. Ideally such a procedure will result in cost minimisation in all using departments, which in turn will reduce total company costs.

By converting maintenance cost into a variable cost for individual departments, the company increases the frequency with which departmental managers make decisions that affect maintenance cost.¹ This increased decision frequency is not true of variable maintenance cost only; all decision affecting variable costs are made at frequent intervals. Every time a production worker decides how to place a piece of metal in a stamping machine his decision affects the cost of material used in his department.² The supervisor decision a departmental manager makes every day


2. Ibid.
influence the labour costs of his department. Most of the
decisions made by operating managers and production personnel
on a day-to-day basis directly affect variable costs.

**FIXED COST DETERMINANTS:**

Fixed costs to a large extent are affected by
the decisions of the senior management level which is
sometimes called as strategic planning level.\(^1\) The strategic
planning decisions that determine production and marketing
capacity occur at relatively infrequent intervals, whereas
the management control decisions resulting in fixed costs,
occur frequently. The difference in decision level and
frequency results in two kinds of fixed costs.\(^2\)

1. Committed fixed costs result from decisions
to acquire productive capacity. Long term lease commitments

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1. Hill, John A. FCMA - Fundamental Principles of

2. N.A.A. The Analysis of Cost-Volume-Profit
   Relationship. Research Reports 16, 17 and
   18 (New York: N.A.A. 1950)
and depreciation costs tend to remain constant for long period of time and these costs change when a decision is made to change capacity.

2. Planned fixed costs result from decisions on staff levels, levels of advertising expenditure, research expenditure levels and so on. Decisions affecting these costs are usually made annually and the costs can be increased or decreased in the short run.

The committed fixed costs originate in the plant capacity decisions and the planned fixed costs originate in decisions on the use of that capacity. Advertising expense is a planned fixed cost incurred by the company to generate a sales volume that allows its plants to operate at efficient levels. Planned expenditure on sales personnel are made for the same reason. Staff levels in administrative functions are planned fixed costs and the level of these costs is planned

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by considering the number of personnel required to perform
the planned level of work. Consequently managers can
increase planned fixed costs whenever they decide to do so.

The relevant level of fixed expense is different
for different decisions. For example, shutdown fixed costs
are usually lower compared to operating fixed costs of a
plant. The shut down fixed cost level is relevant for
planning and control decisions related to utilising the
plant efficiently.

Another consideration influencing fixed expenses
is the degree of traceability of a fixed cost to a specific
time period. Administrative salaries are direct costs of
the time period in which they are paid and lease payments
are direct costs of the time period in which they are paid.
Other fixed costs, however, are incurred in a lumpsum amount

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1. N.A.A., *Accounting for costs of capacity*,
for capacity that will be used over a series of future
time periods. The lumpsum amount is a common cost to all
the periods benefiting from the expenditure and any
apportionment of this cost to an individual time period
is arbitrary.

The apportionment of this common cost to
specific time periods usually takes the form of
depreciation expense - an expense that varies with the
computation procedure selected by a company. Because
selection of a depreciation method is a subjective
judgement, no single depreciation method is correct.
Accordingly, the subjective method of depreciation costs
should be clearly identified in monthly performance reports,
to allow managers to see readily irrelevance of depreciation
expense for planning decisions. It is irrelevant because

it provides no information to a manager for choosing among alternatives. Since depreciation expense is used to compute period net income, monthly income statements should include a separate section in which period cost allocations are specifically identified, thus emphasizing the subjective nature of these expenses. Incidentally, the degree of subjectivity decreases as the time span covered by a report increases. Annual profit figures are less subjective than monthly amounts and a 5-year net profit amount is less subjective than an annual profit amount. \(^1\)

Finally, the viewpoint of the decision maker is also to be kept in mind besides considering the traceability of a fixed cost to a time period. After all, the decisional aspect and its relevance to cost variability is not to be overlooked. Something which is fixed from the viewpoint

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of a department supervisor may be semifixed or variable in the eyes of the plant manager for the simple reason that a department supervisor considers all those costs as fixed that are unaffected by his decisions. Yet many of the costs unaffected by decisions at the department level are planned and controlled at the plant manager level. Fewer costs are fixed at higher levels in the organisation because the time horizon of a top level manager stretches far into the future, which means that almost all costs can change with changes in company activity.¹

PLANNING AND CONTROLLING COSTS:

Costs do not display a specific behavioural pattern because of their nature; behaviour pattern identification is still essential for effective cost

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planning and control. Variable costs are planned by applying unit variable cost to the forecast volume of activity. Material cost is planned by considering the quantity and price of material needed for production. Variable overhead expense is planned by computing the amount of overhead required for the planned production and variable cost is planned by developing the quantity and the rate of labour necessary for the planned production. Variable costs are controlled by comparing actual variable cost for a department with the budgeted variable cost that should have been incurred for the actual department output. The budgeted cost is computed by multiplying unit variable cost elements by actual production. Actual material cost charged to a department is then compared with budgeted material cost for the actual production volume attained in

Planning fixed costs differ according to whether committed or planned fixed cost are involved. Formal procedures and formal decision models are very significant for committed fixed cost planning because of the long time interval between such decisions. Moreover, decisions that generate committed fixed costs affect the company for many years into the future; thus a long range plan is an essential part of committed fixed cost planning. Since a decision today to expand plant capacity influences what the company will be like 10 years from now, a manager cannot make a sound decision today unless he knows that he wants the company to be like a decade hence. The control of committed fixed costs occur simultaneously with the planning of the


Australian Accountant, April, 1972.
fixed cost. Since that is the point in time at which the
future level of the committed fixed cost is set.

Planned fixed costs (or programmed fixed cost),
in contrast are usually developed as part of the annual
profit plan. The sales budget and the level of advertising
and promotion costs are planned simultaneously. Staff
levels in various administrative departments are planned by
considering the number of personnel required to handle the
planned volume of activity for the coming year. Control of
planned fixed cost is accomplished through monthly or
quarterly budget reports in which planned expense for the
period is compared with actual cost.

Semifixed costs may be planned and controlled
like variable costs or like planned fixed costs. They are
treated like variable costs if the steps are so small that
a straight line approximates the step cost function. For
relatively large steps (i.e., costs remain constant over wide
ranges of volume), the costs are treated like planned fixed
cost except that the year is broken into weeks, months or quarters for cost planning. A planning budget showing the expense levels for various ranges of volume provides amounts for planning expense levels for different volume of activity. The same budget is later used to compute budget expense for comparison with actual cost.

Semivariable costs, because they are partly fixed and partly variable, are planned and controlled in two parts. The variable portion of the expense is planned and controlled like a variable cost and the fixed portion (in most cases) is treated like a planned fixed cost.

METHODS OF MEASURING COST BEHAVIOUR:

This section is a precedent to the next part of our discussion which relates to construction of flexible overhead budget under the system of direct costing. The methods of segregating fixed and variable cost from a semivariable cost, which consists of an important part of
Flexible overhead budgeting has been given some further expression there. Hence this part may either be read independently or in conjunction with the following section on flexible budgeting.

Methods are utilised to measure the behaviour of a cost range from simple estimation methods to sophisticated mathematical formulae. However, these methods may broadly be classified under two categories (1) Scattergraph (or graphic) method and (2) least square method. We now proceed to explain these methods.

1) Scattergraph Method of Line Fitting:

One of the simplest and often the most effective ways of determining a relationship is simply to plot a number of points on a graph and to fit a line by inspection. This means that you take a ruler and move it around until it is in a position that seems to be closest to the plotted points.
When it seems that the fit is good, draw a line to the y-axis. Then, the a-value for the equation can be obtained by reading it directly from the graph. (That is the point where the line touches the axis.) The (b) can be obtained by subtracting the a-value from the total value at any point and divide by the value of (x) at that point.

For example, suppose that you want to know the relationship between the volumes of production and the cost of production. You know what the costs and production volumes were for each month of last year and you believe that this relationship will continue. The historical data is as follows:

<table>
<thead>
<tr>
<th>Month</th>
<th>Total Costs</th>
<th>Units Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>110</td>
<td>50</td>
</tr>
<tr>
<td>February</td>
<td>110</td>
<td>60</td>
</tr>
<tr>
<td>March</td>
<td>120</td>
<td>70</td>
</tr>
<tr>
<td>April</td>
<td>140</td>
<td>80</td>
</tr>
<tr>
<td>Month</td>
<td>Total Cost</td>
<td>Units Produced</td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
<td>----------------</td>
</tr>
<tr>
<td>May</td>
<td>130</td>
<td>80</td>
</tr>
<tr>
<td>June</td>
<td>130</td>
<td>70</td>
</tr>
<tr>
<td>July</td>
<td>140</td>
<td>90</td>
</tr>
<tr>
<td>August</td>
<td>120</td>
<td>50</td>
</tr>
<tr>
<td>September</td>
<td>110</td>
<td>40</td>
</tr>
<tr>
<td>October</td>
<td>130</td>
<td>60</td>
</tr>
<tr>
<td>November</td>
<td>140</td>
<td>70</td>
</tr>
<tr>
<td>December</td>
<td>140</td>
<td>80</td>
</tr>
</tbody>
</table>

One of the ways to determine the fixed and variable costs of production would be to plot the points, draw a line through them, and read the information directly from the chart. This has been done in Exhibit II-2.

The line drawn through the plot points intersects the y-axis at Rs. 75. Therefore the fixed costs are Rs. 75.

At a production volume of 90, the line shows the total cost to be Rs. 150. The variable cost of production, then, is
Rs. 75 (150 total cost minus 75 fixed) and the variable cost per unit is $75/90 = \text{Rs. 8.33 per unit}$. This calculation can be made from any point on the graph and the answer will be the same. For example, the total cost of 40 units is something over Rs. 105, say Rs. 107. The total variable cost, therefore, is $32/40 = \text{Rs. 0.80}$ (The difference is caused by the in accuracy of the readings).

2) Method of Least Squares:

The objective of fitting a line to historical data is to draw the line in such a way that the differences between the plotted point and the values indicated by the line are at a minimum. The best fitting line is the one that results in the smallest total difference when the difference between the plotted points and line are summed. The deviations will, of course, be both negative and positive. If actual values of the deviations are used and added algebraically, they might net to a small amount even
though the fit of the line were poor. One alternative is to use the absolute values (the value ignoring the signs) of the deviations. Absolute values, however, are inconvenient to work with mathematically. All the actual deviations can be converted mathematically to a positive sign by squaring them. If the squares of the deviations are used, this eliminates the problem of different signs and, at the same time, provides a more convenient mathematical method. For this reason, the most common method for fitting a line is one that results in a line that minimises the sum of the squares of deviations. This is called the least square method of line fitting.

The least square method of fitting a line is accomplished as follows:

1. Calculate the values for the sum of the:

   (a) Y-Values \( (\delta y) \)
(b) X-Values ($\xi_x$)

(c) X-Values multiplies by Y-Values ($\xi_{xy}$)

(d) X-Values squared ($\xi_x^2$)

2. Substitute the values calculated in (1) in the following two equations:

$$\sum y = na + b\xi_x$$

$$\sum xy = a\xi_x + b\xi_x^2$$

(The value of $n$ is the number of observations or points in your data)

3. Solve these equations like any other system of simultaneous linear equations for $a$ and $b$. Substitute these values in the equation $y = a + bx$, and you will obtain the equation for the line that will minimise the squares of the deviations of actual data from the line.

Let us take the example given in the previous section. Fit a line using the least squares method. First we make the following computations.
<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>x</td>
<td>xy</td>
<td>x²</td>
</tr>
<tr>
<td>Total Cost</td>
<td>Volume of Production</td>
<td>(1x2)</td>
<td>(2x2)</td>
</tr>
<tr>
<td>110</td>
<td>50</td>
<td>5,500</td>
<td>2,500</td>
</tr>
<tr>
<td>110</td>
<td>60</td>
<td>6,600</td>
<td>3,600</td>
</tr>
<tr>
<td>120</td>
<td>70</td>
<td>9,400</td>
<td>4,900</td>
</tr>
<tr>
<td>140</td>
<td>80</td>
<td>11,200</td>
<td>6,400</td>
</tr>
<tr>
<td>130</td>
<td>80</td>
<td>10,400</td>
<td>6,400</td>
</tr>
<tr>
<td>130</td>
<td>70</td>
<td>9,100</td>
<td>4,900</td>
</tr>
<tr>
<td>140</td>
<td>90</td>
<td>12,600</td>
<td>9,100</td>
</tr>
<tr>
<td>120</td>
<td>50</td>
<td>6,000</td>
<td>2,500</td>
</tr>
<tr>
<td>110</td>
<td>40</td>
<td>4,400</td>
<td>1,600</td>
</tr>
<tr>
<td>130</td>
<td>60</td>
<td>7,900</td>
<td>3,600</td>
</tr>
<tr>
<td>140</td>
<td>70</td>
<td>9,800</td>
<td>4,900</td>
</tr>
<tr>
<td>140</td>
<td>80</td>
<td>11,200</td>
<td>6,400</td>
</tr>
<tr>
<td>1,520</td>
<td>800</td>
<td>1,03,000</td>
<td>55,900</td>
</tr>
</tbody>
</table>
we find that

\[ 2y = 1,520 \]
\[ 2x = 000 \]
\[ 2xy = 1,03,000 \]
\[ 2x^2 = 55,800 \]
\[ n = 12 \]

Substituting these values in the normal equation, we get

\[ 1,520 = 12a + 800b \quad (1) \]
\[ 1,03,000 = 800a + 55,800b \quad (2) \]

Multiplying Eq. (1) by 200 and Eq (2) by 3 and subtracting, we find that

\[ (2) 3,09,000 = 2400a + 1,67,400b \]
\[ (1) 3,04,000 = 2400a + 1,60,000b \]
\[ 5,000 = 7,400b \]
\[ 7,400b = 5,000 \]
\[ b = \frac{5,000}{7,400} = .676 \]

Substituting .676 for b in Eq. (1), we have
There are a number of short-cut methods for calculating a least square fit a detailed study of which may rightly be referred to statistics book. We shall, however, take up another example to give a more precise idea about the least square calculation for segregating fixed and variable portion of a cost.

Let us consider the following data:

**Monthly Supplies Expense for Assembly Department**

<table>
<thead>
<tr>
<th>Month</th>
<th>DLH</th>
<th>Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2,400</td>
<td>Rs. 340</td>
</tr>
<tr>
<td>February</td>
<td>2,700</td>
<td>360</td>
</tr>
<tr>
<td>March</td>
<td>2,900</td>
<td>400</td>
</tr>
<tr>
<td>April</td>
<td>2,000</td>
<td>320</td>
</tr>
<tr>
<td>May</td>
<td>2,400</td>
<td>350</td>
</tr>
<tr>
<td>Month</td>
<td>DLH</td>
<td>Expense</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>June</td>
<td>2,900</td>
<td>370</td>
</tr>
<tr>
<td>July</td>
<td>4,000</td>
<td>520</td>
</tr>
<tr>
<td>August</td>
<td>4,300</td>
<td>530</td>
</tr>
<tr>
<td>September</td>
<td>3,900</td>
<td>510</td>
</tr>
<tr>
<td>October</td>
<td>3,300</td>
<td>460</td>
</tr>
<tr>
<td>November</td>
<td>2,800</td>
<td>360</td>
</tr>
<tr>
<td>December</td>
<td>2,400</td>
<td>340</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36,000</td>
<td>Rs. 4,860</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>3,000</td>
<td>Rs. 405</td>
</tr>
</tbody>
</table>

The above data is analysed in Exh. II-3 using the least squares procedure. The first three columns contain the information presented in the above data and the four columns on the right contain the calculations required by the least squares technique. In the middle two columns of data, the plus or minus sign is important for the individual
Least Square Analysis of Factory Supplies Expense for Assembly Deptt.

<table>
<thead>
<tr>
<th>Month</th>
<th>DLH</th>
<th>Expense</th>
<th>Variance from Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(X)</td>
<td>(Y)</td>
<td>(XY)</td>
</tr>
<tr>
<td>January</td>
<td>2400</td>
<td>340</td>
<td>-600 -65 39,000 3,60,000</td>
</tr>
<tr>
<td>February</td>
<td>2700</td>
<td>360</td>
<td>-300 -45 13,500 90,000</td>
</tr>
<tr>
<td>March</td>
<td>2900</td>
<td>400</td>
<td>-100 -5 500 10,000</td>
</tr>
<tr>
<td>April</td>
<td>2000</td>
<td>320</td>
<td>+1000 -85 85,000 10,00,000</td>
</tr>
<tr>
<td>May</td>
<td>2400</td>
<td>350</td>
<td>-600 -55 33,000 3,60,000</td>
</tr>
<tr>
<td>June</td>
<td>2900</td>
<td>370</td>
<td>-100 -35 3,500 10,000</td>
</tr>
<tr>
<td>July</td>
<td>4000</td>
<td>520</td>
<td>+1000 +115 1,15,000 10,00,000</td>
</tr>
<tr>
<td>August</td>
<td>4300</td>
<td>530</td>
<td>+1300 +125 1,62,500 16,90,000</td>
</tr>
<tr>
<td>September</td>
<td>3900</td>
<td>570</td>
<td>+900 +105 94,500 8,10,000</td>
</tr>
<tr>
<td>October</td>
<td>3300</td>
<td>460</td>
<td>+300 +55 16,500 90,000</td>
</tr>
<tr>
<td>November</td>
<td>2800</td>
<td>360</td>
<td>-200 -45 9,000 40,000</td>
</tr>
<tr>
<td>December</td>
<td>2400</td>
<td>340</td>
<td>-600 -65 39,000 3,60,000</td>
</tr>
<tr>
<td>Average</td>
<td>3000</td>
<td>405</td>
<td></td>
</tr>
</tbody>
</table>

Variable rate = \( \frac{\sum{XY}}{\sum{X^2}} \): Variable rate = 6,11,000/58,20,000 = Rs. 105

Fixed Amount = 405 - (3000 \times 0.105) = 405 - 315 = Rs. 90

Exhibit II-3
values because the sign indicates whether the amount is above (plus) or below (minus) the average.

For example, the 2400 direct labour hours worked in January is 600 hours below the average of 3,000. Likewise, the Rs. 340 of supplies expense for January is Rs. 65 below the average. Multiplying the hourly deviation from the average (-600) by the rupee deviation from the average (Rs. 65) provides the total rupee deviation for the month (39,000) shown in the second column from the right. The hourly deviations from the average for each month are then squared, yielding the amounts in the right hand column. The total of the two columns on the right are used to compute the variable amount of expense (Rs. 105) for each direct labour hour worked. This amount is multiplied by average direct labour hours worked. The amount is again multiplied by average direct labour hours (3,000) to develop the average variable expense (Rs. 315), which is subtracted from the average total expense (Rs. 405) to arrive at the fixed expense per month (Rs. 90).