CHAPTER 4

Production and Costs of the Business Enterprise

Existing in historical time, the business enterprise undertakes sequential acts of production through time and as a result incurs sequential amounts of costs also through time. However, even as the enterprise engages in production and incurs costs through time, it is also incurring variations in costs at a point in time. Thus, it is necessary when examining the production and costs of the business enterprise to intertwine a static with a time-oriented analysis. A static analysis of production and costs means that they are going to be studied at a point in historical time. For example, a static analysis involves a two dimensional comparative analysis of costs with respect to different flow rates of output; hence a static analysis concentrates its attention on the "virtual" movement of costs and the flow rate of output and on the relationship between these two variables as if they were being considered isolated in a vacuum. A time-oriented analysis of production and costs is different in that variations in the flow rate of output are sequential, as opposed to comparative. Therefore the analysis concentrates on examining the impact of sequential movements and variations of the flow rate of output on costs. Since the analysis of production and costs considers only time, output variations, and costs, it is necessary to assume that material input prices and wage rates are fixed and technology is given [more on this below].

The productive structure of the business enterprise is composed of the plant, shop technique of production, and the

enterprise technique of production. Similarly, the costs of the business enterprise can be separated into direct costs, shop expenses and enterprise expenses, with the latter two taken together called overhead costs. The chapter is divided into three parts. In the first we shall be concerned with the plant basis of the enterprise productive structure and its corresponding direct costs from a static perspective. In the second part, the shop and enterprise techniques of production and their corresponding costs shall be discussed. The last two parts of the chapter will deal with the productive structure and its costs as a whole from both a static and time-oriented perspective.

Static Analysis of the Production and Costs of the Business Enterprise - the Plant and Direct Costs

Plant and Production

The primary unit of production is called the plant which is defined as the technical specifications of direct material and labor inputs needed to produce a given amount of output in a specific period of time. This usage of direct inputs, is, in turn, uniquely determined by the specifications of the plant and underlying capital equipment and the social/labor conditions surrounding production. Moreover, the specific capital equipment used in production of the unit of output is uniquely related to it in that it is specifically tailored to produce a given amount of output per period of calendar time. The period of time used in the specification of the plant is called the production period and it denotes the amount of calendar time needed to produce the amount of output, starting with the first input and ending with

the output. Therefore, given the capital equipment and their operating specifications and the production period, the plant can be can be delineated in the following manner:

(1) plant: $g <-- m_{d1} \times m_{d2} \times l_{d1} \times l_{d2}$

where m_{di} is the ith direct material technical coefficient which shows how much of the ith material input is needed to produce g amount of output;

l_{dv} is the vth direct labour technical coefficient which shows how much of the vth labour input is needed to produce g amount of output; and

g is the amount of output per production period.

Since each plant is a recipe of rigidly fixed ingredients for producing a single unit of output, it is impossible for any one plant to produce more or less than its amount of output per production period. Consequently, if the business enterprise wants to increase its output at a point in time, then it must bring on line additional plants complete with their specific complement of capital equipment. This, of course, means that the business enterprise must have more than one plant and that the plant can be used in a repeated fashion from one production period to the next.

Let us for the moment assume that an enterprise has more than one plant and that each plant is identical in terms of inputs and output. For the enterprise to increase (or decrease) its output at a point in time, it must bring on line additional plants (or take plants off line). In this case, the amount of direct material and labour inputs increase in the same proportion as the amount of output; hence the average amount of direct material and labour input needed to produce a single unit of output does not change as output increases or decreases. To make

this clear, let us work through an example--Example 4.1.

Example 4.1

(1) Consider the following identical plants:

	P_1	P_2	P_3	P_4
m_{d1}	3	3	3	3
m_{d2}	5	5	5	5
l_{d1}	3	3	3	3
l_{d2}	6	6	6	6
g	10	10	10	10

(2) If P_1 and P_2 are used to produce the output, then the total amount of direct inputs used and the total amount of output produced are 6, 10, 6, 12, and 20 respectively. This same exercise can be repeated for the cases when three and four plants are used--see below.

	if P_1 and P_2 are used to produce the output, then the total output is 20 and the total amount of direct inputs used are	if P_1, P_2, and P_3 are used to produce the output, then the total output is 30 and the total amount of direct inputs used are	if P_1, P_2, P_3 and P_4 are used to produce the output, then the total output is 40 and the total amount of direct inputs used are
m_{d1}	6	9	12
m_{d2}	10	15	20
l_{d1}	6	9	12
l_{d2}	12	18	24

(3) The average amount of direct material and labour inputs needed to produce a unit of output is obtained by dividing the amount of of the input by the amount of the output. So in the case of P_1 this means that 3, 5, 3, 6 are divided by 10 to produce .3, .5, .3, and .6 which are the average amounts of the

inputs needed to produce a single unit of output. This same exercise can be carried out for the cases when two, three, or four plants are used to produce the output--see below.

	if P_1 and P_2 are used to produce the output, then the total output is 20 and the average amount of direct inputs used are	if P_1, P_2, and P_3 are used to produce the output, then the total output is 30 and the average amount of direct inputs used are	if P_1, P_2, P_3 and P_4 are used to produce the output, then the total output is 40 and the average amount of direct inputs used are
m^{*d}_1	.3	.3	.3
m^{*}_{d2}	.5	.5	.5
l^{*}_{d1}	.3	.3	.3
l^{*}_{d2}	.6	.6	.6

(4) These average amounts of inputs are called <u>production coefficients</u> (and are denoted by m^* and l^* for material and labour respectively) and it can be seen from above that they do not change as the amount of output increases (or decreases). In this case of identical plants, we can say that production coefficients are constant with respect to variations in the amount of output produced.

Now let us consider the situation in which the enterprise's plants are not identical. In this case, each plant could utilize different amounts of the same inputs to produce different amounts of the output. In this case we have the inputs and outputs not increasing (or decreasing) in the same proportions, with the result that production coefficients vary as output varies. This can be seen in the following example, where for simplicity sake the amount of output is assumed the same for each plant.

Example 4.2

(1) Consider the following non-identical plants:

	P_1	P_2	P_3	P_4
m_{d1}	3	4	5	6
m_{d2}	5	6	7	7
l_{d1}	3	4	5	4
l_{d2}	6	7	8	9
g	10	10	10	10

(2) If P_1 and P_2 are used to produce the output, then the total amount of direct inputs used and the total amount of output produced are 7, 11, 7, 13, and 20 respectively. This same exercise can be repeated for the cases when three and four plants are used--see below.

	if P_1 and P_2 are used to produce the output, then the total output is 20 and the total amount of direct inputs used are	if P_1, P_2, and P_3 are used to produce the output, then the total output is 30 and the total amount of direct inputs used are	if P_1, P_2, P_3 and P_4 are used to produce the output, then the total output is 40 and the total amount of direct inputs used are
m_{d1}	7	12	18
m_{d2}	11	18	25
l_{d1}	7	12	16
l_{d2}	13	21	30

(3) As in Example 4.1, the production coefficient for each direct material and labour inputs is obtained by dividing the amount of the input by the amount of the output. So in the case of P_1 this means that 3, 5, 3, 6 are divided by 10 to produce .3, .5, .3, and .6 which are the average amounts of the inputs needed to produce a single unit of output. This same exercise can be carried out for the cases when two, three, or four plants are

used to produce the output--see below.

	if P_1 and P_2 are used to produce the output, then the total output is 20 and the average amount of direct inputs used are	if P_1, P_2, and P_3 are used to produce the output, then the total output is 30 and the average amount of direct inputs used are	if P_1, P_2, P_3 and P_4 are used to produce the output, then the total output is 40 and the average amount of direct inputs used are
m^*_{d1}	.35	.4	.45
m^*_{d2}	.55	.6	.625
l^*_{d1}	.35	.4	.4
l^*_{d2}	.65	.7	.75

(4) As can be seen, the production coefficients change as the amount of output increases. So in the case of non-identical plants, we can say that production coefficients vary as output varies. More specifically, in the above example as output increased so did the production coefficients, which means that on average it took more of the material and labour inputs to produce a unit of output. This was due to the fact that the production coefficients for each plant are different, as shown below:

	P_1	P_2	P_3	P_4
m^*_{d1}	.3	.4	.5	.6
m^*_{d2}	.5	.6	.7	.7
l^*_{d1}	.3	.4	.5	.4
l^*_{d2}	.6	.7	.8	.9

Direct Costs

So far we have just described the nature of production of the business enterprise. That is, in order to produce any output, the enterprise must bring a plant on line which involves consuming direct material inputs and utilizing the labour power of direct the labour inputs. The monetary cost of producing the

plant's output can be obtained with the introduction of material input prices and wage rates:

(2) plant cost of production: $PCP = m_{d1}p_1 + m_{d2}p_2 + l_{d1}w_1 + l_{d2}w_2$

where p_i is the price of the ith material input; and

w_v is the wage rate of the vth labour input.

The plant cost of production states how much it will cost the enterprise to produce the output associated with the plant. Therefore, for each plant the enterprise owns, there will be a PCP associated with it. Consequently, the enterprise has to determine the order in which they will be used in production. Assuming that the business enterprise will try to produce any output as cheaply as possible, it will use the least costly plants first and the most costly ones later. Hence the enterprise ranks its plants according to their PCP.[1]

If all plants are identical, then there would be no difference between their PCP; thus non-identical plants create different PCP. Non-identical plants emerge because of technical innovation and change. That is, an enterprise generally introduces a new plant to its productive structure in order to increase its output. When doing so, it has two choices: it can duplicate the most recent plant as needed or it can introduce a new plant which embodies the most recent technical and organizational innovations. If there has been an absence of innovations, the enterprise will take the first choice, which

[1]The ranking of plants according to their PCP only works precisely if the amount of output of each plant is the same; if they are not the same, then it is necessary to divide each PCP by the plant's output to get the average plant cost of production (APCP) and then use the latter to rank the plants.

means that its plants will all have the same PCP. But if innovations have occurred, then it will adopted the second choice. This means that over time the enterprise will have acquired a set of plants some of which contain old or vintage technology and others which contain the newer technology. Consequently, since the PCP of the vintage plants will be higher than the newer plants, when expanding its output, the enterprise will use the newer less costly plants first and the older more costly old plants second; and when it reduces its output, the enterprise takes the older plants off line first.

The implication of the existence of vintage plants is that as the enterprise increases its production, its direct costs of producing the output increases. This can be seen in the following example.

Example 4.3

(1) Consider the following non-identical plants, the prices of the material inputs, and wage rates:

	P_1	P_2	P_3	P_4
m_{d1}	3	4	5	6
m_{d2}	5	6	7	7
l_{d1}	3	4	5	4
l_{d2}	6	7	8	9
g	10	10	10	10

p_1 = £2.00 p_2 = £3.00 w_1 = £4.00 w_2 = £3.00

(2) Using equation (2) above, the PCP for each plant can be determined: PCP_1 = £51.00, PCP_2 = £63.00, PCP_3 = £75.00, and PCP_4 = £76.00. Thus we find that the first plant has the lowest cost while the fourth plant has the highest cost in its output. Consequently as the enterprise increases its production from 10

units to 20, 30, and 40 units, it uses its plants in the order from least cost to highest costs with the results that its total direct costs increases from £51.00, to £114.00, £189.00, and £265.00 respectively. Since the material prices and wage rates did not change as output increased, the increase in enterprise total direct costs (ETDC) is clearly due to the bringing on line the older plants with their older technology.

This point can be better seen when viewed in terms of production coefficients and average direct costs. As noted above each plant has its own set of production coefficients which is obtained by dividing its technical coefficients by its output; hence by introducing material prices and wage rates, the plant's average direct costs can be determined:

(3) plant average direct costs: $PADC = m^*_{d1}p_1 + m^*_{d2}p_2 + l^*_{d1}w_1 + l^*_{d2}w_2$.

Hence the PADC for the newer plants is lower than those for the lower plants. Consequently, as the enterprise increases its output, its average direct costs increase because of the increasing PADC. That is, enterprise average direct costs (EADC) is equal to ETDC divided by output:

(4) $EADC = ETDC/output = m^*_{d1}p_1 + m^*_{d2}p_2 + l^*_{d1}w_1 + l^*_{d2}w_2$.

The increase in EADC is due to the fact that the PADC of the next plant brought on line is greater than the previous EADC. This can be seen in the following example.

Example 4.4

(1) The PADC can be derived from dividing the PCP by its output or working with the production coefficients of each plant, as shown below:

	P_1	P_2	P_3	P_4
m^*_{d1}	.3	.4	.5	.6
m^*_{d2}	.5	.6	.7	.7
l^*_{d1}	.3	.4	.5	.4
l^*_{d2}	.6	.7	.8	.9

p_1 = £2.00 p_2 = £3.00 w_1 = £4.00 w_2 = £3.00

PADC	£5.10	£6.30	£7.50	£7.60
PCP/10	£5.10	£6.30	£7.50	£7.60

(2) Similarly, the EADC can be derived from dividing the ETDC by its output or working with the average of the plants' production coefficients of each plant, as shown below:

	P_1 is used	P_1 & P_2 are used	P_1, P_2, & P_3 are used	P_1, P_2, P_3 & P_4 are used
m^*_{d1}	.3	.35	.4	.45
m^*_{d2}	.5	.55	.6	.625
l^*_{d1}	.3	.35	.4	.4
l^*_{d2}	.6	.65	.7	.75

p_1 = £2.00 p_2 = £3.00 w_1 = £4.00 w_2 = £3.00

EADC	£5.10	£5.70	£6.30	£6.625
ETDC/Output	£5.10	£5.70	£6.30	£6.625

(3) Putting the above together, we can show that the EADC increases as output increases due to the bringing on line of the older and more costly plant:

Plants (new plants first)	Plant Output	Cumulative Output	Plant Total Direct Costs	Plant Average Direct Costs	Enterprise Average Direct Costs	Incremental Costs
P_1	10	10	£51.00	£5.10	£5.10	-
P_2	10	20	£63.00	£6.30	£5.70	£6.30
P_3	10	30	£75.00	£7.50	£6.30	£7.50
P_4	10	40	£76.00	£7.60	£6.625	£7.60

The above example clearly shows that if the enterprise wants to increase its output, then it must bring on line additional

older, less technically advanced plants which have higher PADC, with the result that the EADC increases. However, if the plants of the enterprise are all identical, then for each plant the PADC will be the same, with the result that EADC will be constant as the enterprise increases its output. Hence whether EADC increases or remains constant as output increases is an empirical question whose answer depends on whether the enterprise has experienced technical progress. It may be that a particular enterprise has not experienced technical progress, but as technical progress is a feature of capitalism, it is safe to generally say that the EADC of most enterprises increases as output increases.

Static Analysis of the Production and Costs of the Business Enterprise - Overhead Techniques and Costs

The enterprise incurs two kinds of overhead costs - those associated with the production of a particular product line and those associated with the running of the enterprise in general. The former includes the salaries of foreman, support staff, and supervisors, the material costs needed to maintain the support staff and the technical efficiency of the plant and equipment used directly in production and used to assist the support staff, and the depreciation allowance associated with the plant and equipment. The latter includes those costs associated with the activities which the enterprise must engage in order to coordinate the production flows of the various product lines, the selling of the various products, and the development and implementation of enterprise-wide investment and diversification plans. In addition, it includes the depreciation allowance of

the central office buildings and equipment. The first type of overhead cost costs is called shop expenses (SE) and it can be easily determined at a particular point in time; the second type of overhead costs is called enterprise expenses (EE) and it can also be determined at a point in time and then allocated to each product line at the discretion of management. Thus the overhead costs of a particular product line is the summation of the shop expenses associated with it and a percentage k of enterprise expenses: overhead costs = SE + kEE.

Shop Expenses

As noted above, shop expenses are those expenses the enterprise associated with the production of a particular product but are not directly incorporated into it. Its materials and labour components are involved in the managing of the production process and ensuring that the plants are maintained in good working order. As with the production of a production of a product, an enterprise also selects a particular technique for managing its production within and across plants. The technique, called the shop technique of production (STP), consists of amount of material and labour inputs needed to oversee production of a product for a production period and can be depicted as follows:

(5) shop technique of production: $STP = m_{s3} \times l_{s3}$

where m_{s3} is the shop material technical coefficient; and

l_{s3} is the shop labour technical coefficient.

The STP has two particular characteristics. The first is that the amounts of its technical coefficients do not change with different levels of output in a production period; that is, the STP can accommodate variations in output in a production period

in terms of bring a plant on line or closing a plant down. This means that the average amounts of the shop inputs per unit of output, or the shop production coefficients, decline as output increases. Secondly, the STP does not change for sequences of production periods, except when a new plant is added to production and/or an old plant is scrapped.

The introduction of material input prices and wage rates, transforms the STP into cost of shop technique of production (CSTP) which can be delineated as follows:

(6) cost of shop technique of production: $CSTP = m_{s3}p_3 + l_{s3}w_3$

where p_3 is the price of the shop material input; and

w_3 is the wage rate of the shop labour input.

Since STP hence CSTP does not change during the production period, the average cost of shop technique of production declines as more plants are brought on line and production increased. In addition to these material and labour costs, shop expenses also includes depreciation. Depreciation, as a regular cost to be charged against revenue, when the owners of enterprises and their accountants viewed the enterprises as a 'going concern'. The opposite view to this was viewing the enterprise as a terminal venture which had a beginning date and a terminal date. Consequently, the buildings and equipment of the enterprise were valued at the beginning of the venture and then revalued at the terminal date at liquidation prices. The value of the capital assets at the terminal date was added to the profit account for distribution as dividends.[2] However, when viewed as a going

[2]The difference between the value of the capital assets at the start date and at the terminal date could represent

concern, the business enterprise becomes conceptually distinct from the terminal venture in that it never dies. Thus the value of the assets could not be reckoned at liquidation prices because they were never intended to be sold in the market. Consequently, depreciation as a cost to be charges against revenue emerged.

Since the enterprise is a going concern, its eternal life had to be broken up into well defined time periods, called accounting periods which are generally reckoned as a calendar-year, in order to determine the depreciation costs of the enterprise's buildings, equipment, and other capital assets. If the enterprise's accounting procedures are sophisticated enough, the depreciation costs for the accounting period would be determined for each product; but if not, then the depreciation costs for the enterprise as a whole are determined and then allocated to its various products based on some administrative guideline. In general, accountants use historical costs for valuing buildings, equipment, and other capital assets for depreciation purposes and the straight-line or declining charges methods for calculating the depreciation allowance that would appear as costs to the enterprise and which, as we shall see in the next chapter, would appear in the costing calculations made when setting prices.[3]

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the extent the capital assets depreciated.

[3]It is of interest to note that the tax codes in the United States, Germany, and France stipulate that business enterprises must use historical costs for valuing buildings and equipment, while the tax code in the United Kingdom states that enterprises can use either historical or current costs, although most use historical costs for valuing capital assets.

Once the enterprise and its accountants have determined the allowance for depreciation of the plants, that is the capital assets, that are directly used in the production of a product, the amount is evenly distributed to all production periods which comprise the accounting period. Thus, the shop depreciation allowance for any of the f production periods in the accounting period is denoted as $D_{sf} = D_s/f$, where D_s is the shop depreciation allowance for the accounting period. Since D_{sf} is invariant with respect to variations in output, the shop depreciation production coefficient declines as output increases.

By adding together D_{sf} and CSTP, we arrive at the shop expenses (SE) for any of the f production periods within the accounting period:

(7) $SE_f = CSTP_f + D_{sf}$.

Since SE_f and its components are given for the f-th production period, the average shop expenses (ASE_f) for the period declines as output increases.

Enterprise Expenses

The final category of costs to be analyzed is enterprise expenses. Because an enterprise is generally a multi-product producer and a going concern, it must incur expenses which are common to all of its product but specific to none and are necessary if it is to stay in existence as a multi-product producer and a going concern. In general, these costs are associated with those activities which the enterprise must engage in order to co-ordinate the production flows of its various products, to sell its various products, and to develop and implement enterprise-wide investment and diversification plans

and which include the salaries of management, stationary, selling and other office expenses, and the depreciation of the central office buildings and equipment. As with directly managing the production of its outputs, the enterprise will establish certain procedures based on the most up-to-date technical and organizational information in conjunction with the appropriate buildings and equipment. In turn, the procedures can be seen as an enterprise technique of production (ETP) whose components consist of the various kinds of material and labour inputs used.

With the introduction of material prices and yearly salaries, the ETP is transformed into the cost of enterprise technique of production (CETP). But the costs cover all the products produced by the enterprise, whereas we are interested the CETP for a single product. In addition to CETP, there is also the depreciation allowance for the enterprise, D_e, for the accounting period. Together, CETP and D_e are the enterprise's expenses for the accounting period which cover all its products. As these expenses must be recovered by the enterprise, the management allocations them to its various products so that they are included in their costs. Thus the enterprise expenses for its vth products for the accounting period is

(8) enterprise expenses: $k_vEE = EE_v = k_v(m_{e4}p_4 + l_{e4}s_e + D_e)$

where EE_v is the enterprise expenses for the vth product for the accounting period;

k_v is the percentage of enterprise expenses allocated to the vth product;

m_{e4} is the enterprise material technical coefficient;

p_4 is the price of the enterprise material input;

l_{e4} is the enterprise labour technical coefficient; and

s_e is the salary of the enterprise labour input.

To get the EE_v for the f-th production period, it is divided by the number of production periods in the accounting period:

(9) $EE_{vf} = k_v(m_{e4}p_4 + l_{e4}s_e + D_e)/f.$

Since EE_{vf} and its components are given for the f-th production period, the average enterprise expenses (AEE_{vf}) for the period declines as output increases.

Overhead Costs

Overhead costs for the enterprise's v-th product consists of shop and enterprise expenses. Hence for the f-th production period, overhead costs can be denoted as

(10) overhead costs (OHC): $OHC_{vf} = SE_f + EE_{vf}.$

Since OHC_{vf} is given for the f-th production period, the average overhead costs ($AOHC_{vf}$) for the period declines as output increases.

Static Analysis of the Production and Costs of the Business Enterprise - Total Costs

With each category of costs carefully delineated and analyzed with respect to different amounts of output, a more comprehensive analysis of costs can now be undertaken. Enterprises group their costs of production in two ways: (a) in order to obtain precise information on the cost of producing a particular product and to compare this cost to the cost of producing different products, the enterprises group together direct costs and shop expenses and collectively call them factory costs; and, (b) in order to recover all the costs incurred in being a multi-product enterprise and a going concern, enterprises

add enterprise expenses to factory costs to get total costs of production. To simplify the analysis, we will only be concerned with enterprise's average total costs of production for the v-th product line, f-th production period, and amount of output of q, which is defined as

(11) average total costs of production (ATC):

$$ATC_{vfq} = EADC_{fq} + ASE_{fq} + AEE_{vfq}.$$

Restricting ourselves to a single production period, the relationship between ATC_{vfq} and increasing amounts of output is a declining one as can be shown in Example 4.5. The empirical evidence does support this declining relationship.

Example 4.5

(1) Output and enterprise direct costs are obtained from Example 4.5.

(2) The shop material technical coefficient is 10 and its price is £3.00; the shop labour technical coefficient is 7 and its wage rate is £5.00; and the shop depreciation allowance for the f-th production period is £25.00. Thus the shop expenses for the f-th production period is £90.00.

(3) The enterprise material technical coefficient is 15 and its price is £4.00; the enterprise labour technical coefficient is 20 and its yearly salary is £12.00; the enterprise depreciation allowance is $100.00. Thus, enterprise expenses for the accounting period is £400.00. The enterprise has ten products and allocates the v-th product 15% of enterprise expenses or £60.00. There are four production periods in the accounting period, so the enterprise expenses for the v-th product and f-th production period is £15.00.

(4) The total costs of production for the v-th product and f-th production period can be obtained from (1) - (3) above, as shown below.

Cumulative Output	Enterprise Direct Costs	Shop Expenses	Enterprise Expenses	Total Costs of Production
0	£ 0.00	£90.00	£15.00	£105.00
10	£ 51.00	£90.00	£15.00	£156.00
20	£114.00	£90.00	£15.00	£219.00
30	£189.00	£90.00	£15.00	£294.00
40	£265.00	£90.00	£15.00	£370.00

(5) From the total costs of production, the average total cost of production for the v-th product and f-th production period can be obtained.

Cumulative Output	EADC	ASE	AEE	ATC
0	-	-	-	-
10	£5.10	£9.00	£1.50	£15.60
20	£5.70	£4.50	£0.75	£10.95
30	£6.30	£3.00	£0.50	£ 9.80
40	£6.63	£2.25	£0.37	£ 9.25

Time-Oriented Analysis of Production and Costs

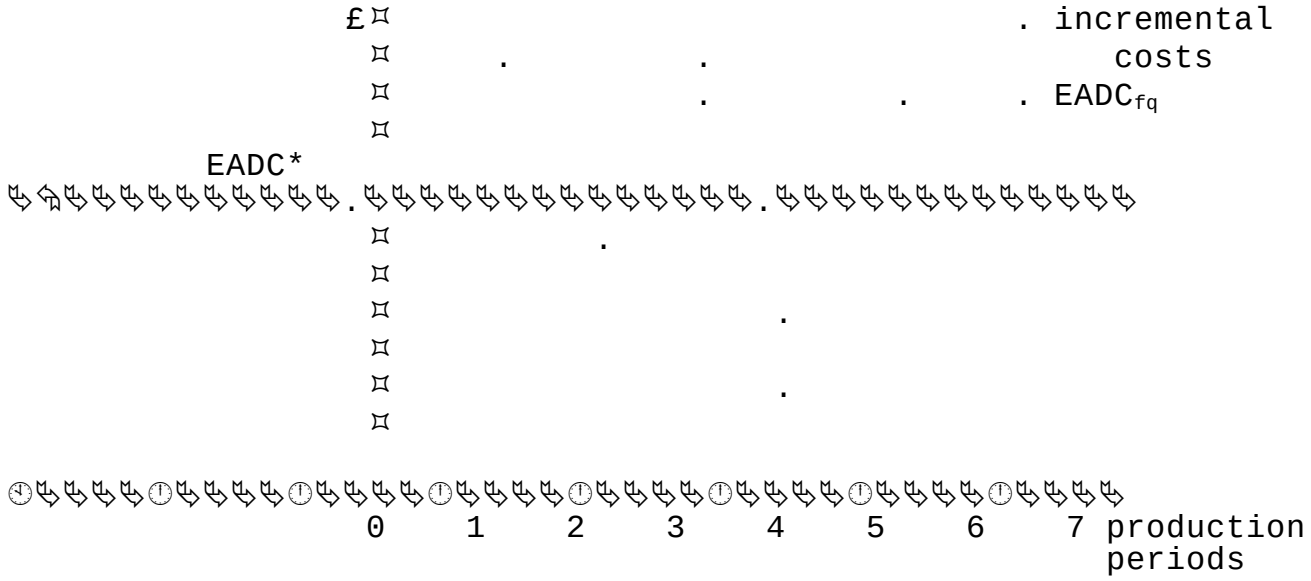
Enterprise Average Direct Costs

Now we are in a position to analyze the movement of the enterprise's average direct costs over production periods, i.e. the movement of EADC with respect to sequential acts of production. Since input prices and technology (hence technical coefficients) are given, variations in EADC over sequential production periods occurs because of variations in output. Let us begin the discussion by first specifying a particular amount of output which notionally will be the same for each production period. This amount of output, q*, is called a bench-mark output and the EADC* associated with it will be the same for each

production period. Now let us impose actual movements of $EADC_{fq}$ on EADC* from which we get $EADC_{fq}$ varying around EADC* as q amount of output varies around the bench-mark q*. This is obvious due to the non-homogeneity of the plants employed by the business enterprise. Thus, the movement of EADC over production periods can be understood in terms of variations in output with respect to EADC* and with respect to EADC of the previous production period. In either case, the variations occur because of the non-homogeneity of the PS and plants employed which is clearly discerned in the bench-mark analysis.

The above discussion can be represented in Figure 4.1 below:

Figure 4.1



The horizontal line (EADC*) depicts the flow dimension of enterprise's average direct costs of production which results solely from sequential acts of production. It is also the bench-mark by which variations in EADC arising from output fluctuations is clearly shown to be due to the existence of non-homogeneous plants. Figure 4.1 also shows that the movement of EADC over

production periods is due to the sharper movements of the 'incremental costs'. Finally, although not so obvious at this point, Figure 4.1 implies that EADC can no longer be viewed as a lump sum of money that must be paid out in order to produce a given volume of output. Rather, it is a flow of cash dispersement which enables the business enterprise to continually engage in sequential acts of production.

Average Total Costs

In a sequential production framework, we will find that ATC_{vfq} is dependent on the variations in the amount of output, q. By employing the bench-mark approach developed above with respect to EADC, we can explain the forces at work which affect the movement of ATC_{vfq} over the accounting period. That is, if the ATC_{vfq} is compared to a bench-mark ATC_v* that is common to each production period, then the actual ATC_{vfq} for any production period and its movement over the production periods can be explained. To construct a bench-mark ATC_v* that is the same in every production period, its components must be specified so as to be the same for each production period. As noted above, to obtain an EADC which does not change for each production period, a bench-mark amount of output, q*, must be specified that will be common to all the production periods in the accounting period. Further, since shop and enterprise expenses are the same for each production period, the same bench-mark flow rate of output can be used to obtain bench-mark average shop and average enterprise expenses. This construction of the bench-mark can be shown in the following manner:

(12) bench-mark average total costs:

$ATC_v^* = EADC^* + ASE^* + AEE_v^*$.

Since ATC_v^* remains the same for each production period, it can be used to explain, comparatively, the actual position of the ATC_{vfq}. That is, for any production period f, the difference between ATC_{hkf} and ATC_{hk}^* can be summarized as follows:

(13) $ATC_{vfq} - ATC_v^* = (EADC_{fq}-EADC^*)+(ASE_{fq}-ASE^*)+(AEE_{vfq}-AEE_v^*) >< 0$.

Looking at the equation closer, we discover that $(EADC_{fq} - EADC^*)$ will in general vary directly with the difference in actual output from bench-mark output since the enterprise generally employs a non-homogeneous set of techniques of production. However, in the special case in which the enterprise does employ a homogeneous set of techniques of production, $(EADC_{fq} - EADC^*)$ will equal zero for any amount of output. As for $(ASE_{fq} - ASE^*)$ and $(AEE_{vfq} - AEE_v^*)$, non-zero results will arise when actual output does not equal bench-mark output. So, in general, it is sufficient to say that the actual amount of ATC_{vfq} compared to ATC_v^* and hence the movement of ATC_{vfq} over production periods (that is over time) will depend on the technical and organizational innovations embodied in the techniques of production and on the flow rate of output.

The sequential production theory of costs developed above highlight the importance that technical and organizational innovations, and technical and managerial considerations play in determining ATC_{vfq} and its movement over time. With respect to $EADC_{fq}$, it has been shown that its deviations from $EADC_k^*$ and that changes in $EADC_{fq}$ with respect to production periods were due to the non-homogeneity of the techniques of production employed by the business enterprise. Thus the concept of constant average

direct costs within a sequential production framework cannot be sustained as a general theoretical principle. Therefore ATC_{vfq} and its movement over time not only reflects the above technical, organizational, and managerial considerations mentioned above, but also the existence of an enterprise within a capitalist economy continually undergoing technical and organizational change.

Terms

direct costs
plant
technical coefficient
production coefficient
production period
plant cost of production
enterprise total direct costs
plant average direct costs
enterprise average direct costs
cost of shop technique of production
average shop expenses
shop expenses
accounting period
shop technique of production
enterprise expenses
average enterprise expenses
overhead cost
average overhead costs
depreciation
enterprise technique of production
cost of enterprise technique of production
factory costs
total costs of production
average total costs of production
bench-mark output

Exercises and Questions

1. Describe the cost structure of the business enterprise.

2. What is the difference between production period and accounting period?

3. Data

	output	PCP
plant 1	200	£300.00
plant 2	200	£325.00
plant 3	200	£375.00
plant 4	200	£400.00

plant 5 200 £425.00

shop expenses per production period = £900.00

enterprise expenses for the accounting period = £600.00

# of production periods in the accounting period is 5.

Questions

(1) derive the average direct costs for each plant.

(2) derive the enterprise average direct costs for output levels of 200, 400, 600, 800, and 1000.

(3) derive the average shop expenses per production period for output levels of 200, 400, 600, 800, and 1000.

(4) what are the enterprise expenses per accounting period?

(5) derive the average enterprise expenses per production period for output levels of 200, 400, 600, 800, and 1000.

(6) derive the enterprise's average factory costs per production period for output levels of 200, 400, 600, 800, and 1000.

(7) derive the enterprise's average total costs per production period for output levels of 200, 400, 600, 800, and 1000.

(8) assume that production for the business enterprise over the accounting period is 600, 1000, 400, 200, and 800, determine the enterprise's average direct costs, average shop expenses, average enterprise expenses, and average total costs for the accounting period.

4. Data

	output	PCP
plant 1	300	£600.00
plant 2	275	£500.00
plant 3	250	£470.00
plant 4	310	£650.00
plant 5	290	£575.00

shop expenses per production period = £500.00

enterprise expenses for the accounting period = £500.00

# of production periods in the accounting period is 5.

Questions

(1) derive the PADC for each plant. What order are the

plant segments used as the business enterprise increases its output?

(2) derive the EADC, AFE, and ATC for output levels of 275, 525, 815, 1115, and 1425.

(3) what are the determinants of the shape of the EADC?

5. Under sequential acts of production, why would enterprise average direct costs and average total costs vary over production periods?

6. What options does an enterprise have to produce more output? What impact would these options have on its cost structure?

Readings

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