CHAPTER IV
PRODUCTION MANAGEMENT IN HPF AND HTL
Production management is concerned with the system employed in creation of goods and services. It is the actual process of effective planning and regulating operations for transformation of input into output with minimum cost and time. Both HPF and HTL evolved strategies comprising the following functions to undertake production process - production planning, production scheduling and production control.

The objective of production planning and scheduling is essentially to produce goods at the rate required by the schedule at minimum cost. Operationally production planning and scheduling take into account the economic use of resources for achieving production target. The complexity of planning and scheduling for production depends on the production system employed.

This chapter attempts to analyse the organizational development of the manufacturing division in HPF and production department in HTL, techniques adopted by both PUs for planning, scheduling and controlling of the production process and computes the weighted percentage rate of change of cost of raw materials ($X_2$), power and fuel ($X_4$), stores and spares ($X_5$) from 1967 to 1982 in HPF and from 1962 to 1982 in HTL respectively. These three factor inputs - raw materials, power and fuel, stores and spares - are considered important for the study of composite/weighted rate of change of input, as both PUs are industrial concerns.
The organizational patterns of production divisions in HPF and HTL show variations and reveal that the trend was towards complexity. These divisions were established to formulate strategies for achieving production targets through a feasible process.

ORGANIZATIONAL DEVELOPMENT IN HPF

HPF adopted the principle of decentralisation and formulated independent divisions in 1967 for production scheduling and control. The manufacturing division was responsible for production scheduling and control, whereas engineering services provided assistance in restoring production process in the area of disorder for ensuring higher efficiency. Both these divisions were merged in 1969 and was headed by a manager. With the occurrence of major drawbacks leading to machinery breakdowns and wastage of raw materials, efforts were made to strengthen higher efficiency by encountering inhibiting forces. It now comprises three main sub-divisions namely, processing chemicals, manufacturing, and engineering services headed by production managers and a manager respectively as shown in figure 4.1.

Figure 4.1 envisages the manufacturing sub-division to comprise seven departments, namely, film base, emulsion, coating, conversion, silver nitrate, fluids and energy, production and material planning, headed by senior managers except film base which is headed by a manager. Each of the departments has

scalar organization structure with deputy managers and assistant managers, entrusted with specific functions. The span of control at higher level is 1:2 or 1:3 whereas at lower level it is 1:10 to 1:12.

The manufacturing process in HPF starts with the preparation of mixture of cellulose triacetate dissolved in methylene chloride and methanol by film base department, and cast into films of different thickness on stainless steel belts. The resultant safety film is treated in a substracting operation to ensure perfect adhesion of high sensitive layer, then rolled in required dimensions of about 1.2 metres wide and 450 to 650 metres long, depending upon the type of product to be manufactured. The emulsion department prepares emulsion of silver nitrate (Ag NO₃) by adding alkalihalides and gelatin. The prepared emulsion and the substracted base is coated by the emulsion and sent to conversion department, where cine film is slit to required width, perforated and wound on plastic covers, while x-ray and sheet films are slotted and cross-cut into required size. Manufacturing process in HPF is summarized below:

```
Film Base
\[\rightarrow\] Coating \[\rightarrow\] Conversion \[\rightarrow\] Packaging
```

The chemical processing sub-division is an innovation in the process in HPF is known as manufacturing process.
previously adopted structure of production division, for ensuring periodic checks on the quality of raw materials. The deputy managers are entrusted with production and maintenance functions to review and assess requirement of materials.

The engineering services offer civil and mechanical maintenance along with instrumentation and modifications. Each of the maintenance departments is headed by managers except the modifications and improvements departments which are headed by the deputy manager. The departments of industrial engineering, modifications and improvements were evolved in later years to develop a scientific method of time and motion study for improving work standards through work simplifications, and wherever possible to improve the manufacturing process and judiciously use improvements in designs and installation of integrated systems for effective co-ordination among men, raw materials and equipments utilised together for achieving the targets. Both departments were also to specify, predict and evaluate the results to be obtained from the system. Their study helped in expanding the organization structure both - vertical and horizontal - directions, giving ample scope for delegation of authority, specifications of jobs, and carved a career development in the HFL.

ORGANIZATIONAL DEVELOPMENT IN HFL

HFL organised the production department in 1961. This was headed by a manager (production) for production of teleprinters only. The production in HFL, was started in 1961 in a

---

3 Ibid., p. 11.
temporary shed. Initially finance, administration, production, projects and purchase departments were independent to perform the entrusted functions. In 1966, the first effort was made to establish a design and development section, with an aim to improve and develop new varieties of teleprinters to meet the special need of consumers; to promote import substitution, to diversify the production and to augment exports. The purchase department was merged with the production division in 1971, for better co-ordination and avoiding duplication of work to achieve effective balance between regular supply and utilisation of raw materials. The production division in RTL in 1971 comprised three departments, namely, maintenance, materials (purchase) and production, headed by a civil engineer, materials manager and a production manager respectively.\textsuperscript{4} The overall in-charge of production division was the general manager as shown in figure 4.2.1.

In 1980 the production division underwent modifications as shown in figure 4.2.2. This department was strengthened by introducing one more level in middle management to reduce the span of control. The posts were created in almost all departments except in purchase, and are as shown in fig. 4.2.2. In the production department the post of metallurgist was created to check the purity of raw materials/components which caused higher rejection levels and sub-standard finished goods and also

\textsuperscript{4} Ibid., p. 14.
to study combinations of elements to be used in production of components by replacing the previous combinations.\(^5\)

The production department now comprises an assembly, metallurgy and work shop as sub-departments. The function of assembly sub-department is to assemble and check the quality and performance of teleprinters; metallurgy for checking the purity of raw materials used; the work shop actually transforms the metal sheets into various components/parts of teleprinters.

The study highlights the fact that there are variations in the organization structure of the manufacturing division in HPF and the production division in HTL due to complexities in the production process. HPF is a chemical industry whereas HTL is an engineering industry. It thus has difference in the application of technology. The tendency of HPF is to group the various production functions in different departments so as to have more delegation of work and higher efficiency. This is termed as decentralisation in HPF, whereas HTL adopted the principle of centralisation and efforts are made to avoid duplication of and delay in work. The superficial variation is evident from the positioning of purchase and production planning departments in both PUs. The purchase department has a separate identity in HPF, whereas it is secondary to production department in HTL. The production planning department has a separate identity in HPF whereas it is closely associated with production division in HTL and acts as secondary unit.

Though there are superficial differences, the organizational development in production divisions of HPF and HTL suggest a step-by-step strengthening of initially adopted organizational structure by eradicating drawbacks found in production process. The factors affecting both PUs were the delinking of imports by indigenously manufactured raw materials/components which has caused problems like frequent machinery break-downs and production of sub-standard goods. To overcome these deficient areas both PUs formulated quality control, research and development departments. Further to improve coordination between production and engineering services, both departments were merged.

These modifications in production divisions in HPF and HTL, relate to the steps taken to overcome deficiencies in production process. The production process in both PUs comprises - production planning, production scheduling and production control. Each of these aspects of production process in both PUs is dealt with to reveal the strategies adopted.

PRODUCTION PLANNING

It is the foremost function in production management. Production planning covers a careful and exhaustive study and pre-arranging of the technique, involving a long and complicated series of separate operations so that the required product of the proven quality and quantity may be manufactured at the right time and at the most economic cost. Production planning trans-
lates sales forecasts into master production schedules, takes off material, personnel, and equipment requirements and prepares detailed or departmentwise schedules.

HPF produces a variety of photographic goods, meant for different market segmentation, whereas HTL produces teleprinters that are directly consumed by government departments mainly railways, posts and telegraphs and defence. The production planning in HPF and HTL, therefore, depends on varied principles.

The production planning in HPF is initiated by indents fed by the marketing division in advance for deciding material planning - 12 to 15 months in advance for procuring important items and six months for raw materials locally.

The production planning in HTL is initiated by indents of the government departments mainly posts and telegraphs, and railways. Thus production planning department does not focus its attention on the process of estimation of indents, but depends upon the estimates sent by the government departments on the basis of projection technique.

Initially both PU's depended mainly on imports of raw materials. It also shows that both PU's procured finished products/components through imports, thus increasing the lead time\(^6\) and causing delays. The demand for sensitized goods and teleprinters was increasing annually. This made it necessary for both PU's to formulate production programmes on market fore-

\(^6\) Lead time is the time taken for replenishment from the time a requisition is submitted to stores or purchase department to the time the material is at the stores or using point.
cost and production feasibility through import substitution for decreasing the lead time and cost of raw materials.

The following measures are involved in production and material planning in NPP and HTL:

1. The available operational speeds of machines to their maximum capacities at different stages of production process are ascertained for optimum output of a desirable product mix.

2. Depending upon the management policy, from time to time and on the basis of negotiations (in the case of HTL) a final programme is prepared in both PUs.

3. The market forecasts furnished by the marketing division and government departments in HTL are related to their available capacity, for readjustment in consultation with cost and budget controller.

4. In NPP, normally an increase of 10 percent is formally decided against current production programme, except for cine positive (black and white) because of the changing trend towards cine colour positive. HTL, on the other hand, depends upon the indents of government departments based on their projection of future development. Thus no specific target is formulated.

5. The production programme in NPP is approved by the costing department and it initiates material planning exercise for deciding quantity of raw materials to be replenished by taking the following factors into account - (a) Quantities already available in stores and shop floor, (b) Quantities
received but awaiting inspection, (c) quantities already intended against the requirements of the current year.

(6) HTL formulates production and material requirement against the targets on the basis of the following factors—
(a) raw materials/components already available in stores (b) components received and others already intended against requirements (c) balancing of components between workshop and assembly departments. (d) components to be covered under production programme.

The production planning and programming constantly keep balance among annual market requirements, finished goods level and inventory of raw materials. These functions in HPF are carried out by production and material planning department headed by chief manager (production) as shown in figure 4.3. This department is divided into three sub-departments—production and material planning, sales co-ordination and production planning—each headed by senior manager, deputy manager and manager respectively. The material planning department carries out material planning exercise on the informations received from the progress stores (also known as in process stores) and stores sections for semi-finished and finished goods respectively, and also undertakes modifications in accordance with the production programme. The progress stores also carries out a periodical check on quality of raw materials and semi-finished goods. The stores section performs quality control on packaging of
finished products and also maintains a stock of engineering and consumable goods. The sales co-ordination department keeps a balance between market indents and monthly production to actual sales. The production programme is then finalised by actual assessment of raw materials in stores and expected requirement to initiate production. The load charts for each of the production departments are prepared to guide them to deal with package production in balancing the functions, for feasibility of production process, and to keep an average outflow of finished products.

In HFL, the demand of the government departments is the basis for preparing production plan. The indents received by the production and material planning department serve as a guideline to prepare annual production programme, which is divided into month-wise and department-wise, after reviewing stores section. This department is headed by a manager and assisted by a planning engineer and a deputy manager (production planning) as shown in figure 4.4.7

The hierarchical structure of production and material planning department in HFF has more delegation of work in comparison with HTL. HFF adopted the present organization structure of production and materials planning department on a functional basis and provides an easy assessment of stores and raw materials for effective planning, whereas HTL has a

simplified structure on the basis of centralisation.

PRODUCTION SCHEDULING & CONTROL

The management of production function in both PUs is generally divided into two distinct functional areas. The line function is concerned with direct supervision of the production process and the staff function with planning and control of production process. To have the staff function more effective both PUs patronise various committees for planning, review and control of production function. The control function of production is concerned chiefly with an appraisal and evaluation of the results achieved against the standards of performance set by the plans. It is concerned equally with locating deficiencies in the actual working of the organization and taking the necessary corrective steps to set things in order. The production control requires the following for its operation.\(^6\) - (a) complete information relating to previous performances (b) accurate information of stores (c) knowledge of work-in-process (d) data on power, speeds of all machines.

HPF adopted the following committees to review and control the misappropriations in production process - budget committee, production planning committee, purchase and stores committees, product and scheduling committee, value analysis committee and inventory control committee.\(^9\)


1. The budget committee was constituted in January 1973 with the managing director as chairman; the financial adviser and chief accounts officer as vice-chairman; managers of the production departments; the chief engineer, the production manager, the chief of laboratory and research, the personnel manager, the marketing manager, the accounts officer, the cost and budget controller as members.\(^{10}\)

This committee prepares the annual budget of HPF, reviews budget estimate divisionwise and consolidates recommendations; reviews performance reports, compares budget provisions to actual performance and issues policies for follow-up procedures; regulate changes in profit plan, budget policies and procedures; scrutinises and approves the production programme for next year.

2. The scheduling committee was reconstituted in 1980 as the production planning committee with the works manager as chairman; process controller, the chief marketing manager, the chief production manager, the senior manager (stores and production planning), the manager (purchase), the deputy manager (cost and budget) as members and the deputy manager (sales co-ordination) as the member-secretary.\(^{11}\)

It recommends annual production plan and quarterly production schedules and establishes programme with particular attention to - (a) current and forward purchases, inventory position


\(^{11}\) Ibid.
of raw materials and components, (b) modifies purchase commitments to meet market variation in the supply of materials in accordance with demand formulated; reviews sources of supply and recommends changes in procurement policy from time to time.

3. The purchase and stores committee was constituted in May 1967 to scrutinising and recommend purchases at the following levels:

(a) Raw materials and Packaging materials:

The officers of purchase, finance, planning and quality control, in the level of Rs.700-1300, Rs.1100-1600 and Rs.1300-1700 are associated with recommending the purchase indents valuing up to Rs. 2 lakhs; Rs. 2 lakhs to Rs. 5 lakhs and Rs. 5 lakhs and above respectively.

(b) Engineering Stores and Other Supplies:

The levels of officers forming this committees are the same, but in place of the quality control, an officer of the concerned department participates for purchase of engineering stores.

The purchase of all kinds is made through tenders. The stores are supplied for the groups:

Group 1 - Production stores
Group 2 - Factory supply stores
Group 3 - Finished products stores
Group 4 - Laboratory Stores
Group 5 - Stationery stores
Group 6 - In-process scrap
Group 7 - Empties and unserviceable items.
The group 1 comprises stores for the filmbase, coating, emulsion, conversion and silver nitrate. Group 2 stores are for the civil, mechanical and electrical departments.

This committee comprises - the managing director as chairman; the general manager, the management consultant, the process controller, the financial controller, the senior manager production, the senior manager (quality control) and the deputy purchase officer as members.

4. The product and scheduling committee was reconstituted in November 1980 with the process controller as chairman; the works manager, the chief production manager, the chief marketing manager, the senior manager (TSSL), the senior manager (research and development) as members and the manager quality control (finished products) acts as member-secretary.

This committee considers recommendations of the marketing division on a general pattern of items manufactured and changing trend for development of new products; evaluate level of quality of products periodically; reviews reports of heads of departments on rejection levels at various stages of manufacturing process to identify causes and suggests remedial measures; considers variations in product specifications or modifications in product designs; reviews complaints of marketing division regarding products and recommends remedial actions.
5. The value analysis committee was constituted in November 1976 with financial controller as chairman; manager (purchase) as vice-chairman; manager (planning and material planning) as secretary; finance manager; manager (quality control) and manager (production) as members. In 1978, the manager (engineering services) and the manager (internal audit) as members and assistant manager (stores) as part time member were included.

The committee performs cost and value analysis at different levels of manufacturing process. Value analysis is a technique of cost reduction based on systematic examination of each item required for production process. The marketing, engineering and manufacturing divisions are associated with synthesis of value analysis. This committee has the following functions to perform - to synthesis possible eliminations in consumption of raw materials; to effect combinations of various functions in production process; to evolve strategies to minimise rejections and recommend safer methods.

6. The inventory control committee was constituted in May 1969 with the undermentioned primary objectives:

(a) To minimise the idle time caused by shortage of raw materials, spare parties etc. and maximise production and sales.

(b) To minimise the working capital investment, cost of procuring and carrying the inventory.

The head (purchase and stores) acts as its chairman. It
also comprises the manager (sales), the manager (production),
the director (development and control), the financial adviser
the chief accounts officer, the cost accountant and the assis-
tant manager (production planning and control) as secretary.

The functions of this committee are (a) to determine the
stock of items, (b) to review existing method of inventory
control, classification of cost (selective control by ABC ana-
lysis) at various levels for the inventory, economic order sizes,
store facilities (including receipt, material handling and
storage), modes of physical verification of inventories and make
recommendations for improvements in these areas; (c) to perform
an accurate analysis of costs in minimizing cost and working
investment through standardization and simplification of
specifications; (d) to examine proposals for disposal of slow
moving and obsolete goods and recommend various measures; (e)
to conduct cause-wise analysis of wastage of materials at each
stage and suggest measures to prevent the recurrence.

Operation: This committee decides on standard and non-
standard items on the following points - (a) inventory at the
beginning of the month, (b) the estimated sale and usage for
the month, (c) planned operation on the basis of lead charts
(d) purchase orders outstanding, and (e) the required inventory
for the month end.

In controls slow moving and obsolete inventory through
two operations, namely, preventive measures and measures for
disposal of such stocks. The former includes control of inventory to prevent excessive production and accumulation due to change in consumers demand, design and usage of the plant. The disposal of obsolete and slow moving material is carried out by the sales and stores departments. The assistant manager (stores) provides information on these accounts.

The chief marketing manager (CMM) and the chief production manager (CPM) submit quarterly report of agewise analysis conducted on finished goods inventory. A proper and systematic classification and codification is necessary as a basic measure for the control of the inventory. Classification is the systematic arrangement of similar items into suitably selected categories. In the absence of proper classification and codification, no check or control can be exercised over the existing stock, and it may lead to disorders and accumulation of stock more than required. The method of selective inventory control is based on an analysis of high value (A), medium (B), and low (C) inventories in terms of value of annual consumption. This systematic approach of inventory control is ABC analysis, which is adopted by HPP and HTL.

ABC analysis coupled with stock levels of 'A' and 'B' groups is carried out for raw materials and factory supplies. The ordering levels of quantities are fixed on the basis of the following factors - (a) reliability of estimated requirement (b) availability of storage accommodation, (c) cost of
storage \textsuperscript{12} includes cost of obsolescence; interest on capital investments physical deterioration; handling, distribution, transport, taxes, insurances and storage facilities, (d) cost of ordering, \textsuperscript{13} and (e) choice of commercial units, seasonal fluctuations in prices, lead time, quantities at discount are the determining factors to assess the cost of acquisition and possession.

The inventory in HPF is done at three stages: finished goods; raw materials, manufacturing and packaging supplies; and factory supplies. At each stage, the "minimum", \textsuperscript{14} "reorder" \textsuperscript{15} "maximum" \textsuperscript{16} levels are calculated. For items constituting group 'C', two-bin system has been adopted i.e., an order is placed when the first bin is empty and the quantity in the second bin is sufficient to meet demand during lead time. This is only meant for consumable items.

HTL patronises a limited number of committees to formulate, review and control production process. The annual pro-

\textsuperscript{12} Cost of storage is also known as Inventory carrying cost.

\textsuperscript{13} Cost of ordering (also known as buying cost, purchase cost or procurement cost), is the cost of processing a purchase order, transportation cost, inspection cost, etc.

\textsuperscript{14} The minimum level is the level below which available supplies should never drop so as to take care of unforeseen circumstances.

\textsuperscript{15} Reorder level is the level at which a replenishment order should be issued to ensure that fresh supplies will arrive sufficiently in time to keep the item running out of stock.

\textsuperscript{16} Maximum level is the sum of the minimum level and the quantity ordered.
duction plan prepared by the manager (production and material planning) is submitted to the committee for its approval. This committee is headed by the chairman-cum-MD and comprises the heads of various divisions. This committee incorporates the dual function of approval of budget and assessment of feasibility of production programme on consideration of various factors and limitations. 17

2. The periodical committee in HTL is somewhat disorganised, as there is no systematic organization of principal executives as found in HPF. The review committee in HTL is headed by the general manager or the chairman-cum-MD and comprises other executives as members. A periodical review meeting is held to analyse the overall situation of the production process, procurement of raw materials/components to assess the causes of failures and suggest remedial measures.

HTL also categorises and codifies raw materials and components on the basis of ABC technique, similar to HPF. The ordering levels of components are fixed on the basis of following factors - (a) cost of storage, (b) cost of ordering, (c) cost of commercial units, lead time, seasonal fluctuations in prices are determinants for assessing cost of acquisition.

Both FUs make use of their main devices to effect co-ordination among departments like production, stores, purchase stores etc., by (i) providing a common head for various depart-

ments, (ii) setting up representative committees of
departments, and (iii) holding co-ordination meetings. It
reveals that similar to the organizational development of
production divisions in both PUs, the committees also came
into existence to carry out certain functions in co-ordination
with others. The efforts were made by both PUs to revive in-
adequacy of demand, paucity in procurement of raw materials,
streamlining other related functions for increasing capacity
utilisation leading to higher efficiency level. Both PUs, in
1969, adopted ABC analysis for inventory control committee,
whereas HPF, in 1976 constituted value analysis committee to
synthesize cost and value of raw materials/components and
finished products.

The study discloses that HPF patronises more number of
production review and control committees than administered by
HTL. This identifies that there is more red tapeism in HPF
than HTL, though it has set procedures and established sect-
ions for gathering different details. There is however simi-
arity in the constitution of these committees, as only principal
executives in production, maintenance, quality control, finance
and personnel are associated directly or indirectly in one or
more committee(s). The study also reveals that functions of
few committees in HPF are similar, and can be incorporated into
one e.g. production planning committee and project planning
committee in HPF review and recommend annual production plan
on the basis of market indents fed by marketing division. To avoid duplication it may be recommended to incorporate the functions of both committees into one.

The strategies adopted by HPF and HTL for incorporating production function can be analysed by considering their actual performance.

PERFORMANCE OF HPF

HPF commenced its production in 1967-68 with a total installed capacity of 6.150 million sq.ms. (million square metres) and was able to produce 0.916 million sq.ms. against the target of 1.467 million sq.ms. as shown in table 4.1. Initially, cine, bromide paper and medical x-ray were taken over by HPF and these were termed as principal products. It took over manufacture of roll film in 1971 and conversion of cine colour in 1974-75, achieved 0.001 million sq.ms. and 0.55 million sq.ms. respectively. In the initial production, the percentage of cine positive was 87.3 percent as against 0.87 percent of bromide paper. As the demand for principal products increased gradually, HPF also increased production. In 1975-76, HPF was able to achieve more than the installed capacity. The percentage rate of change of total production was 80.58 percent, the highest achieved in 1969-70 and gradually increased to 3.295 million sq.ms. in 1971-72. In 1972-73 there was a sudden decline of 12.47 percent in the total production and was reduced to 2.884 million sq.ms. With the

---


conversion of cine colour in 1974-75 it was able to produce at an average of 33.90 percent from 1973-74 to 1976-77. The growth rate of actual production was 0.33 percent at minimum in 1977-78 and in later years was marginal.

HPF started with three products only, viz, cine positive, bromide paper and medical x-ray, but increased it to seven products with the inclusion of roll films, cine colour, industrial x-ray, graphic arts film. In 1974-75 the cine positive was 44.1 percent of the total production achieved, conversion of cine was only 11.6 percent, medical x-ray 19.1 percent, bromide paper 20.8 percent, roll film 1.6 percent. The actual production in 1980-81 was 135.0 percent higher than that achieved in 1974-75. The percentage of cine colour, medical x-ray, bromide paper, and roll film increased 22.9, 19.7, 29.7, 4.61 percent respectively whereas cine positive decreased from 44.1 percent in 1974.75 to 21.0 percent in 1980-81. This proves that there was a steady shifting from cine positive (black and white) to cine colour. Each product steadily increased from 1974-75 to 1981-82.

The percentage of actual production to target was comparatively less from 1967-68 to 1974-75, and only from 1975-76, it was able to achieve more than 100 percent of the target, and when analysed with respect to installed capacity a similar trend is shown as noticed in the above case of actual production to target.

This locates that initially, the HPF faced problems to augment production process. The factors responsible for low production in HPF are as follows:

1. The Indian technicians were non-conversant with the design of the plant and equipment.

2. The plant primarily designed to produce cine film positive, subjected to a series of improvisations for producing different types of products, led to machinery break-downs.

3. The rejection level was higher initially, as the process carried on the trial and error basis registered low production.

4. The paucity of imported raw materials, namely, methylene chloride, gelatin and cellulose tri-acetate resulted in under-utilisation of production capacity.

5. The process involved more automation and good quality of raw materials and semi-finished products for finished products. HPF was incapable of assessing the quality in absence of quality estimation process.

6. The use of jumbo rolls with long gestation period caused higher rejection level due to development of scars, non-sticking and uneven spread of emulsion. This led to three major technical problems—remelting of emulsion and gelatin layers; dark coated lines and appearance of discontinuous white lines on cine film positive and black print on x-ray sheets.21

---

7. HPF took the initiative to substitute imported cellulose triacetate by indigenously prepared and tried combination of two types of cellulose triacetate which led to higher rejection level due to elongation of base cut and partly with the result of additional edge waste arising from constraints of sizes of the final products.

8. The above factors also ascertain that low managerial efficiency and less developed skills had partial effect on labour productivity ($R = + 0.35$). The absence of training programmes initially increased rejection levels.

9. No systematic approach to have an integrated inventory control system and a quality analysis of raw materials, semi-finished (work in process) and finished products was adopted, which led to an increase in expenses on raw materials, stores and spares as examined by tables 4.2, 4.3 and 4.4 respectively.

The effect of these factors led to many changes in the production planning and scheduling leading to misappropriations and exposed managerial effectiveness. HPF carries out production in two ways - conversion and actual production. The former process is the coating of imported jumbo rolls with emulsion prepared by the emulsion department in HPF, whereas the latter involves all stages of process from raw materials to end products. Initially the former was applied in producing photo sensitised goods, but HPF gradually switched over to the latter and from 1977 maximum production is achieved with this.
Table 4.2 envisages the trend of raw materials cost and analyses its share in real value of production to achieve weighted percentage rate of change from 1967 to 1982. HPF started partial production in 1965 with an aim of making technicians acquaint with the production process but achieved no progress, as rejection rate was much higher. In 1967, HPF started its integrated production, there was an increase of 19.48 percent in the cost of raw materials, further in next three years 122.92, 120.84 and 54.34 percent.\textsuperscript{22} The growth rate in expenses of raw materials was 16.5 percent at an average from 1971 to 1974. With the start of conversion of cine colour in 1975, the expenses increased by 107.89 percent, the highest recorded. From 1976, the growth rate slackened, decreased by 16.78 percent in 1978, gradually increased in the following years which is in relation to the growing production in each year.\textsuperscript{23} This further shows that recovery of silver from waste (slag) increased efficiency and helped in decreasing the expenses on raw materials. The other factors were substitution of imported raw materials with the indigenously produced, increase in managerial efficiency, streamlining of drawbacks found earlier in manufacturing process.

The analysis of its share in real value of production signifies that it had a major share from 1969 to 1973. However

\textsuperscript{22} Annual Report, (Gotecamund : HPF, 1970).

\textsuperscript{23} Annual Report, (Gotecamund : HPF, 1981).
it declined gradually from 1.5760 in 1969 to 1.251 in 1973, and further to 0.788 in 1981. This also has shown, its share was higher initially due to a higher rejection level, lack of inventory control and of quality analysis, full dependence on imports. In 1970, HPF introduced an import substitution programme which to some extent achieved success and its share declined from 1.5760 in 1969 to 1.022 in 1970, but the poor quality of the indigenously procured raw materials further deteriorated product image, increased the expenses and its share to 1.382 in 1971, 1.272 in 1972.

The weighted percentage rate of change of \( X_3 \) in HPF shows that it was the highest, 138.97 percent, in 1969, declined to minus 15.27 percent in 1972, increased again to 106.84 percent in 1975, again decreased to minus 0.12 percent in 1978. The trend visualises similarity to the percentage rate of change of \( X_3 \).

The growth rate of expenditure incurred on power and fuel \( X_4 \) in producing the quantity of photosensitized goods has been examined in table 4.3. It reveals that expenses on power and fuel increased considerably to 107.48 percent in 1968 but decreased by 7.36 percent in 1969, showed an average increase of 15.16 percent from 1970 to 1975, increased by 94.89 percent in 1976 with the adoption of the conversion of cine colour.\(^{24}\)

\(^{24}\) Annual Report (Ootacamund : HPF, 1976), p. 3.
mal and revealed that HPF regularised changes to reduce the rejection level and reprocessing of raw materials. Its share in real value of production gradually decreased from 0.5060 in 1968 to 0.0146 in 1981. The weighted percentage rate of change was 27.19 percent was the highest but decreased to minus 2.37 percent, varied marginally in the remaining years.

Table 4.4 reveals that expenditures on stores and spares increased by 133.53, 89.43, 85.17 percent in 1968, 1969 and 1970 respectively. The expenses on stores and spares showed a higher growth due to an increase in consumption rate. The growth rate declined from 133.53 percent in 1968 to minus 22.54 percent in 1973, signifying the effect of adoption of integrated system of inventory control in 1969. The expenses on stores and spares increased to 92.08 percent in 1975, varied marginally from 1978 to 1981. Its share also showed a decline from 0.2988 in 1968 to 0.0079 in 1981, establishing the fact that HPF carried out innovations to prevent frequent breakdowns, to effect preventive maintenance and adoption of new techniques. The weighted percentage rate of change of stores and spares declined gradually from 19.95 percent in 1968 to 12.72 percent in 1970, but decreased considerably to 5.74 percent in 1971 and further to 0.36 percent in 1979 after an increase of 8.24 percent in 1975.

PERFORMANCE OF HTL

HTL took over production in 1961–62 and was able to assemble 270 units of teleprinters. In the initial years the teleprinters

were not actually manufactured, but imported parts and components were assembled, sometimes complete machines were imported and marketed in the country under their trade mark. Table 4.5 shows that actual production increased 137.04 percent in 1963, but slackened gradually to 10.79 percent in 1965, again visualised a sudden increase of 129.96 percent in 1966 and was marginal 7.96 percent in 1967. The percentage increase of actual production was 5.99 percent in 1970, declined gradually to minus 8.12 percent in 1971, and increased marginally 0.38 percent in 1974. It increased from 6,142 in 1978 to 8,394 units of teleprinters in 1982 roughly at an average of 4.77 percent.26

The analysis of trend of total demand reveals that in 1982, it has grown eight times the demand envisaged in 1963. The percentage of actual production to target was below 100.0 percent from 1963 to 1967 due to the following factors: (1) Being an engineering industry, the components involved in producing one unit of teleprinter is approximately 130. There was no systematic approach followed in initial years to harness various production functions. (2) The import substitution programme was implemented immediately after the rupee devaluation to decrease both the growing expenses on raw materials/components and the lead time of procurement causing delays, further led to procurement of raw materials with less tenacity and other properties resulting in higher rejection level. (3) The production in

initial stages, after incorporating the import substitution programme, did not account for the rejection level which further reduced the actual production. (4) Apart from less developed managerial and labour skills, it was also affected by the power cut imposed by the State government due to drought conditions in Madras. (5) No systematic inventorying of men and raw materials.

HTL was able to produce higher than the target envisaged in 1968, but declined to 89.3 percent in 1971 and further to 79.7 percent in 1972 due to delays in procurement of raw materials, power cut and labour unrest. In the following years it showed a satisfactory level of actual production to the target. The discrepancies in the production process can be ascertained by exploring the percentage rate of change of expenses incurred on raw materials, power and fuel, stores and spares, denoted by $X_3$, $X_4$, and $X_5$.

Table 4.6 depicts the percentage rate of change in raw material expenses and analyses weighted percentage rate of change in HTL. The expenses increased 138.19 percent and 586.52 percent in 1965 and 1966 respectively due to devaluation of rupee. The introduction of an import substitution programme in 1969, enabled HTL to reduce the growth rate by 24.91 percent, again by 12.05 percent in 1971. With the increase in production targets in the following years, the growth rate varied but increased steadily. The marginal increase in the expenses of raw materials directly envisages a steady procurement of indigenous raw
materials/components, systematic inventorying of items and strengthening of the production planning department to formulate production plan on the basis of new techniques and procedures.

Its share in real value of production declined from 0.6360 in 1962 to 0.3089 in 1965, increased considerably to 1.1720 in 1967 and thereafter it decreased gradually from 0.3900 in 1968 to 0.2366 in 1981 with slight variation in 1972 and 1978 when it increased to 0.3027 and 0.2917 respectively. This directly shows that effective programming and control was implemented after 1968. The increase in the share of raw materials expenses in real value of production was due to the adoption of diversification of product range. The weighted percentage rate of change of this input shows variation from 1968 to 1975, but declined gradually to 2.48 percent in 1980 after an increase to 8.798 in 1976.

Similar trends in the growth rate of power and fuel expenses in HTL are disclosed by table 4.7. The expenses on power and fuel increased from 1962 to 1970, but the growth rate decreased gradually each year from 250.28 percent in 1963 to 45.04 percent in 1969 and further to 3.40 percent in 1970. The expenses again showed a reduction by 6.78, 15.91 and 1.52 percent in the next three years, and increased marginally thereafter. This shows that the power and fuel expenses were related to its availability. The consumption rate slackened
due to shortage in power supply in drought conditions. The marginal variation in the expenses of power and fuel after 1974, signifies no significant change in the total demand and the power and fuel utilised in each year. Its share in real value of production was 0.0313 in 1964, decreased to 0.0142 in 1965, increased to 0.243 in 1969 but reduced gradually to 0.0134 in 1973 and marginally varied in later years. This again identifies the factors mentioned above. The weighted percentage rate of change of this input was comparatively less than that calculated for raw materials. Initially it decreased to 5.07 percent 1964, but declined to minus 0.30 percent in 1972, increased considerably to 0.92 percent in 1976.

Table 4.8 computes the weighted percentage rate of change of stores and spares expenses ($X_5$) from 1962 to 1982. From 1962 to 1972, it showed higher growth rate and the expenses increased by 573.62, 101.66, 172.85 and 211.11 percent in 1965, 1967, 1969 and 1971, but in 1972 it increased by 17.77 percent and thereafter increased marginally.²⁷ Its share in real value of production from 1962 to 1971, first increased to 0.0549 in 1965, declined to 0.0116 in 1966 and thereafter increased to 0.0932 in 1981. The share of this input in real value of production showed an increasing trend, unlike that of raw materials, power and fuel respectively. The weighted percentage rate of change was 21.68 percent in 1965, decreased

to 0.5 percent and 0.38 percent in 1966 and 1979 respectively. In the period from 1967 to 1978 and after 1980 it showed variations as ascertained by table 4.8.

The analysis of organizational development of production divisions, procedures, and the actual performance of HPF and HTL shows the adoption of different strategies by both PUs. The affect of the morale of employees on labour productivity and other aspects may be able to reveal the dependence of various factors.

LABOUR PRODUCTIVITY

It is concerned with the relationship between output and the effort required to achieve it or with the quantity of output per unit of input. Tables 4.1 and 4.5 analyse the trend of labour productivity in HPF and HTL. Table 4.1 signifies that there is a steady increase in labour productivity from 0.0007 in 1968 to 0.0092 in 1982. It varied marginally from 1968 to 1975 as the rejection level was higher and the output was considerably less. With the start of conversion of colour film in 1975, the labour productivity increased from 0.0010 in 1974 to 0.0024 in 1975. HPF also took steps to regularise the intake of employees, which helped in steady increase of labour productivity from 0.0024 in 1975 to 0.0092 in 1982. It varied marginally from 1976 to 1981.

Table 4.5 shows that labour productivity was 2.57 as least in 1962 in HTL. It increased considerably to 3.55 in 1963, declined to 2.66 in 1965, again increased to 4.37 in 1969.
From 1970 to 1980, it varied marginally between 3.5 to 4.5. With the improvisations and modifications, labour productivity increased from 3.20 in 1978 to 4.98 in 1982.

The correlation co-efficient ($R = + 0.96$) shows that average morale index of employees affected labour productivity.

It is analysed that in the initial years of production of photo-sensitised products and teleprinter units, the rejection levels were higher than that of the last five years. It shows that average rejection levels were higher in HPF than in HTL. The correlation co-efficient ($R = + 0.96$) shows that morale of the employees had an effect on rejection level. The rejection level increased the expenses on raw materials due to higher consumption, as the correlation coefficient ($R = + 0.85$) indicates.

The study reveals that production management plays a pivotal role in the efficient and economical running of industrial enterprise. Proper management of production not only helps to optimise production but also reduces the cost of production, without compromising on the quality of products. The three important production functions—planning, scheduling and control—complete the production process. The production planning is to link the series of steps of distinct operations in such a manner that routine managements suffice to cause production to happen in the right place and at right time.

The production organization is to co-ordinate and control the
activities of an enterprise by minimising friction and defining responsibilities to achieve the objectives.

The study shows that both PUs accepted the borrowed technology, to which exposure of Indian technicians was negligible. The working environment was more sophisticated and called for higher skills and managerial effectiveness in both PUs. The production division was set up with only production function to perform which was not based on the cost and value analysis. This led many technical complications and under utilised production capacity.

These short comings led HPF and HTL to review their organisation set up for evolving deficient areas and augmenting changes that appear in the existing machinery for co-ordination. The following innovations were carried out by both PUs: (1) Strengthened production planning department to inhibit the effect of relevant factors. (2) Establishment of quality control department. (3) Strengthened production divisions by incorporating manufacturing, maintenance and processing chemicals in HPF whereas in HTL a purchase department was set up and instead of processing chemicals a metallurgy department was established along with production and maintenance department. (4) Removal of technical problems by improvisations and indigenisation helped to overcome delays and regularised efficient production. (5) Reprocessing the waste for maximum recovery of silver, improved efficiency and reduced the expenses on raw materials. (6) Provided more co-ordination
by adopting three devices - (i) providing a common head for various department, (ii) setting up representative committees of departments, and (iii) holding co-ordination meetings.

The series of changes in the production divisions and indigenisation of the production process in both PUs has increased their efficiency as revealed by the achievement of higher production targets.

The analysis of capital formation in both PUs is also essential to examine the trend of capital stock formation, and computation of weighted percentage rate of change of this input (capital stock) is dealt in the following chapter.