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# COST MANAGEMENT IN A SPECIAL MACHINERY COMPANY

—Especially on the Standard Direct Costing—

by

*Kazuo Adachi*

This paper is intended to describe the cost management practices in a company specialized in the manufacture of time control machines. Presently (in 1963) a standard direct costing system is employed by this company. Theoretically speaking the company's system is somewhat different from the so-called direct costing. Yet some difference is unescapable, since such ideal form as "a differential cost for a differential purpose" appears to be difficult to supply data on costs as rich as possible to serve for business management in view of the limited man-power for clerical works. Practically the most multi-purpose use of limitedly available cost informations is required. From such viewpoint, the standard direct costing system of the company seems very suggestive. So, in this paper we want to present the company's practices laying stress on the manufacturing profit report as the most significant information to be derived by the system, as well as the management methods for cost-down, in connection with the systems of accounting and production control.

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## ***I. Preface***

### **1. History of the Company**

This company was established in 1931 by the present president. The damageability of foreign-made time stamp, then in popular use, induced him, an engineer, to manufacture and offer to market creative and troubleless time control machines. The company, thus born, succeeded to develop the first home-made time stamp machine, and gained public attention and reputation, being partially supported by the national policy encouraging domestic production of prevalent imported goods in those days.

Thereafter time stamp and time recorder, the latter being improved to the present type in 1933, have been the main products of the company throughout up to present, excepting a wartime period when a certain kind of military goods was produced.

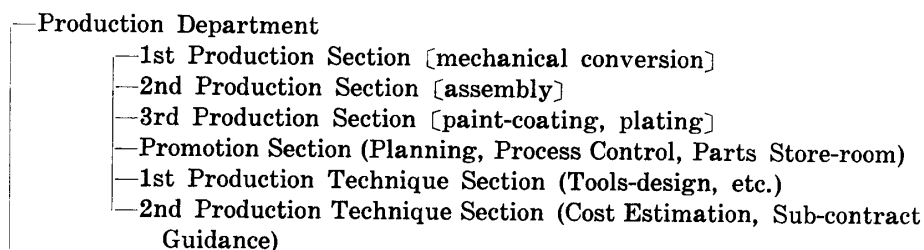
Home-made time control machines have expelled foreign products on account of low cost and easy repairableness, until presently they are accounting for almost 100 percent of the home market. The share of the company in the market is the largest among makers.

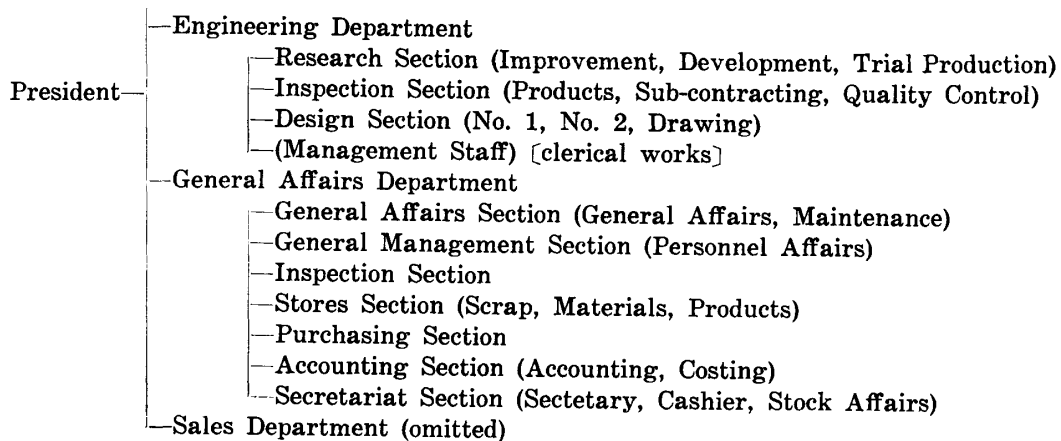
#### **[Present state of the company]**

- 1) Sort of business—Manufacture and sale of office machines.
- 2) Main products—Time recorder, time stamp, moisture separator (developed in 1952), machine operation-hours recorder (developed in 1953), normal temperature dry air generator (developed in 1956), industrial vacuum cleaner (offered for sale in 1955), card rack (manufacture was commenced almost at the same time with time control machines); all these are standardized catalogue products.
- 3) Capital stock—400 million yen. (Listed in the Tokyo Second Security Exchange.)
- 4) Disposition of plant—See Chart 2.
- 5) Number of employees—650 persons; 350 persons in manufacturing division (of whom 170 persons are direct workers), 190 persons in sales division and 110 persons in general administration division.
- 6) Organization chart—See Chart 1.

**Chart 1. Organization**

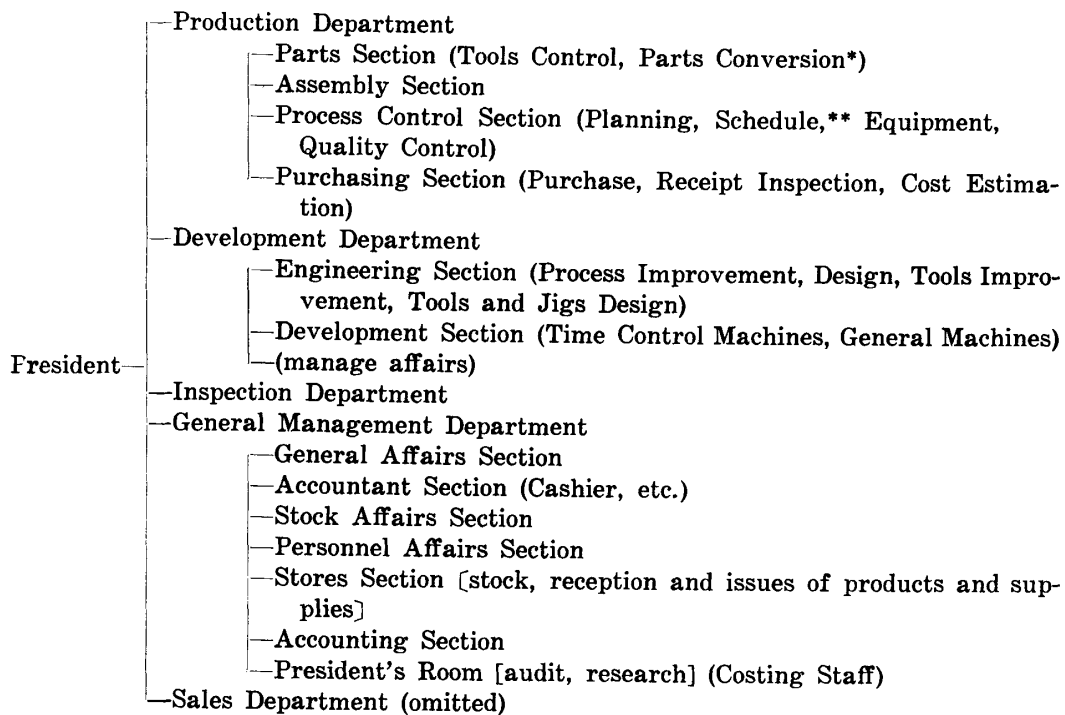
(A) As of 1960





Note: Mark ( ) denotes names of Subsections, and [ ] job contents.

(B) As of 1963



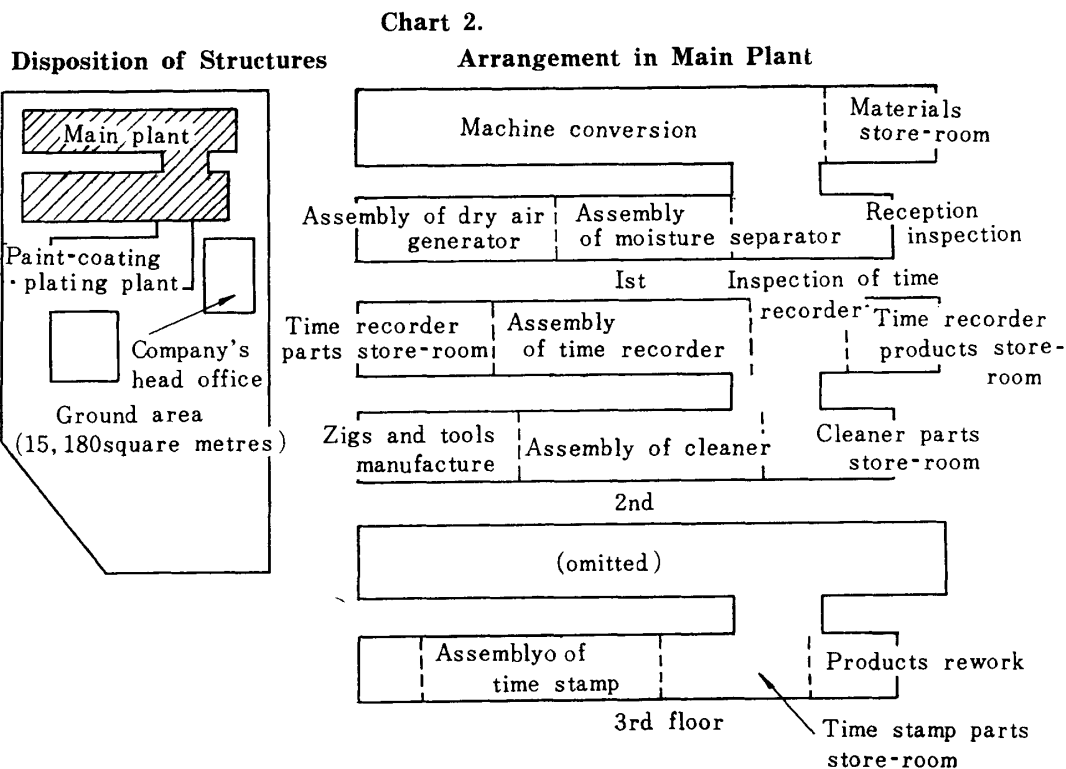
Note: \*Subsection is Subdivided → Group → Rank

\*\*Responsible also for stock of parts and materials.

## 2. Products and Production System

Until a few years ago, the production scale of most standardized products (catalogue products such as time recorder, time stamp, card rack, etc.) had not been so large as to carry on continuous production through a month, although the volumes were appreciably great. Some of standardized products including dry air generator and order-production goods (non-catalogue products requiring new designing for each order received) were manufactured on orders.

Currently, however, time recorder, with increasing demand (3-fold during the past three years), is being built with conveyer system for a certain fixed



units every day on the base monthly production planning. There are three types of time recorder, namely standard type, popular type (partially simplified one of standard type) and cumulative type (a standard type with cumulative mechanism). The differences between the three are small, with only slight changes in the attachments. (The volumes of production of the three types are in the ratios of 60: 38: 2, on monthly man-hours base). Occasionally fashions are changed to a small degree according to orders of customers.

Card rack is manufactured on monthly planned volumes samely with time recorder, though not by conveyer system. Time stamp and some brands of moisture separator, vacuum cleaner and machine operation-hours recorder are produced by lot production system to be planned each month. Other catalogue products such as dry air generator are manufactured according to orders received.

The proportions of sales amount and total man-hours of major products (catalogue brands) are:

	Sales amount	Man-hours
Time recorder .....	60%	60%
Moisture separator .....	13	2
Industrial vacuum cleaner .....	9	2
Card rack .....	9	5
Time stamp .....	4	12
Dry air generator .....	5	19

The rate of order-production of standardized goods to total production is about 2 percent on the man-hours base.

Pure order-production is limited to such orders that have some relations with the development of new products. (The rate of man-hours to total is 10 percent.)

Largely production takes form of assembly parts, including both self-made and out-order goods (the ratio is 1:1). Substantially many of such parts are common to several product lines. Some are sold as they are (the ratio of finished and part goods in sales is 9:1).

The part goods are clearly distinguishable into self-made and out-order ones, because out-orders are placed on planned order system. Subcontractors count about 100 companies, including 10 companies that are specialized in the subcontract for the company. (However, there has been no case of capital participation to these companies.)

As for time recorder, for example, unit parts amount to about 1,300 pieces. Purchase and storage of parts are carried on under the ABC system. A and B groups are ordered or produced for periodical unit of ten days or a month according to respective monthly production planning. As for C group necessary volumes for three or four months are ordinarily stored.

These unit parts are composed into intermediate parts by degrees; by the first assembly process into 800 pieces, by the second into 200 pieces, and by the third into 20 pieces. The intermediate parts are built up to finished products, utilizing conveyer system. (Intermediate parts after the third process are, for example, case, base part, watch, spring winding, printing, ribbon exchange, joint, card · pocket · sliding mechanisms, electrical mechanisms, magnet and hammer, etc.)

### 3. Outline of Production Planning

Production planning is established with regard to each business term (six months), quarter (three months) and month (working program).

Production planning as to standardized products is made as follows. First a master plan is established by Sales Section (Sales Department) and Process Control Section (Production Department) after fundamentally examining demand, profit and production of a product. This is prepared four months before a beginning of business term.

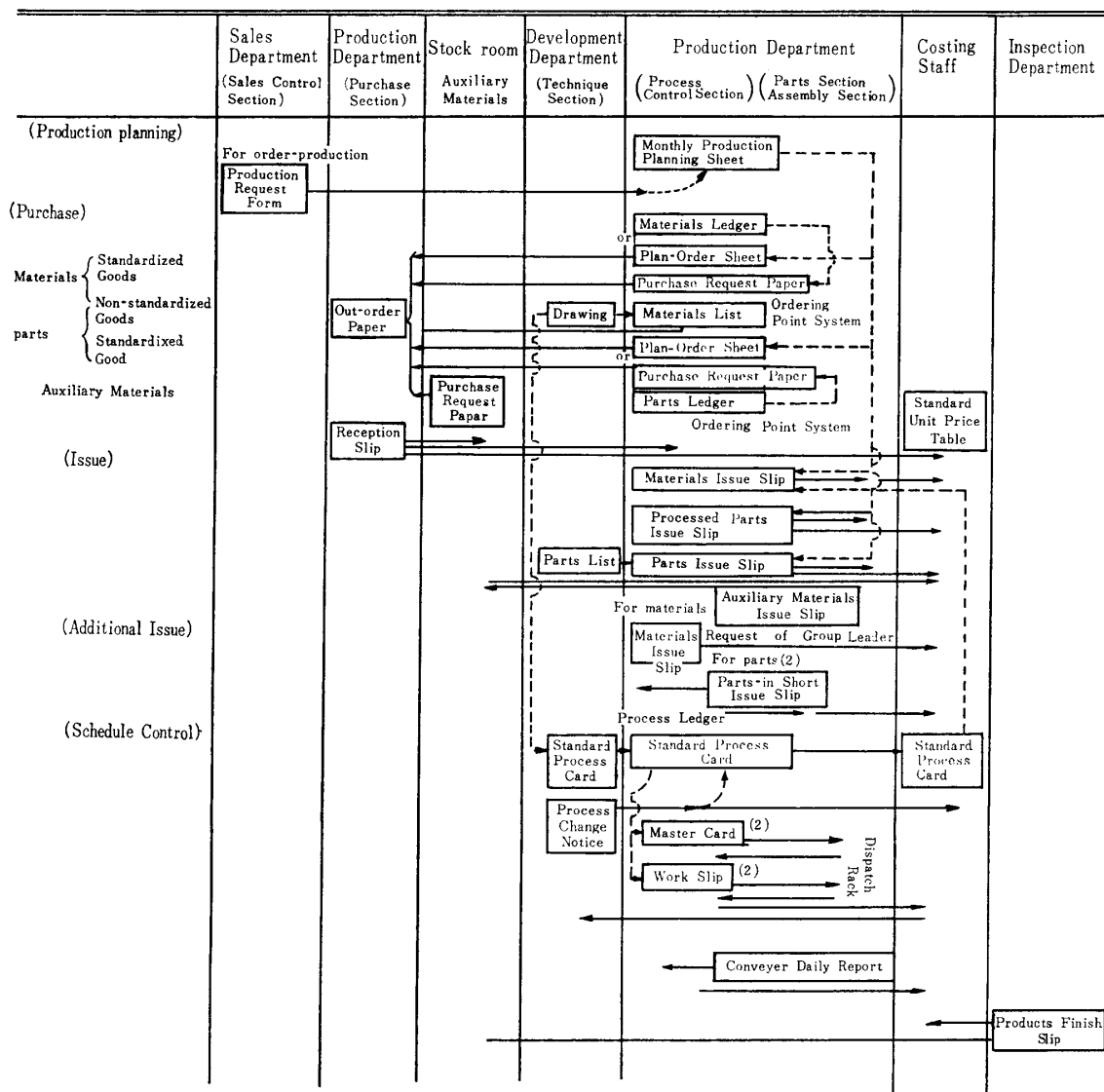
Next a more concrete planning for a quarter is designed three months before a start of quarter. This plan is embodied into a "monthly production schedule sheet". Such early decisions are required because arrangements for parts must be made three months before use. Intermediate parts with marketability may be procurable in a month to spare, but most of parts, being the company's particular ones, need preparation preceding three months. Monthly working program is determined on around the twentieth of preceding month, in which the monthly plan in the above said "sheet" is revised if necessary. In this are entered the volumes of parts and finished goods to be produced in the month, taking into account additional in-orders after a quarterly plan is decided. A spare capacity of 10 percent is estimated in a quarterly plan.

In the case of order-production goods, Sales Department examines the order in cooperation with Development Department as well as Production Depart-

ment, and then Sales Management Section (Sales Department) issues "Production Request Form" to Schedule Subsection (Process Control Section) to request manufacture.

When an in-order concerns a goods of special pattern (non-standardized product), after the Information from Sales Department, Engineering Section (Development Department) makes broad estimations on engineering and costs, and if the reception is decided by Sales Department "Production Request Form" is issued to Planning Subsection (Process Control Section). The Re-

Chart 3. Flow of Forms for Production



quest is then transferred to Development Department for designing.

The quarterly plan involves major and minor ones. The major plan settles monthly production volume of continuous production goods, and volume and date of non continuous goods (charged by Planning Subsection), and the minor plan determines schedule and purchase or out-order programs (charged by Schedule Subsection, Purchase Subsection, etc.). A revision on the monthly working program, say revision of production units, must be limited to a small extent, since, as mentioned already, date or volumes as regards purchase or out-order are difficult to change widely.

## *II. Cost Accounting System*

### **1. History of the Costing**

Until about 1955 the costing had been carried on as mere estimation, and the need had been sharply felt of establishing a perfect cost accounting system that could help the preparation of financial statements. In October, 1956 a step toward such system was taken. An actual cost system was introduced in face of strong resistance by reason of its troublesome nature. The adoption owed much to the full recognition of necessity by company's staffs. At first the main object was placed on providing useful data for monthly closing.

By the second half of 1957 the need of standard cost system grew greater for cost management. As a single-stroke conversion to this system seemed difficult, gradual shift was projected.

First, in October, 1957, the standard was applied to purchase prices of materials. This field was firstly taken up because here a change was possible independent from other field, and further the determination of standard prices was relatively easy.

Next, in April, 1958 the standard of materials quantity was settled, and thereafter the issue from store room has been based on the standard. (Such standard, however, was rather lower level at the beginning.)

Further in October, 1958 the standard for direct labor hours was set out, and in April, 1959 also the standard for conversion costs.

The form of cost system being employed at around 1960 was a standard lot cost system, in which material costs for lot production was calculated by line of products (by lots), and conversion costs were distributed to each lot, making the factory a cost center. (Hence, evaluation of work in process was necessary at each month end and business term end.)

Such system, however, has been remarkably changed by the current year 1963, especially with regard to two points as below.

One point is: the factory, that had been regarded as one cost center formerly, has been divided into four centers, that is, introduction of departmental accounting.

Another point is: as to monthly cost accounting full cost accounting has been revised to direct cost accounting, that is, introduction of direct cost

accounting, a more fundamental change.

Such introduction of departmental cost accounting on conversion costs has been made in order to perform more accurate costing of products as well as for request of cost control. In principle cost control must be executed in a form closely connected to profitability of each product. Especially in the case of this company where profitability with every product is aimed at, such departmental determination of conversion costs rate makes it possible to find a cost emerging, for instance, in the dry air generator section from the viewpoint of independent profitability, and besides transfer prices of self-made part goods, when transferred to other section by request, can be more appropriately determined. (Transfer prices are set 10 percent higher than standard costs.)

The reasons for introducing direct costing are as follows.

(1) Profit management by way of analytical management of marginal profit, or, in more concreteness, to obtain data for the optimum composition of products from a long-run viewpoint. For this company, a short-run increase in the volume of a product on account of its high ratio of marginal profit is difficult, in view of the company's sales conditions. Contrastively the company's objectives are being set on the long-run optimum mix of products on the base of marginal profitability (including a problem of selection between self-making and out-order).

(2) Cost management. This is a subsidiary function. Direct costing enables grasp of fixed costs, and so serves to impress the importance of cost management. Also it makes possible the measurement of the effects of industrial engineering in the place of operations, on which the cost-down in this company principally depends.

Direct costing is employed not for the sake of saving troubles of costing procedure. It has not so much utility of lessening the trouble of calculation, if the calculation for adjustment at term end is taken into account. Stillmore, direct costing itself has no influence upon the management of direct costs, a cut-down of which should be pursued in work spots by medium of industrial engineering methods.

## 2. Outline of Standard Direct Cost Accounting

The cost accounting of monthly-production goods is carried on as standard direct costing, in relation to the financial record. The direct costs in this company are the sum of main material costs and distributed direct conversion costs. The distribution of direct conversion costs is made by multiplying the burden rate [budget of direct conversion costs  $\div$  planned volume (in terms of standard hours)] by allowed standard hours for the product.

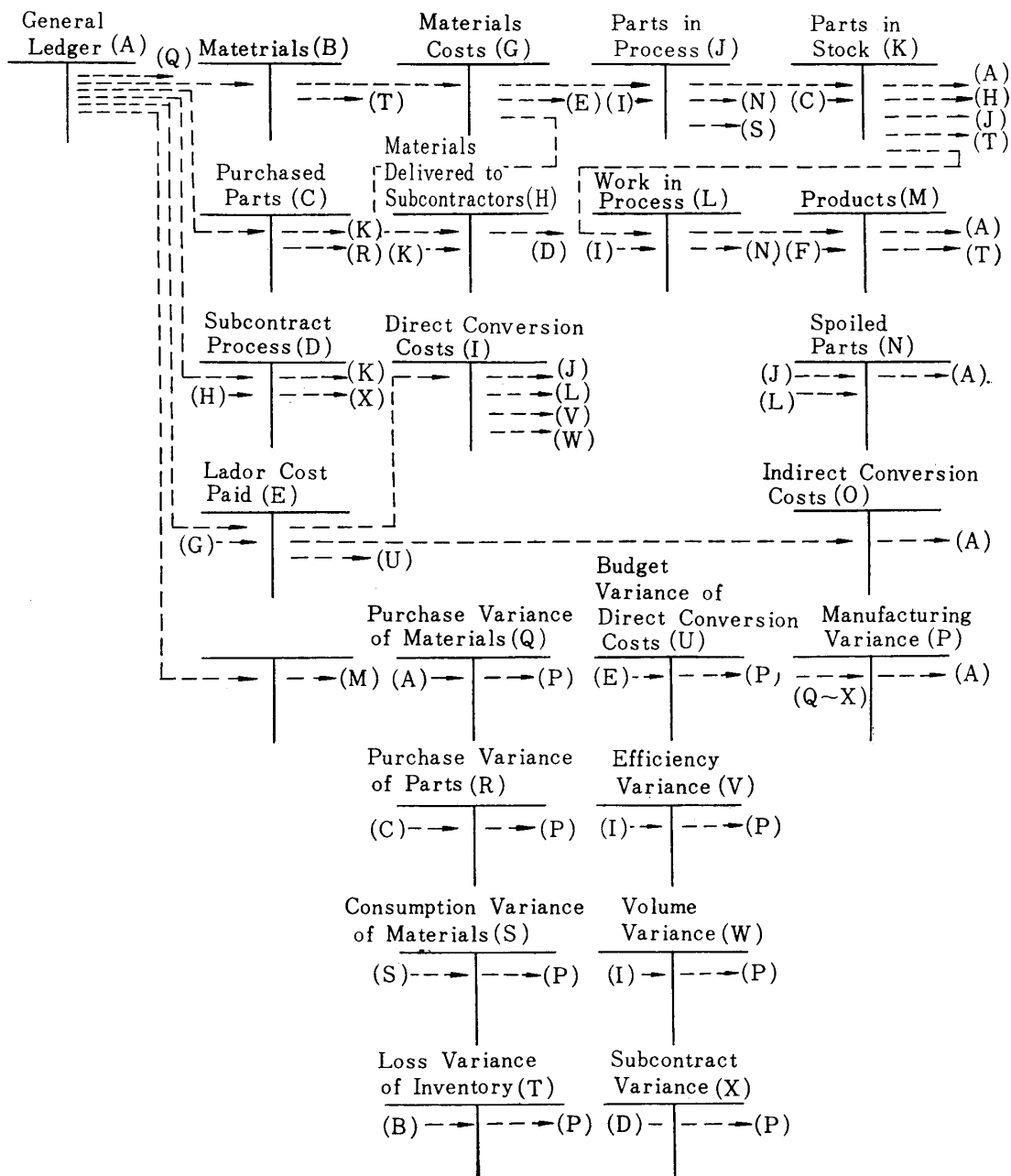
Standard conversion cost are the sum of direct labor costs (pay to workers including head workers when they themselves work) and variable expenses. The burden rates for this costs are computed with regard to the above mentioned four cost centers respectively (four centers of machine processing, assembly, paint coating-plating, and dry air generator).

Direct labor costs are included into product costs because near half of

labor costs holds a nature of variable costs; because consideration is paid to tax law; because there is a fear that a cost information excluding labor costs might lead to a misconception regarding business planning (especially because data on direct costs are used for long-run planning).

Overhead conversion costs and actual-standard cost variance are treated as period costs in monthly financial accounting, and at term end are allocated to terminal sales cost and term end inventory assets on the base of their standard costs.

Chart 4. Relations between Accounts for Production



However, in order to find monthly manufacturing profit on the full costing base, as observed below, burden rates of indirect conversion costs are calculated beforehand, and on these rates full cost for each product line is estimated (the rates are common to the whole factory).

(Product lines count ten; time recorder, spring-type time stamp, electric-type time stamp, knight-watch-man's time recorder, card rack, normal temperature dry air generator, machine operation-hours recorder, moisture separator, industrial cleaner, and special order goods.)

In other words, inclusive full costing is made with, for example, time recorder as a line, while product costs with respect to respective standard type, popular type and cumulative type ones are grasped only as standard direct costs, in their relations with financial accounting. As the monthly calculation, however, actual full product costs for these particular products are estimated separately from standard costing.

### 3. Actual Product Costing

As observed above, product costing combined with monthly accounting is carried on as standard direct cost accounting. Additionally, although not being involved in monthly accounting, a crude actual full costing is being conducted by way of distributing monthly actual overhead conversion costs and monthly actual-standard costs variance to standard direct costs. This calculation is made as follows.

First, the distribution of overhead conversion costs is made by the same procedure with that of distributing direct conversion costs to products. In other words, they are distributed to each product by multiplying respective burden rates (to be obtained by dividing the budget amount of overhead conversion costs for a term by the planned production volume in terms of standard hours) by allowed standard labor hours of products.

Next, monthly cost variances are distributed by a simple procedure as below.

(1) Those monthly variances that are not grasped by product lines are distributed to lines. In the case of materials purchase variance, for instance, firstly it is divided in proportion to the ratio of the materials spending of a term and the stock at term end; next, the portion distributed to the current-term spending, in addition to other variances that are not grasped by lines, is distributed to lines in proportion to respective actual produces (in terms of standard direct costs). Theoretically it may be more proper, for example, to distribute in proportion to total direct materials costs of each line, but such simple method is taken because the total amount of the purchase variance is not so large.

Variances of materials spending and the like are originally counted up by product lines. As to those materials or parts common to several lines, proportionate distribution is made by adding to the above mentioned purchase variances and others.

(2) Next, the amount of variance distributed to each line is allocated to finished products, in-process products, finished parts and in-process parts

within each line by a method below.

First, total base of distribution is computed by each product line.

- i) Total rate for finished goods in a term.  
 $\text{rate} = \text{rate for a unit of product (that is, allowed standard materials costs as for variances concerning major materials, and allowed standard labor hours as for variances concerning costs)} \times \text{units of products of the line}$
- ii) Total rate for in-process products at term end.  
 $\text{rate} = \text{rate for a unit of product (the same with i)} \times \text{number of in-process units (on the base of inventory report from work spots*)} \times \text{rate of finishing (only as for variances concerning conversion costs)}$   
 \*Head worker or head of group reports named and volumes of in-process products as well as their rates of finishing (the rate of allowed standard hours of the work-in-process to required standard hours of the process) on inventory list.
- iii) Total rate for finished parts in a term.  
 $\text{rate} = \text{rate for a unit of finished parts (the same with i)} \times \text{number of finished units (sum of the numbers of daily reception into parts warehouse)}$
- iv) Total rate for in-process parts at term end.  
 $\text{rate} = \text{rate for a unit of finished parts} \times \text{number of in-process parts (on the base of inventory sheet from Schedule Subsection*)} \times \text{rate of finishing (only with conversion costs)}$   
 \*Schedule Subsection head reports the number of in-process parts by the proceeding table on inventory sheet.

(3) Variances of a product line are divided by the sum of (2) [(i)+ii)+iii)+iv)] to compute the variance per the base.

(4) Actual full manufacturing costing (by product): standard direct manufacturing cost = distributed overhead conversion cost + (standard main materials costs  $\times$  materials costs variance per materials costs) + (standard direct labor hours  $\times$  conversion costs variance per hour)

The calculation of actual cost by this method is not so troublesome, since the sorts of products are not numerous. The behaviors of actual costs are reported to top-management as time-series graph, because of their large concern about fluctuations in actual product costs.

### ***III. Methods for Cost Management***

#### **1. Calculation of Manufacturing Profit**

A manufacturing profit calculation for each month, on the base of monthly direct costing, is prepared by the middle decade of following month, and reported to the president and head of Production Department. So far, it is not presented to heads of sections and lower class men, but this is only a custom without any clear sense. The calculation is also plotted in a graph

and samely presented to the president and head of Production Department. (See Chart 5.)

The form of Manufacturing Profit Calculation is shown below. This Statement, or its graph, can illustrate only a broad line of the results of the whole factory. Hence, for the purpose of concrete actions, detail tables by product lines (above mentioned ten lines) are prepared in addition (Table of Relative Contribution to Profit by Lines).

#### Manufacturing Profit Calculation Statement

Monthly total production ①  
Standard direct manufacturing cost ②  
 Expected marginal profit  
Overhead cost (fixed cost) distributed ③  
 Expected manufacturing profit  
Adjustments for variances ④  
 Gross manufacturing profit  
Administration costs distributed  
 Net manufacturing profit

① Monthly total production is the product of the number of finished units and transfer prices, excluding finished parts and in-process products. (Hence it does not show net monthly produce.) As such, it is affected by the change in unfinished products (incl. parts) between beginning and end of a month. Yet such in-process produce is ignored in the table, because what is concerned is the profit realized in the current month. (However, this change in in-process goods is indirectly reflected in profit through the distribution of volume variance to finished products.)

Transfer prices are determined by the following method. They have been long unchanged, and the company's policy is to exert no revision for the coming years. The calculation is made on the base of figures of 1960, a year when production and sales showed relatively normal condition. A transfer price is determined by: divide the operating profit of the term by the number of total employees, to seek per-head profit; multiply this per-head profit by the number of employees in productive department, to compute the distribution of profit; this amount is added to the sales costs for the term, and the ratio of this sum to net sales is calculated; transfer price is determined by multiplying this ratio by catalogue price of a product.

An example of calculation:

Assuming net sales 1,000 thousand yen, sales costs 360 thousand yen, operating profit 300 thousand yen, employees of manufacturing department 80 persons, those of sales department 20 persons, catalogue price of product A 10 thousand yen;

$$\begin{aligned} \text{transfer price} &= ¥10,000 \times \left\{ \left( \frac{¥300,000}{100 \text{ persons}} \times 80 \text{ persons} + ¥360,000 \right) \div ¥1,000,000 \right\} \\ &= ¥6,000 \end{aligned}$$

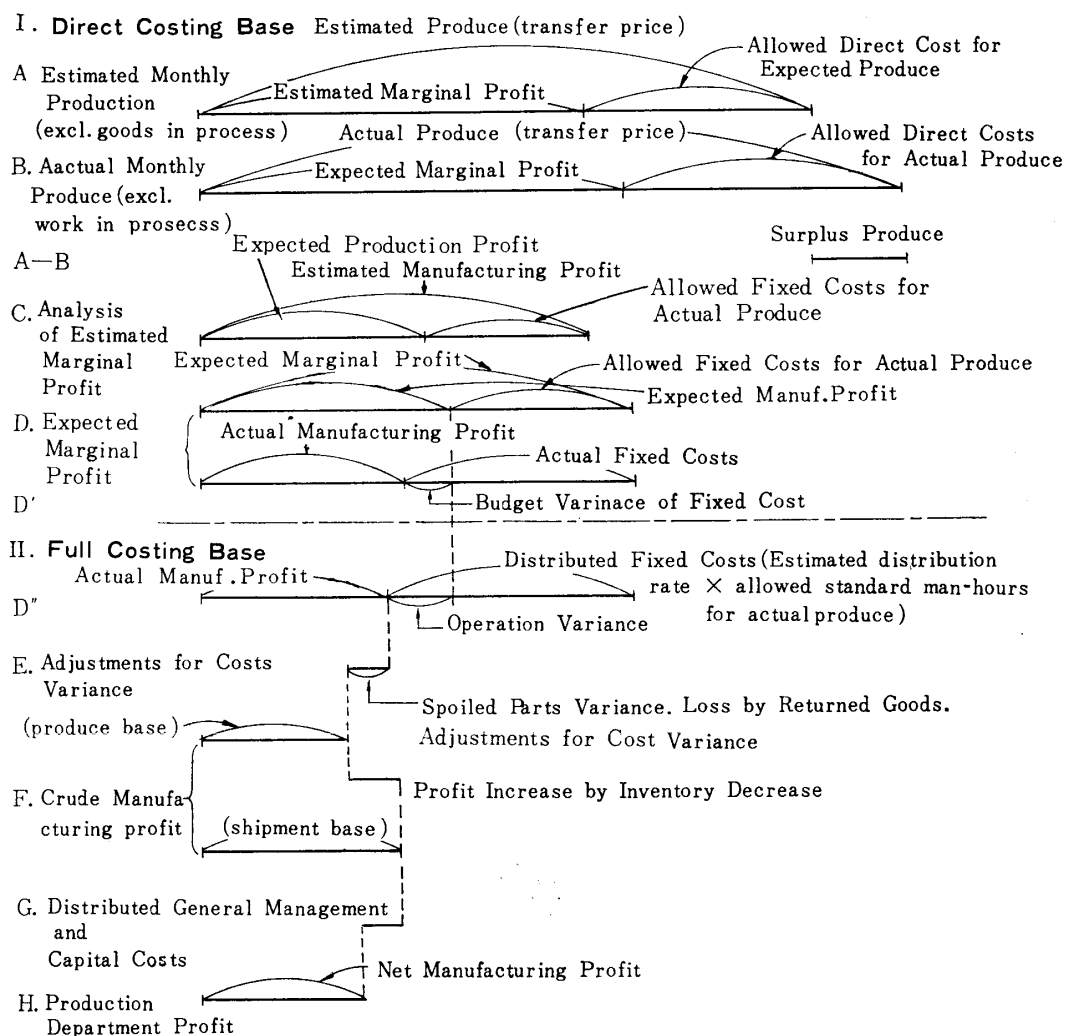
Such transfer price, however, brings about an appreciable differential in the rate of manufacturing profit (manufacturing profit per unit ÷ transfer

price) between a product with larger portion of materials costs and that with smaller portion. Hence, some adjustment is made on the prices of some products. Nevertheless, this standard transfer price is the principle. And this is serving for the selection of product sorts in order to produce those with the highest profit rate possible, and for the cost management in order that each line can raise presupposed manufacturing profit.

② Standard direct manufacturing cost is the sum of standard direct materials costs and the above mentioned distributed amount of presupposed direct conversion costs (looking as variable costs). Labor costs are deemed proportional costs because, as is elsewhere explained, almost half of its total outlay has a nature of variable costs as against total produce, and also it is more convenient for cost plans to include labor costs into manufacturing costs.

③ Distributed amount of overhead conversion costs in the presupposed

**Chart. 5. Monthly Production Department Profit Statement**



distribution of overhead conversion costs (fixed costs) to the finished products in the current term. Therefore, the expected manufacturing profit in the Statement, to be obtained by deducting distributed overhead costs from expected maximum profit, is based on standard full costing.

④ Adjustments for cost variances represent the distribution of variances between standard and actual cost to finished products. Hence, crude manufacturing profit in the next line is based on actual full costing.

In theory, such portion of variances distributed to direct costs is to be shown as a deduction from expected marginal profit (by this, actual marginal profit will be presented). This calculation is not taken presently because of the smallness of variances in direct costs. If they are large the said formula would be adopted.

⑤ Notes on Chart 5 above. This graph is designed to make the Manufacturing Profit Calculation Statement more understandable. Analysis of expected marginal profit shown in the graph is not presented in the above mentioned "Table of Relative Contribution to Profit by Lines." But it is desirable for the long-run decision of product lines and cost-down to grasp some particular items of fixed costs, for example, zigs and tools expenses (especially depreciation for die casting and plastics moulds), design expenses or depreciation for machines and equipment in assembly section (boring machine, conveyer, etc.), because these are fairly of large amount. This analysis serves to avoid such unreasonableness that zig and tools or design expenses attributable to new products are charged upon other unrelated products. A problem here, however, is the grasp of design costs by lines. A weighing would be necessary between the trouble of recording hours for a design and its fruit.

## 2. Cost-down by VA Methods

During the two years beginning October, 1960, the company conducted cost-down attempts several time, throughgoingly and on whole-company scale. The opportunity and duration of the attempt were not established beforehand, nor the proposers were the same, having been the president, heads or subheads of production department. When any one of these staffs or tops responsible for production recognized a necessity of cost-down effort, a committee for cost-down was organized to devise and take concrete actions. None of the committees ever held had not been proposed by the costing staff, although their products, such as Relative Contribution Table or Relative Actual Costs worked stimulus to such movement.

The members, e.g., of the first committee were heads of Production Department, Inspection Section, Promotion Section, Production Department and Purchase Section. The Head of Inspection Section, being most earnest in cost-down, was selected for the chairman. The Costing Staff worked actively to provide informations on costs and to guide the lines of cost-down.

The first task of committees has been to determine the objects of action. By the first committee twenty sorts of products in the higher order of costs were selected, on which studies were centered. For these goods, however,

little room had been left to take steps toward exercising stricter process control and decreasing man-hours, and so changings in design and materials had to be relied upon, that is to say, VA methods were necessary.

As the result, a substantial cost-down was effected by, for instance, adopting die casting to setting-board and attachments of time recorder instead of setting to steel board; replacing the materials from pyritic copper to aluminum (the price of aluminum is higher on weight base but cheaper on volume).

As for the cut-down of subcontract conversion costs, by the first committee flat-rate cuts of unit costs were enforced in exchange for a three-month-plan-order system. The second committee requested some certain rates of unit cost cuts in exchange for increased order volume. Presently no action is being taken for cost-down in subcontractors. The application of VA methods are confined to the company itself. And, currently the main direction of effort is placed on such designs and specifications in the development stage that can attain the goals of planned costs, rather than the way of special committee.

### 3. Budgetary Control

#### (1)

In this company, the standard cost management is mainly relied upon for the management of monetary input, and the management by terminal budget is not carried on as a system. The reason for this is that if original budget plans are to be prepared by individual departments and sections there would be a danger of falling into a budget determined by "relative weight of power"; and a control of expenditures by way of "appropriation" type of budget is also inadequate since the ultimate objective should be increase in profit, not mere decrease in expenditures.

Nevertheless, terminal budget is compiled. But the responsibility of managing such budget is held by nobody. (By this budget the distribution rate of standard conversion costs is calculated, on which standard product cost is based.)

Still, if an expense proves to be exceeding allowed amount by cost analysis, necessary actions are taken for control, for instance, to regulate indirectly wastes of materials by directing Purchase Section to restrain purchase order of supplies. Under such direction the Section endeavours to exert over-counter control over the delivery of such supplies.

The policy on entertainment expenses is to confine them to a certain limit. When an extraordinary amount is needed to receive a particular order, specific recognition is required. Also as for maintenance expenses, control is performed examining the order paper, which is required when a maintenance requires materials of more than five thousand yen or one man-day labor.

#### (2)

On the other hand, terminal budget for output, such as sales amount or production volume, are estimated most strictly while the management for attaining such goals is conducted powerfully. For instance, as for the production volume budget, schedule is settled to each process (divided by worker groups or by operations of lathe, auto-lathe etc.) in terms of standard

hours, the attainment of which is made a strict duty. The schedule is determined according to the production planning for a term, and is not changed for six months. The degree of attaining the target has a connection with the incentive pay to be referred later.

(3)

As to some items of overhead cost that could be saved or decreased by efforts, one fourth of the economized amount (from monthly allowed amount derived from flexible budget) is reserved for reward fund. The rate, one fourth, has no special sense except some relation with the production incentive pay. These items are electricity, gas, water and telephone charges, office and factory supplies, consumptive instruments and appliances, auxiliary materials and other controllable expenses. (Entertainment expense is not included because its proportional share in the total is small; it is excluded also as for Sales Department because the sales incentive is decreased when entertainment expense has exceeded an allowed limit.)

This reward fund is merely a nominal total reserve, not being directed to individual persons or sections, because no one is responsible for the terminal budget, but the system seems to have some effect on promotion of cost consciousness. Use of the fund is still undermined, but possibly for working funds of employees' cooperatives.

#### 4. Calculation of Actual and Standard Costs Variance and Cost Management by Routine Works

First, at the time of purchasing materials or parts, price variance [actual sum of purchase—standard price  $\times$  number (weight) of purchase] is separated. (see Chart 4.) Issue of materials or parts is made at standard prices at the time of issue (in the case of standardized goods). Variance of materials spending is not grasped at the time of delivery. Issue is made for allowed number (weight) according to planned production volume. As to materials of serial products, even when they have become short due to spoiled work or so, no additional delivery is made. As to order products and lot products, "Additional Materials Issue Slip" or "Parts-in-Short Issue Slip" is issued, but variances are separated at the finish of their production to coordinate the shortage for serial products. In other words, variance of materials spending (or of spoiled parts) is grasped as the sum of the allowed variance for serial products and the additional issue for order and lot production products.

Variance of direct conversion costs is calculated as follows. (Because direct costing makes the principle, in monthly accounting overhead conversion costs are transferred to the next month as an over-term expense, although its distribution to products is made for the calculations of monthly manufacturing profit and manufacturing costs.)

- 1) Actual conversion costs emerging — their budget amount = variance of direct conversion costs budget
- 2) burden rate<sup>①</sup> of direct conversion costs  $\times$  (actual working hours — estimated effective working hours)<sup>②</sup>  $\times$  standard working efficiency = operation variance of direct conversion costs

- 3) Burden rate of direct conversion costs  $\times$  (actual working hours<sup>③</sup>  $\times$  actual working efficiency—actual working hours  $\times$  standard working efficiency) = efficiency variance
- ① budgetary amount of direct conversion costs  $\div$  estimated available standard hours
- ② estimated workable hours  $\times$  standard attendance rate  $\times$  standard working hour rate
- ③ actual available standard hours (total of standard hours incerted in Finished Operation Slips)  $\div$  actual working hours

Example of calculation:

Assuming: burden rate of direct conversion costs 50 thousand yen, estimated working hours 180 hours, standard working efficiency 95%, actual working efficiency 90%;

volume variance = 50 thousand yen  $\times$  (180 hours — 200 hours)  $\times$  95% = —950 thousand yen

efficiency variance = 50 thousand yen  $\times$  (180 hours  $\times$  90% — 180 hours  $\times$  95%) = —450 thousand yen

Beside the above explained calculation of variances connected to finance record, operation report in terms of monetary value, especially as to working hours variance, is supplied to super visors such as foremen and group heads, since the maintenance and advance of operation rate depend on attendance rate, actual working hour rate and working efficiency which are influenced by the ability of these men.

To speak more concretely, variances of workable hours, attendance rate, working hour rate and working efficiency between estimation and actuals, being converted into monetary values, are reported to these staffs in every decade of month regarding respective responsible spheres. Further, as to price variance and spending variance, as soon as any variance becomes clear (that is, at the time of purchase for price variance and at the time of finish of a lot of parts or products for spending variance), its cause is pursued by inquiring with the sections concerned.

One who is lowest and most immediately responsible for the cost management in routine works is the Rank Head. His main tasks in this regard which is physical cost control are; (1) Keeping of production objective and schedule. (2) Control of spoiled works. (3) Control of materials spending.

Responsibilities for cost management of supervisory personnels upper than Rank Head are supervise and adjustment of subordinate sections or subsections.

#### [Supplementary Note I. Calculation of Standard Conversion Costs Rate]

Standard conversion costs rates are settled for every business term (six months). A rate is calculated by dividing the budget of conversion costs by the planned produce for the term (in terms of standard hours).

The rate is settled separately for direct conversion costs (a variable costs) and for overhead conversion costs (fixed costs). The former is made with respect to the four costing centers already mentioned.

(A) The formula to calculate the denominator.

denominator = estimated number of direct workers<sup>①</sup> × attendant days possible<sup>②</sup> × 480 minutes<sup>③</sup> × standard attendance rate<sup>④</sup> × standard working hour rate<sup>⑤</sup> × standard efficiency rate<sup>⑥</sup>

1) Estimated number of direct workers: This is a total of the numbers settled for each group. Each group's number denotes effective persons for the coming term. For the April-September term expectable new members are included.

The line organization in production department, e.g., machine process (for parts) is Section Head, Subsection Heads (three persons, such as Head of Machine Process Subsection, etc.) Group Heads (one or two persons in a Subsection; assistant to Subsection Head; a group consists of lathe, cog cutter, auto-lathe, etc.) and Rank Heads (one or two persons for each machine sort, e.g., a rank of auto-turret.)

2) Attendant days possible exclude holidays and vacation days.

3) 480 minutes means eight-hours a day and six days a week. The product of the above three items shows estimated workable hours (in terms of minutes).

4) Standard attendance rate is determined by Costing Staff on the base of figures presented from Personnel Affairs Section. The median figure of past rates, or attendant hours ÷ workable hours for the whole company is used. It is common to all departments. It is used also for a base of personal merit rating (e.g., bonus, promotion, etc.).

5) Standard working hour rate (effective operation hours ÷ attendant hours) is determined by past actual figures (obtained from job ticket).

6) Standard working efficiency is the ratio of earning standard hours to actual workable hours. This is obtained by adding some value to past figures.

(Note: presently sales ability is ignorable, since demand is surpassing production capacity.)

(B) The formula to calculate the numerator (budget of conversion costs).

(I) For direct conversion costs budget

numerator = monthly basic pay<sup>①</sup> for all members of the section and incentive pay<sup>②</sup> × 6 (months) + other personnel expenses<sup>③</sup> + budget of direct manufacturing expenses<sup>④</sup>

1) Basic pay for a employee is decided on integrate evaluation of skill, job, experience, school career, age and past performances. All employees are on monthly-pay system.

2) Incentive pay system was commenced in 1959. This is a kind of profit sharing plan. Total profit is divided to employees after deducting tax, stock dividend, officers' bonuses and retained earnings.

Incentive pay to individual employee is determined as:

total incentive pay ÷ (total basic pay × average attendance rate × average merit score) × person's basic pay × attendance rate × merit score

(Merit score is determined by working efficiency, business position, etc.)

The ratio of incentive to basic pay has been exceeding 30 percent. There is no other allowance for employee, such as family subsidy, in this company.

(Extra-hour pay is small. Communication subsidy is treated as welfare expense.) Almost half parts of both basic pays and incentive pays may be deemed proportional costs.

3) Other personnel expenses include bonuses, employer's charge of health insurance, welfare pension insurance, unemployment insurance, workmen's accident compensation insurance, retirement allowance and welfare expenses. These are fixed costs but included into direct costs.

4) Expenses to be included into direct conversion expenses are consumable tools expense (17–18 % of the total), auxiliary materials expense (ditto) and other factory supplies and instruments. These are proportional expenses. Charges for electricity, gas and water are treated as fixed expense, because the amounts are small and the basic rates are fixed.

(2) For indirect conversion costs budget.

Major items of this budget are depreciation (about 30 percent of manufacturing expenses), tax and other public charges (7–8 percent, mainly fixed assets tax), rent, maintenance expense, etc.

#### [Supplementary Note 2 Compilation of Flexible Budget of Conversion Costs]

Budgeting of conversion costs for a coming term (six months) is conducted by Costing Staff after the following procedure.

1) With respect to each item, input or output factor with the largest correlation is searched. In order to save the trouble of computing correlation coefficients between all items and all factors of input and output, a procedure below is taken.

i) Time series of actual figures for the past seven business terms are plotted on half-logarithm graph using transparent paper. The effect of price variation is neglected because prices were relatively stable during the period.

ii) As to items with extraordinary emergence in a certain term, adequate adjustments are made.

iii) On other sheets of papers of the same kind, time series of major input and output factors are figured.

iv) The above graph papers of cost series are put on these factor series, to pick up a pair showing the most resembling variations.

v) The correlation coefficients between the pairs are sought. The coefficient must be + 0.9 or over to be adopted.

2) With respect to each pair with coefficient of + 0.9 or over, regressive (linear) curve is plotted. The curve is adjusted, if necessary, for the normalcy of the item as cost.

3) Forecast is made on each expense item with respect to its variables, namely input or output factors. For this purpose, firstly maximum and minimum sales amounts are estimated and the mean amount is taken. On this, corresponding production amount is estimated (as a part of the production planning for the term). Against this estimated production amount, estimation of input or output factors are performed.

4) Allowed amounts of expense items, being the functions of these input or output, are determined by the above regression curves respectively.

Major items of conversion cost budget and corresponding functions, namely input or output factors, are shown below.

Input or Output	Item
Production amount (transfer price)	Package expense
Production amount (standard man-hours)	Factory supplies, lubricating oil, auxiliary materials
Electricity equipment (in terms of KW)	Electricity charge
Actual working hours	Expenses of consumable tools, instruments, and appliances
Number of workers (direct or/and indirect workers)	Expenses of welfare affairs, office supplies, travelling expenses and carfare

Other items that have no adequate correlated factors, such as entertainment and maintenance expenses, are estimated on other bases; for example, entertainment expense is restrained to 0.3 percent of sales in view of tax regulation; maintenance expense is regulated at the level of the preceding term.

## 5. Schedule Control

Schedule control is managed principally by Schedule Subsection of Process Control Section.

(A) As to process of part goods.

(1) Standard hours (for standardized products) or estimated hours (for non-standardized products) of operations for planned monthly products are posted to "Master Card" (schedule table) from "Process Ledger" (a file of process standard cards) of the Subsection. Process standard card shows standard or estimated hours determined by Technique Section on the base of past experience or estimation by drawings.

Next, on the Master Card, entry is made of scheduled dates of start and finish of each process. To make this decision properly, "Capacity Reserve Table" is prepared by this Section. (Extra-hour work or holiday work are avoided in principle, because of the numerous number of un-adult and female workers and probable decline in efficiency.)

Schedule Subsection prepares also "Job Ticket" from Master Card for each process necessary, to inform allowed hours for each operation and to record actual labor hours.

(2) Twice a month and at least fifteen days before the start of an operation, the Subsection delivers Master Card (copy) and Job Ticket (of necessary number for each process) to Group Heads of work spots. These Master Card and Job Ticket are arranged into respective "daily-segments" of the upper section of the Group's shelf, in the order of start days, and transferred to the lower section when the start is made. (Hence, if an operation does not start at the schedule day, they remain untouched.)

Eachworker imprints time stamp on the Slip by himself, at start and finish of work (as to set-up work, also at start and finish of work preparation.)

(3) Job Ticket is returned to Schedule Subsection as soon as the designa-

ted operation is finished. By the Ticket returned, the Subsection enters records of finished performances on Master Card and Capacity Reserve Table once a day. (The number of Tickets amounts to four hundred sheets in a day in average.) Thus, Master Card and Job Ticket are utilized as a Proceed Table.

(4) The Tickets are transmitted to Costing Staff, where incerted labor hours are summed up, daily and by product lines. Then, they are transferred to Improvement Subsection of Technique Section to be recorded. This record is referred for setting and revision of standards.

(5) Master Card plays the roles of "Article Slip" and "Transfer Slip" at work spot, until the operation concerned is finished there.

The inspector man enters on "Finish Slip" after final inspection of processed goods. A sheet of the Slip is kept there and others are sent to Costing Staff and stock room.

(B) The former Promotion Section, whose tasks are now charged by Process Control Section, had conducted direct control over out-order goods as well as self-products. This function is now performed by Purchase Section. Both ways have merits and faults, but the present form of separating out-order and self-making goods seems more appropriate, since for the control of former goods particular techniques are required.

(C) As for assembly operation of intermittent products, a similar Job Ticket with that for parts conversion operation is used. But the control of progress for these goods is managed independently at work spots. Only when there is a fear of delay in delivery time, Schedule Subsection urges progress. As to serial products Job Ticket is not used, since the assembly work is done by conveyer system. Daily performances are reported to Schedule Subsection as "Conveyer Daily Report".

## **6. Purchase, Inventory and Spending Controls of Materials and Parts**

### **[Purchase of Materials and Parts]**

The method of placing order varies somewhat between materials and parts, and between standardized and non-standardized goods.

As to materials, the reception, delivery and storage are charged by Schedule Subsection. The Subsection holds "Materials Ledger." The order for ordinary supplies is placed when the stock has declined to a certain level. This "order-point" system is being gradually changed to a "plan-order" system, by which order requests are made being based on production planning.

The stock room of parts is also managed by Schedule Subsection. For standardized parts, plan-order system makes the principle. Necessary parts, of both order-making and self-making, must be fully stocked fifteen days before the start of assembly work. Order sheets are prepared by Purchase Section by "Plan-Order Table" two months before use. (Plan-Order Table is compiled by Schedule Subsection on the ground of production planning to be established three months before as explained already. On the table are incerted required parts names, standard volumes, standard unit prices and suppliers, and sub-contractors of parts.) When a shortage of parts has emerged due to spoiled

work or others, order is made by the same procedure with non-standardized goods. As for some of ordinary stock goods, management by the order-point system is also used beside plan-order system.

#### **[Booking of Purchased Materials]**

Materials or parts delivered from suppliers or subcontractors are stocked into respective stock rooms after inspection. A sheet of "Reception Slip" issued by Purchase Section is sent to the person in charge of stock room of Schedule Subsection, and booking of actual volume, unit price and total price is made of Materials Ledger or Parts Ledger. Actual unit price is entered on the ledger:

- 1) To make reference data for another purchase of similar goods. The person in charge of stock room adds this actual unit price on Order Request each time.
- 2) As a reference for supplying materials or parts to subcontractors at cost.

Other four sheets of a Reception Slip are sent to Accounting Subsection (financial accounting), and three of these are utilized in place of Suppliers Ledger, Accounts Payable (Ledger a/c) and Purchase (Ledger a/c). Remaining one sheet is sent to Costing Staffs. Costing Staff sorts Slips by contents (as to major materials, by quality, as a whole as to auxiliary materials, and by product lines as to part goods), post respective standard unit prices by standard Unit Price Table and enters purchase amounts in terms of standard prices.

If there is variance between actual price and standard one, inquiry is made with Purchase Section. Since market prices of major materials are fluctuating always, price variance emerges with each purchase naturally. Hence, the inquiry is made merely for the sake of verification of the figure itself, being rarely combined with the actions of cost management.

As to non-standardized goods, actual prices are entered in the column of standard price. As for part goods, standard prices are revised according to changes in contract prices, and so no variance emerges between the revised prices and actual prices.

As for the variance of materials purchase, account table is made for every five days, and aggregate table is compiled monthly to level off booking works. These tables are sent to Purchase Section for reference data.

#### **[Method of Setting Standard Unit Prices of Purchased Materials and Parts]**

Standard unit prices of materials are computed as follows.

Formerly standard unit prices of major materials (steel plate, steel bar, copper plate, copper bar, plastics, celloid, bakelite, aluminum, pyritic copper) and purchased parts were settled by the broad estimation of Costing Staff and some adjustments on these by Purchase Section made on the ground of big makers' official prices or past experiences. At present, however, the determination is entrusted to purchase Section singly, to whom Costing Staff requests the determination.

Contract unit prices of out-order parts are determined according to conditions of sub-contractors (equipment, etc.).

Standard unit prices are not provided for major and auxiliary materials and parts of non-standardized goods. However, when materials or parts of standardized products are used for non-standardized products, standard prices of these goods are applied.

As to auxiliary materials, no standard unit prices are settled. But it is an easy matter to set the standard price of paints that account for about 60 percent of auxiliary materials.

The task of deciding standard unit prices of out-order goods is charged upon Estimation Subsection of Purchase Section presently, in place of Second Production Section who was formerly responsible. But the actual bearer is the staffs of the former Second Technique Section.

This transfer of the task of estimation from technique department to purchase department was made because the selection of sub-contractors would be more properly conducted by Out-Order Subsection of (Purchase Section).

#### **[Revision of Standard Unit Prices of Materials and Parts]**

Standard unit prices are revised for every year as to major materials, and for every six months as to purchased parts and others. Price variances were few in around 1960 because of stabilized market prices. Its total amount was only 1 percent of the actual amount. It rose, however, to about 15 percent as to major materials in November, 1962 due to the unstable economic situations since March of the year, when revisions of unit prices were made.

Standard unit prices of major materials are to be settled for a year, because their prices had been stable when the standard system was introduced. With increasing variations of prices, revisions at every six months are thinkable, but such change of system is not yet decided in view of the existing clerical ability. While revisions as to major materials may be done in 160 man-hours, accompanied revisions of parts and product prices would require substantial hours. Another reason is that the amount of major materials registers only one fifth of that of purchased parts.

#### **[Mid-Term Revision of Standard Prices]**

Even amid a business term, when prices of parts and others have changed appreciably, revised prices are entered on Standard Price Table. According to the above mentioned information from Estimation Subsection of Purchase Section. However, the calculation of price variance and valuation of inventory are made on the base of standard prices at the beginning of term. This is due to a reason that, as stated above, revisions of all related goods need much troubles and, as another more important reason, even if some prices have risen total amount of purchase would be restrained at the level of standard prices, through efforts of responsible men to cut down other prices. Hence, price variances are grasped as the variances between standard prices of term-beginning and actual prices. The responsibility for the total amount of variance is put upon Purchase Section, that is to say, it is deemed

a responsibility of Purchase Section to cut down some prices corresponding to rises in some other prices.

However, if a price variance is large due to price revision amid a term, the part of variance caused by the revision is noted in the report to upper staffs.

#### **[Issue from Stock Room]**

Issue of major materials is conducted by Materials Issue Slip to be issued by Schedule Subsection of Proceed Section. (A Slip contains four sheets.) The Subsection posts on the Slip the quality, raw material, size and number from Standard Process Card, enters designation of date, and sends to stockmen.

They deliver to work spots one or two days before processing. Entry of actual quantity of Issue Slip is made by stockmen. (Standard quantity is the principle, but often total stock is delivered if it is approximate to designated quantity, as to standardized part.) Two sheets of Slip are transmitted to Costing Staff, where one makes the credit slip (of materials a/c) sorted by qualities, and the other the debit slip (of in-process parts a/c) sorted by product lines. Also by the Slip, Costing Staff counts actual issue quantity, standard quantity and its variance (spending variance of materials).

Issue of conversion parts (self-processed parts after subcontractor's processing) is made for the quantity entered on the Slip by Schedule Subsection.

Issue of finished parts for assembly is made for standard number, a week before its operation, into the stock place of work spots. (All parts are always carried into stock room when they are finished or received.)

Additional issue of materials is made on the request of Rank Head or Group Head by the Slip. The note of "additional issue" is incerted on the Slip, to be checked by Schedule Subsection. This Slip is also sent to Costing Staff.

Additional issue of parts is made by Parts-in-Short Issue Slip, on the request of spot workers to Schedule Subsection.

Auxiliary materials are delivered by Issue Slip of Auxiliary Materials to be issue by Group Head, for each one unit of can, case or barrel. Costing Staff's management on the spending of these goods is performed indirectly by the restraint of purchase section, and directly by the over-counter control by stock at the time of issue.

#### **[Setting of Standard Volume of Materials Spending]**

Standard volumes (usually weight) to be entered on Materials Issue Slip are determined as follows.

##### **(A) For conversion of part:**

(1) Designing of the product or parts is performed by Product Design Subsection (Technique Section, Development Department), and the drawings are sent to Process Improvement Subsection.

(2) The Subsection prepares "Process Standard Card" by the drawings. On the card are entered necessary process and labor hours for the part as well as required quality and sizes of materials (usually JIS standard materials) and the number of cutting. This card is transmitted to Schedule Subsection

and Costing Staff. When the method of process or others have been amended later, informaton is made to Costing Staff by Process Revision Notice.

(3) Costing Staff makes measurements of the weight of a unit of materials and the number of products obtainable from a unit, and by dividing the former by the latter, calculates the theoretical weight of the product.

Formerly some allowances (say, for spoiled work) were taken account for the standard weight, to be determined by Second Technique Section (now Process Improvement Subsection). But presently the theoretical weight makes the standard weight as it is, as the principle. This is because such allowances tend to derive subjective and easy determination of the standard figures, and also because the spending coefficients of materials must approach to the theoretical figures as near as possible. Some allowances, however, are admitted to those works that inevitably bring about some degree of mis-products, e.g., auto-lathe process.

As to non-standardized products, the above procedure is taken for each designing. A different point compared with standardized goods is that the required weighting is made merely as an estimation.

(B) The necessary number of parts for a unit or products is posted on Parts Issue Slip from Parts List by products (designing, for each product, the design number, section number, outline of drawing, name, number, materials, surface treatment, heating treatment and the division of self-making and out-order) issued by Process Control Subsection. Thus, on the slip the necessary number for a unit product as well as the total number is entered. A sheet of this form is sent to Costing Staff where sorting and summing by product sorts are made.

#### [Additive Words]

This paper is a summary of hearings through Questions and Answers at the occasions of my visits to the company, counting more than ten times in 1960 to 1963. I am much grateful to the Company and especially to the Head of Costing Staff for kindly supports, and the permission to publicate this report. And, this survey is a link of chain of the Research on Plan Costing, a research project of the Institute Of Management and Labor Studies of Keio University. (July, 1963)