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Costs as an aid to management

John M. Scanlon

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As Operated in Plants Supervised by the S. K. F. Industries, Inc.

JOHN M. SCANLON,
Comptroller,
The Hess Bright Mfg. Co.,
Philadelphia, Pa.

BUSH TERMINAL BUILDING
130 WEST 42ND STREET, NEW YORK CITY

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OCTOBER 1, 1921

COSTS AS AN AID TO MANAGEMENT

A cost system, in order to secure the best results, should, among other things, enable the manufacturing executive to know the departments or operations which require attention and thus enable him to reduce costs. A system that points out to the management wherein the actual performances differ from set standards, enables the management to concentrate on these differences and institute measures that are necessary to correct them.

This article explains how standards are prepared and how comparisons of actual costs against standards are made. It also brings out how cost records are converted into efficiency data and gives a method of gauging production. It explains also the use made of reports covering departmental expense, efficiency and inventories.

Before discussing the cost keeping methods that are used in the plants under consideration, a brief description of the manufacture of ball bearings may be of interest. Ball bearings consist of inner and outer rings made of alloy steel, hardened and ground on all surfaces. Each ring contains a groove in which highly polished steel balls roll. The chief dimensions of these bearings are held to an accuracy of from .0004 to .0006 of an inch, depending upon the size of the bearing. The balls are held to a limit of .0001 of an inch on the diameter and are fitted to the same limit in the grooves.

The principal operations in the manufacture of ball bearings are forging, turning, stamping, hardening, grinding, polishing, and assembling. Upon the completion of every operation the product is inspected. The workmanship is held to the highest standard. The work to be done in the shop is laid out in advance in the planning department, and the progress of the work is shown on the planning board, the records on which tie up as to quantity, size, and part number with those of the cost department.

Cost Methods

The general principles followed in finding costs in the plants under consideration do not differ materially from those quite generally followed. Shop orders are issued which cover the required quantity of each part and size, and deliveries are made from these

orders to finished parts stock. From this stock they are withdrawn as required on assembly orders which cover each lot of a given size. When these orders are completed deliveries are made to finished stock. Work in process is charged in the usual way with material, labor, and burden, and in turn is credited with deliveries to finished stock. All cost accounts interlock with the control accounts in the general books.

A system of tabulation by machines is used for the collection and distribution of cost data, tabulating tickets being used as job cards, material requisitions, material credits, etc. Since the operation of this system is familiar to many it is unnecessary to go into detailed explanations concerning it.

It has been found of great advantage to keep a continuous record of the progress of each order by operations. This is done on cards filed by order numbers. To these cards only quantities are posted. While this work is done by clerks under the control of the cost department, their office is in a place where they can be in close touch with the actual work going on in the shop. This continuous record provides a check on quantities from operation to operation, and makes it possible to locate and correct errors quickly. The tabulating machine cards are so designed that they may be punched and sorted by the machines in such a manner that the continuous records mentioned can be secured with the minimum of labor. By checking these shop records monthly with the quantities posted by tabulation to the cost sheets any errors in punching or tabulating are quickly discovered.

The cost of idle time is taken out of costs in proportion to the idle hours, as compared with the possible working hours. The amount subtracted from the costs for this reason, includes the proportion of all items of expense which have no direct relation to production.

When orders have been completed and the current unit cost is ascertained, it is analyzed into material, labor and burden, and is listed on a form which shows comparisons with previous costs. In this manner any fluctuations that occur are brought to the attention of the management. The element or elements which cause these fluctuations are recorded and also presented to the management. Additional information on the form consists of the number of the good units made and the units which must be scrapped, notations being made on the form as to the manufacturing methods used in each instance. This latter information is essential since several possible methods of manufacture might be used in a given case.

Standard Costs

A more interesting phase of the cost system than the collection of costs is the method employed to place before the manage-

ment the story of the efficiency or inefficiency of plant operations which is hidden in the cost figures. The determination of this information can be ascertained only by a thorough analysis of costs by operations, comparing each cost element with a standard cost based upon the best performance that can be attained under the manufacturing methods in use at the time the comparison is made.

The standard costs are arrived at in the following manner. In regard to labor costs the lowest piece rate paid for each operation, which must be performed under the most efficient method of manufacture known at the time the standard is set up, is determined. It might be remarked that the wage system is on a piece rate basis. Wages are figured weekly. Another feature of the wage system is a guaranteed minimum wage.

The percentage of overhead expense to productive labor based on normal overhead expense under conditions of maximum production is also calculated.

Material cost standards are based upon the cost at current prices of the estimated material requirements. In connection with the system being discussed, standards are revised from time to time as more economical methods of manufacture are put into effect, considering also the fluctuations in the market value of raw materials.

Actual and Standard Costs Compared

In order to place facts promptly before those who are responsible for the efficient operation of the factory, the practice is to analyze the cost of all work done in each department monthly, the figures for a given month being completed early in the following month. In order to do this, a report is issued for each department.

The report[1] has the following columnar arrangement:

Departmental Comparison of Actual and Ideal Costs by Operations.

1. Bearing number
2. Part number
3. Quantity operated
4. Operation number
5. Quantity scrapped
   a. Due to operation
   b. Due to defective material
   c. Due to other causes
6. Uncompleted work
   a. Paid for
   b. Not paid for
7. Defective work
8. Quantity good
9. Actual cost
   a. Material
   b. Labor
   c. Burden
10. Ideal cost
    a. Material
    b. Labor
    c. Burden
11. Difference between actual and ideal
    a. Material
    b. Labor
    Burden

[1]The two chief headings of this report are Departmental Comparison of Actual and Ideal Costs by Operations and Departmental Analysis of Differences between Actual and Ideal Costs. The major and minor subdivisions of these columns appear as arranged in the above chart.

12. Cost of scrap
    a. Due to this operation
    b. Due to defective material
    c. Due to other causes
    d. Total

Departmental Analysis of Differences Between Actual and Ideal Costs.

13. Bearing number
14. Designation
15. Part number
16. Operating number
17. Pieces paid for
18. Piece rate
    a. Ideal
    b. Actual
19. Piece rate or hourly earnings
20. Labor differences
    a. Not included in piece rate earnings
        1. Inefficiency
        2. Set up
        3. Helping
        4. Overtime
        5. Miscellaneous
        6. Explanation
    b. Included in piece rate earnings
        1. Scrap paid for
            a. Defective material
            b. Other causes
        2. Inefficient machines
        3. Hourly rate
        4. Uncompleted work paid for
        5. Defective work
        6. Extra operations
        7. Miscellaneous
        8. Explanation
21. Material Differences
    a. Due to excess material used
    b. Scrap loss
22. Analysis of Burden
    a. Due to increases in direct labor.
    b. Due to increases in burden percentage.

The report shows a list of the parts by sizes and operations on which work was done during the month covered. These figures are subdivided to show the quantity put through each operation at each piece rate where two or more rates are paid for a given part and operation. This condition often arises due to the necessity of using equipment which is not the best adapted for the work in hand, or due in some instances to an hourly rate being paid. In order to tabulate this information, an auxiliary tabulating machine card is punched from data on each productive shop card, there being insufficient punching spaces on the latter card for the recording of all the data necessary. By means of this auxiliary card the following information is tabulated on the report referred to in this paragraph for each ball bearing number, piece rate, helping time, setting up time, and miscellaneous charges.

1. Number of pieces paid for.
2. Number of pieces of scrap, classified as to causes of, such as, faulty workmanship, defective material, and faulty preceding operations.
3. Number of pieces incompleted, classified as to paid for and not paid for. This classification covers work which must be done over or repaired before passing through the next regular operation.
4. Number of pieces defective.
   This classification covers pieces not up to standard, but which may be corrected on the next regular succeeding operation.
5. Actual piece rate paid
6. Piece rate earnings or hourly rate earnings according to the basis of compensation.
7. Inefficiency
   This is the term applied to the difference between piece rate earnings and day rate earnings, when the latter is more than the former.
8. Setting up
9. Helping
10. Overtime
    This includes extra pay for overtime only.

The above items include practically all of the classifications ordinarily established but provision is also made for tabulating and recording on the report any miscellaneous productive labor not already covered. From the tabulated data of pieces operated, the number of good pieces and the total number of pieces manufactured are computed and entered in their proper places. The next step is to enter the standard piece rate covering each operation and the standard unit material cost in the case of initial operations. These values are obtained from charts which show standard rates by operations. Actual material cost is also entered on the report. This information is secured from the tabulation of requisitions and credits for the period and a physical inventory of the material on the machines at the beginning and the end of the period priced at current values. The total actual labor cost for each item is now recorded on the report, which is the sum of all of the elements of labor cost. This total includes items six to ten inclusive, listed on page 6. Actual burden is applied on the basis of the current burden percentage for the department concerned. Standard labor and material costs are computed by multiplying the number of good pieces by standard wage rates and standard material costs. In the case of material, incompleted work must be included in computing the standard cost, as these pieces are good as far as the material is concerned. Standard burden is arrived at by applying standard burden percentage to standard labor. The differences between actual and standard costs are analyzed in the following manner.

Analysis of Differences Between Actual and Standard Costs

On the report being discussed differences between standard material costs and the actual costs of material consumed are analyzed so as to show the amounts owing to other operations, defective material and variations in the quantities of material used per unit.

Variations in labor may be classified into two general groups, The first of these includes amounts not represented in the piece rate earnings of the operator who actually does the work. In this group are excess costs due to inefficiency, setting up, helping, overtime, etc. These items have already been determined by tabulation. The second group consists of the differences which are included in the piece rate earnings of the operator who is working directly on the job. They are as follows:

1. Amounts paid for scrap on the operation concerned classified into two classes, those due to preceding operations and those due to defective material.
2. Uncompleted work paid for.
3. Defective work not paid for.
   These three items are figured at standard unit costs. Fluctuations in these items due to other causes are shown under their respective headings.
4. Variations due to inefficient machines.
   This is the difference between the actual wage rate paid and the standard wage rate, times the number of pieces paid for on a given operation.
5. Variations due to hourly rates, this being the difference between the amount paid on a day rate basis and the amount figured on the basis of standard operation hourly rates.
6. Variations due to extra operations which is the total labor cost of such operations.

In the majority of cases the above headings include all of the causes of variation, but should any others occur, they are taken care of by the miscellaneous column and a foot-note explanation.

There is another element of cost which it is desirable to show in connection with a report of this kind, but which does not enter into the analysis of the expenses incurred by the department itself, except in the departments where initial operations are performed, and that is the cost of scrap. It consists of the cost of preceding operations and material used in the production of the scrap pieces. Scrap cost is analyzed separately, the amount being based on the cumulative standard cost up to but not including the operation from which the work was scrapped. The amount is divided in such a way as to show the losses due to operators in the department, due to faulty previous operations, and due to defective material, respectively.

The report for each department is completed by a summary of the total differences between actual and standard costs analyzed by causes, such as, those due to fluctuations in burden percentage, those under the control of the department, those due to faulty operations in other departments, and those due to defective material.

The ratio of actual value over the standard value for the total work done in the department is also shown. This amount which is divided into labor, burden, and material is a very good index of the efficiency of the department for the period covered.

It will be noted that in a report of this kind a department head is not held responsible for variations in costs due to causes beyond his control. This feature is very important since it is always desirable to secure the coöperation of shop executives which can be done only by placing responsibilty where it belongs.

Measuring Production

Standard costs also provide a means of gauging production, the gauge being the standard labor cost of work done. By the use of the latter standard, the total standard production may be calculated easily. It is the amount that would be paid for productive labor under conditions of full operation and perfect efficiency. Furthermore, a record of idle hours and costs, in conjunction with the analysis of the difference between actual and standard costs already discussed, provide a means for analyzing the reasons for production falling below the standard, giving also the relative effect of each cause. In this way a complete picture of the losses caused by scrap, extra operations, etc., is gained. These losses are not confined to direct losses but include those due to lowered production. The latter are not so readily discovered but under certain circumstances they are more important than the direct losses.

Expense and Efficiency Reports

In addition to the reports already referred to, monthly statements are issued to the heads of the operating departments in order to keep them informed as to the expenses of their departments. Among these statements are an expense analysis sheet, on which is analyzed the expenses which make up departmental burden; a machine repair sheet, showing repairs by machines; a departmental efficiency sheet, showing efficiency by individual operators and of each department as a whole, based upon the time saved over the time allowed for work done. On this efficiency report is also entered the attendance of workers, good pieces, and scrap pieces, etc., made by each individual operator from which the relative value of an employe may be readily ascertained.

Inventory of Stores

A perpetual inventory is kept of all items in stores, including shop supplies, raw materials, prepared materials, and finished stock. Stock records for these items show both quantity and value, and the order or account number on which the material was drawn out. The money values shown on these records tie up with the respective control accounts in the general books. A check with physical inventories is continually being made, so that all items are covered at least twice during the year.

Monthly exhibits are issued which show the value of each class of material on hand together with the quantity used and the number of months' supply on hand. By means of this information, inventories may be kept to the lowest amount consistent with the requirements of the shop.

Analysis of Cost of Non-Productive Work

In the case of non-productive work, it is not possible to go into as great detail in making comparisons with standard values. Standards are compiled, however, covering all work that is frequently repeated. Comparison is made between actual and standard costs by operations, indicating wherever possible in these cases, the reasons for variations. It has been found useful to keep a continuous progress record of non-productive jobs which is accomplished by posting labor and material daily from job cards and requisitions to the back of one of the copies of the non-productive shop order, which is provided with a form for that purpose. These entries are checked daily by the head of the department doing the work, and an opportunity is thus given, while the job is still in the initial stages of completion, to correct any errors that may occur or to indicate the reason for any excessive costs. Through these accumulated figures it is frequently possible to detect excessive time on a job due to a degree of finish too refined, accuracy or other cause. If excessive time is not eliminated or reduced, obviously the costs will be unnecessarily high.

Continuous records of non-productive labor and material accumulations have made it possible to compile the cost of this class of work immediately upon its completion. It is thus possible to place cost figures before those who are responsible for ordering the work, as well as those who are responsible for carrying it out, while the circumstances are fresh in their minds. This information together with comparisons made with standards wherever possible is of great value in keeping the cost of this class of work to a minimum.

Unusual Variations

In connection with all of the reports outlined in this article, an examination of any unusual variations is made before the reports are issued. If the variations are substantiated by facts, the reasons are ascertained and brought to the attention of those who are interested and affected by them in order to insure the best possible results. Cost information increases in value and effectiveness in proportion to the degree that it serves to guide the management in the efficient operation of the factory. This purpose is admirably served by acquainting the shop executives and foremen with the methods of cost keeping, thereby showing them that the primary object is not to show up past weaknesses, but to point the way to better productive efficiency.

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