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A Problem in the Distribution of Expense Burden

(A Paper for Accounting Students)

BY H. C. BENTLEY, C.P.A.

(First Article)

The accompanying problem in cost finding is designed to illustrate in a limited and somewhat elementary manner the distribution of manufacturing expenses according to the principles set forth in A. HAMILTON CHURCH'S two works, *Production Factors* and *Proper Distribution of Expense Burden*. The problem is purely suppositional, the figures given not illustrating the results of any one plant's operation. Nor has any effort been made to present figures which are relatively correct. The sole function of the problem is to illustrate the workings of the methods of distributing expense burden in so far as they may be reflected through a set of ledger accounts and thence into the balance sheet, condensed statement of production costs, and profit and loss statement.

The writer does not claim that the titles of the operating accounts are ideal, nor that the general scheme of classification could not be improved. A lesser or greater number of accounts might be employed in working out such a problem as the one presented, and the titles of these accounts might be very different from those given here. Such differences of classification and ledger captions would not affect the principles involved. For the sake of simplicity it is assumed that all of the accounts employed are carried in the general ledger.

It is taken for granted that those interested in this problem are reasonably familiar with the principles of expense distribution as laid down by MR. CHURCH; also with the forms and functions of records commonly used in connection with a manufacturing accounting system where monthly costs are determined.

MR. CHURCH defines a production factor as "any expense that has a *definite* relation to cost of production." Production factors may be divided into three general classes:

(1) Direct labor.

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- (2) Materials, finished parts, etc., which are directly chargeable to specific production orders or processes.
- (3) Expense burden, more commonly termed manufacturing expenses, overhead expenses, or indirect production expenses.

A production center is a machine, workman's bench, open floor space for assembling, vat, etc., used directly in producing or assembling finished products or parts. It does not comprehend machines and spaces which are not used directly in producing, such as power house equipment, machine room equipment, elevators, grindstones, transport equipment, or space used by stores department, receiving department, shipping department, etc.

The first two elements of production cost are comparatively easy to handle in a cost system, because they are capable of being charged directly to the specific production orders or processes into which they enter.

To aid in properly allocating the materials and finished parts which go to make up finished goods, these are requisitioned from stock, and from these requisitions the accounting department determines the quantities of the various kinds of materials and finished parts to be charged to each production order or process. On these stock requisitions is shown the date, quantity and description of each item required, the number of the production order or process for which they are required, the name of the person by whom the requisition is made, etc.

To allocate labor charges properly, the time devoted to each job by the operatives is recorded on time cards or time tickets, a separate daily time card or ticket being made out for each operative. In many cases a new ticket is made out for each production order or process on which the operative is engaged during the day. Under this latter plan, if an operative worked on six different jobs during a day, he would receive and turn in a separate ticket for each one of these jobs, or six time cards or tickets for the day. The tickets or cards give the accounting department the necessary data for labor charges.

From the detailed material requisitions and time records, the accounting department is able to determine the cost of raw materials, finished parts, and direct labor chargeable to each active production order or process. At the close of each month, the total cost of each of these direct elements is debited to manu-

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facturing account, the credits being made to raw materials, finished parts, and pay roll accounts respectively.

The third element, overhead expense, is extremely difficult to handle satisfactorily, because it is an indirect charge. The great problem is to ascertain what part of the cost of power, heat, light, repairs, depreciation, taxes, insurance, superintendence, etc., is chargeable to each production order or process. The enumerated expenses, together with the various other elements of expense which go to make up the expense burden, may be common to all production orders, and to apply these specifically and equitably so as to determine the unit cost of each kind of product manufactured is the difficult part of cost finding. The present problem deals more particularly with this third element of production—the expense burden.

In MR. CHURCH'S two works already referred to, he has dealt almost exclusively with the third element of production, showing the weaknesses and defects of the man-rate, man-hour, and old machine-rate methods of distributing overhead expense and explaining in detail the advantages of what he terms the scientific method of distributing expense burden. Briefly, his method consists in establishing the proper classification of the elements of expense burden, in determining the fixed, and estimating the variable expenses for a year in advance, and in distributing these over the different production centers in order to determine the proportion of the total annual expense burden which is chargeable to each production center, *i. e.*, each machine, bench, open floor space, etc., used in producing and assembling manufactured products.

It might be well to state here that a shop consists of production centers (machines, workmen's benches, assembling spaces, etc., used directly in production) and non-producing departments or spaces (such as receiving department, superintendent's office, office for factory clerks, stores department, shipping department, tool room, etc.).

Establishing a proper classification to cover the various elements of expense burden is work for an accountant, but estimating these various elements, exclusive of those which are fixed and tolerably constant, is *not* work for an accountant, as it requires a knowledge of production technique and also a very complete knowledge of the conditions peculiar to the plant for

which the system is being designed, which the accountant ordinarily does not possess. The accountant may designate the data required and prepare schedules for properly classifying such data, but the estimating should be done by persons who are expert in that work or who are particularly familiar with conditions.

On subsequent pages are shown fourteen schedules which give some idea of the manner in which the various elements of expense burden—some fixed but most of them estimated—are mustered under classified headings. In these schedules both the monthly and yearly charges are shown with respect to each element, the annual charge being determined in advance and the monthly charge being fixed at one-twelfth of the annual charge. Obviously in practice it would be inaccurate to allot to each month just one-twelfth of the annual expense burden, since some months include a less number of working hours than others, as a result either of their being shorter months or of their including a greater number of Saturdays, Sundays or other holidays. The monthly charges of the accompanying schedules are estimated as one-twelfth of the annual charges for the sake of simplicity. It might be preferable in some cases to divide the year into thirteen periods of four weeks each.

In actual practice the schedule should show the annual charges in the first column, with twelve additional columns following—one for each month—in which should be entered the proportion of each element applicable to the month for which that column stands. Then the footing of the first column—column of annual charges—would equal the sum of the footings of the twelve monthly columns—no two of which might exactly agree.

The following method for determining the proportion of each element of expense burden which applies to a given month suffices for all practical purposes. Estimate the total normal working hours for one year, each month of the year to be considered separately in making this estimate. If Saturday is a short day, it will be necessary to take this into calculation. A schedule should be prepared showing the number of working hours for each month. To compute the proportion of each element of annual expense burden applying to a given month, divide the annual amount by the total estimated working hours for the year. This gives the amount of expense burden chargeable to

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each hour, and this multiplied by the estimated working hours for the given month gives the total normal charge for that month. Insert this product under the proper month on a line with the title of the element under consideration. In like manner compute the monthly production of each element for each of the twelve months. The items shown under any given month are used in the monthly journal entries for that month.

It is an excellent idea to keep a record in a loose-leaf ledger or on cards for each production center, showing its annual charge for each element of expense burden, its normal working hours per diem and per annum, and its hourly rate. This record should show the number of actual hours worked during each month, the lost time and the overtime. If found desirable, an hourly rate for overtime of each center may be estimated, and these overtime rates may be used in charging overtime to production centers.

To estimate the overtime rate of a given center, determine the ratio of its annual elements of expense burden which are affected by overtime to its total annual expense burden, and multiply its normal hourly rate by this ratio. When overtime rates are employed, the overtime of each center should be recorded on the cost sheets or cards separate from the normal time and preferably in a different color of ink. The total cost of normal time of centers is debited to manufacturing and credited to estimated manufacturing expenses account. The total cost of overtime of centers is debited to manufacturing and credited to overtime of production centers account. The actual cost of working centers overtime may be debited to overtime of production centers at the same time that the various operating accounts which show increased charges as a result of working overtime are credited. Of course overtime rate would not be employed if it were known in advance that certain or all production centers would be operated overtime during a given month or longer period. In such case the estimated running times would contemplate such overtime.

Attention is called to the order of the fourteen schedules which are brought in later, beginning with land expenses and closing with estimated manufacturing expenses—so called because the majority of items composing the expense burden are not fixed. Land expenses are first assembled and distributed on

a definite logical basis. Then the expenses of the different buildings are assembled and distributed, and so on, each group of expenses being assembled and distributed according to the year in which they, or at least some portion of them, find their way to the final summing up place—estimated manufacturing expenses. The basis of apportioning each element of expense burden is fully discussed in MR. CHURCH'S work *Production Factors*, to which reference is made.

Having determined the fixed, and estimated the variable elements of expense for one year in advance; having scheduled all of them under properly classified headings; and having distributed the annual charge for each element over the twelve months; the next step is to determine the proportion of each element which applies to each production center.

Building expenses (including a proper proportion of land expenses), expense of lighting, and expense of heating are apportioned on the basis of the floor area utilized by each production center. The floor area of each center (shown on diagram, page 40) is determined in the process of computing the total usable floor area of the factory, as the total usable floor area must, of course, represent the aggregate of the areas apportioned to the various producing and non-producing centers or departments.

Taxes and insurance on production centers are based on the relation which the cost of each center bears to the aggregate cost of all centers. Repairs is an estimate in which each center is separately considered. Depreciation is based on a flat rate per annum for each center. Power expense is apportioned on the basis of estimated H. P. consumption of each center which requires power. Oil, waste and grease used are based upon an estimate which considers each center separately.

The remaining elements, representing indirect personal services (superintendence, clerk hire, buying, receiving, stockkeeping, etc.) must be apportioned on whatever may be considered the most equitable basis; *i. e.*, each center must be charged with its share of these elements. To decide each center's share intelligently, practical judgment and a careful consideration of all conditions which have a bearing upon these elements in their relations to the various centers, are necessary.

A separate schedule should be made out for each production

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center, after the manner illustrated by schedule No. 15. If there are several similar machines, benches or open spaces, constituting duplicate centers, it is necessary to compile only one schedule for each group of duplicate centers. Thus, if there were twenty duplicate spinning machines, one schedule would suffice as it would show the hourly rate to be charged for each of the twenty centers. By dividing the proportion of annual expense burden applicable to a given production center by the number of hours it is expected to be operated during the ensuing year (its normal running time per annum), the quotient will represent the cost per hour for operating that particular production center.

The time which each production center is operated on each production order or process is usually determined from the time records of the operatives, and such time is recorded on the proper cost sheets or cards, a separate sheet or card being kept for each production order or process. At the close of a month the time of each production center charged on each cost sheet or card is totaled, and each total is multiplied by the rate per hour referred to in order to determine the proportion of expense burden chargeable to each of the active production orders or processes. These separate products are recorded on the proper cost sheets or cards. The sum of these products should represent the total fixed and estimated elements of expense burden applicable to the month, provided all of the production centers have worked the estimated number of normal working hours allotted to that month.

Of course each of the three elements of production (direct labor, material, and expense burden) may be allocated to the various jobs or subdivisions of a production order when deemed practicable. The term "production order" as used in this problem corresponds to what MR. CHURCH calls "works order." Sub-production orders correspond to what MR. CHURCH terms "jobs."

It will thus be seen that each production center is placed upon an independent basis. It must, if it may be so expressed, pay for itself (depreciation) and also for its proportion of the remaining elements of expense burden, and it will do this if the rate per hour is correctly computed and if it is employed the estimated number of normal working hours. If it works less than the estimated normal running time, its owner is the loser by reason of lost efficiency. It will further be seen that

each production order or process is charged with its proper proportion of productive expense burden on the basis of the number of hours each center works on that particular order or process. If there is idle time of production centers to dispose of, an extra assessment may be levied on each active order or process to cover the loss resulting from this unproductive expense burden. The extra assessment is levied according to the total number of hours which the different centers work on each active order or process during a month, as explained hereafter.

Accounts are kept in the ledger to correspond with the fourteen schedules given hereafter. The monthly debits to these accounts agree with the corresponding monthly columns on the schedules. The credits show that the debits have been distributed to some other account or accounts. The final summing-up account—estimated manufacturing expenses—shows by its monthly debit footing the total fixed and estimated elements of expense burden applicable to the month.

If every production center works its normal number of hours during a month, all the estimated and fixed elements of expense burden will be distributed among the production orders or processes because the total of hours worked by each production center on each production order or process is charged for at an hourly rate which includes a proper proportion of the elements of expense burden. These computations are made at the close of each month. The sum total of all such charges to the active production orders or processes will agree with the monthly charges to estimated manufacturing expenses account, provided every center has been operated at its normal running time. If the aggregate charge to the production orders or processes to cover expense burden is less than the sum of the debits to estimated manufacturing expenses account, then, generally speaking, there is a loss from idle time of production centers to be levied upon the active production orders or processes. Under ordinary conditions the loss occasioned from idle time of production centers would never amount to a very large figure as compared with the total expense burden.

If the undistributed expense burden is to be assessed to the active orders or processes it becomes necessary to distribute the loss from idle centers and also the loss from idle time of operatives on some arbitrary basis, as the man-rate, man-hour, or

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“supplementary rate.” In other words, if certain or all of the production centers have worked less than their estimated normal running time, a portion of the annual expense burden applicable to the month in question will remain undistributed over the production orders or processes. This residue will represent the cost of lost time production centers and may be distributed, as suggested, by the man-rate or the man-hour, or by means of what MR. CHURCH terms the “supplementary rate.”

The cost of lost time of operatives may be distributed in the same manner by dividing the sum of the residue referred to, plus the lost time of operatives, by the total hours worked by all production centers, the quotient being the ratio of loss from idle time to actual running time and showing the amount of this loss which must be charged against each hour's time of actual working. This quotient should be multiplied by the total time of centers charged on each cost sheet or card during the month, regardless of the time of each production center, and the product should be recorded thereon. The aggregate of these products should equal the amount of the undistributed expense burden plus the cost of any lost time of the operatives. It might be desirable to distribute the lost time of centers and lost time of operatives separately. The first distribution, based upon the actual running time of the production centers, provides a means of determining costs on a normal basis, while the second distribution, based upon the “supplementary rate,” provides a means of determining costs under abnormal conditions. Each result is shown separately, thus affording consistent comparisons in costs quite regardless of whether the conditions are normal or abnormal, and yet affording equally valuable comparisons of results based upon the actual conditions existing.

If desired, however, the undistributed expense burden of centers, and the lost time of operatives, may be charged direct to some nominal account such as “Lost Time of Centers and Operatives,” instead of being distributed among the active jobs or processes. This plan is consistent with the idea advanced by those who contend that lost time of centers and operatives is a dead loss, and *not* a proper charge to production costs. MR. CHURCH states: “Under any circumstances, the rate is simply a memorandum of the ratio of waste to production. It is in no sense a cost, since it can afford no information of service

either for estimating or for comparison with past or future jobs of the same kind. It merely represents the accidental circumstances of the shop during the period, and to that extent is a barometer of conditions." It is "the ratio of wasted capacity to utilized capacity."

No mention has yet been made of the difference which may exist between variable elements of expense burden as estimated and as actually incurred. As stated heretofore, all the elements of expense burden, except those that are fixed, are estimated for a year in advance. This is a requirement precedent to the workings of MR. CHURCH'S methods. At first sight this appears theoretical and unscientific. As a matter of fact it is usual and absolutely necessary to estimate many of the elements of expense burden in advance when monthly costs are computed under any costing system. Thus, such elements as depreciation and taxes must be estimated in advance, and so much repairs, unless the monthly repairs as incurred are charged in place of a fixed monthly charge for which a reserve is provided. There are also certain fixed charges which can be determined in advance with accuracy, such as insurance, interest on capital if that element is to be included, etc. Then there are various elements which are tolerably constant, such as the annual salaries of officers, department heads, office help, wages of watchmen, etc. There are also certain elements of expense burden which it is impossible to estimate in advance with absolute accuracy, such as fuel consumption, water rates, lighting, power plant wages, receiving, warehousing and storing wages, oil, waste, and grease used, etc.

As a general proposition, neither the fixed charges nor the tolerably constant charges are affected by lost time or overtime of production centers. Of course, depreciation and repairs are influenced somewhat by overtime on the assumption that production centers depreciate more rapidly and require more repairing if they are worked overtime, but they do not depreciate in the same ratio, provided the rate of depreciation contemplates obsolescence, as well as wear and tear. It is also a question whether the necessity for repairs is increased proportionately by reason of working overtime. Certainly it would not seem desirable to attempt any adjustment of the reserve accounts for depreciation and for repairs and renewals by reason of working production

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centers overtime or undertime, unless it was known in advance that the shop was to be run on short time or extra shifts, in which case the estimated normal running time of centers would contemplate such conditions. The reserve accounts for repairs and renewals may be either closed each year, or carried forward in the expectation that their balances will be equalized during the following year, the particular practice as to this depending upon the policy adopted.

Various operating expense accounts are kept with the fixed elements, tolerably constant elements, and fluctuating elements of expense. Such accounts are credited each month with the estimated or fixed amounts applicable to the month, and at this time estimated manufacturing expenses account is debited. The operating accounts are debited with the actual expenses as incurred. All such accounts, except the depreciation reserve accounts, show by their balances the difference between the estimated expenses and the actual expenses incurred. The question is, Shall such differences be disposed of each month? Or, shall only the balances of those accounts representing variable expenses be thus disposed of? Or, shall all such differences be carried forward until the close of the final year and then be disposed of? If the last course is adopted it will be necessary to determine from such of the accounts as involve one or more of the non-manufacturing departments (selling, shipping, and general administration), the proportion of each of their balances which applies to one or more of the departments mentioned above. Journal entries should then be made transferring these proportions to their proper departments. The adjusted balances of the operating accounts which involve the non-manufacturing departments, together with the balances of the operating accounts which apply exclusively to manufacturing, should be transferred to the adjustment of estimated manufacturing expenses account, the net balance of which will show the difference between the actual expense burden incurred during the year and the estimated expense burden for that year. Of course, the adjustment account is closed into profit and loss, but in the annual report it should be merged into the item of manufacturing expenses.

Actual conditions should largely determine the manner of disposing of the balances of all accounts representing variable elements of expense burden. In case of lost time these accounts

should normally show credit balances, and in case of overtime the reverse condition would hold. In the summer, the fuel consumption and lighting accounts may show credit balances which will be equalized by heavier charges in the winter months, and reversed conditions may apply to water rates, oil, waste and grease used, etc. Such accounts as office supplies used, miscellaneous expense accounts, etc., may fluctuate quite widely as between months and yet such fluctuations may equalize during a year regardless of the effect of overtime or undertime. In view of these conditions it would not seem desirable to adjust the differences between the estimated and the actual elements of expense burden each month, except in the case of a heavy run of overtime, in which case all excess expenses which can be traced to overtime should be distributed as explained hereafter. Or, if desired, an hourly rate for overtime may be estimated for each production center. In such case the normal time is charged for at the normal rate and the overtime at the overtime rate. The credit for the former would be taken into the estimated manufacturing expenses account, while the credit for the latter would be taken into overtime of production centers account, against which should be charged the cost of working overtime as determined from the operating accounts, which must be credited.

If the time worked by production centers during a month exceeds the estimated normal working hours for that month, then the aggregate amount of expense burden charged on the cost sheets or cards would exceed the estimated expense burden applicable to that month, thus leaving a credit balance in the estimated manufacturing expenses account instead of a debit balance as in the case of idle time. Since the fixed hourly rate of each production center contemplates the total annual fixed expenses, including such charges as taxes, insurance, interest, wages of watchman, salaries of persons who are not paid for overtime or who would not necessarily work overtime even though the operatives did, it follows that the amount of expense burden charged to each production order or process is excessive. Overtime will, of course, cause more expense for power, heat, light, oil, waste and repairs, and depreciation to a limited extent, etc. If overtime occurred infrequently, or if the amount of overtime in any one month was not large, it might be desirable to let the credit balance to estimated manufacturing expenses

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account stand, and close it out annually into the adjustment of estimated manufacturing expenses account.

If it is deemed advisable to dispose of the credit balance of estimated manufacturing expenses account, it may be accomplished as follows: Determine from the various operating accounts which show by their balances the differences between the estimated and the actual expenses, the cost of running production centers overtime. Deduct this cost from the credit balance of the estimated manufacturing expenses account and distribute the difference negatively over the active production orders or processes on the "supplementary rate" basis. It will then be necessary to make a journal entry debiting estimated manufacturing expenses account with an amount equal to the credit balance, crediting manufacturing with the balance distributed negatively, and crediting the different operating accounts with the amounts used in determining the total expense of working production centers overtime. This method would not be resorted to if an overtime hourly rate for each center were used in charging overtime to production centers.

It seems hardly wise to consider the various reserve accounts for repairs and depreciation when determining the expense of working production centers overtime, since these accounts are based upon an estimate which is at best more or less of a personal guess, and also because depreciation does not contemplate wear and tear only. The efflux of time frequently plays a large part in determining the actual depreciation of wasting fixed assets.

As a matter of general information, it seems desirable to touch briefly upon two features that have a direct bearing upon the subject under discussion, although they are in no way related to the particular problem submitted.

Where automatic machines are employed, MR. CHURCH advocates the inclusion of the tenders' wages in the hourly rate of such production centers. If a man is employed to tend four automatic screw machines, or three automatic turning lathes, his wages are included in the hourly rate prescribed for each of the centers he tends. If he tends four machines, and is paid at an hourly rate of twenty cents, the hourly rate of each of the four machines would include five cents to cover his wage. This introduces a factor which must be provided for by an additional

operating account under some such heading as "Wages of Automatic Machine Tenders." Like all other accounts kept with variable elements of production, this account should be credited at the end of the month with the estimated cost of wages of operatives employed in tending automatic machines; and at the same time Manufacturing Expenses should be debited. The actual cost of such operatives' wages, as per monthly analysis of pay roll, should be debited to Wages of Automatic Machine Tenders, and credited to Pay Roll.

Where automatic or semi-automatic machines are used, and the operatives who tend them are paid on piece-work basis, it may be found desirable to establish standardized unit rates embracing both burden and wages of tenders in place of the hourly rate. To carry out this method, determine the expense burden applicable to each production center in the same manner as prescribed for the hourly rate method. In a weaving room, for example, all machines of the same make, type and cost would bear the same proportion of expense burden. Now determine by several careful tests, made on different days, under conditions as diverse as the circumstances permit, and giving due consideration to the maximum and minimum skill and speed of the operatives, how many units (*i. e.*, pecks, yards, feet, dozens, thousands, barrels, etc.) should be turned out by a given machine in, say, an hour. As the volume of work accomplished is influenced by the skill, speed and trustworthiness of the operatives, it will not be advisable to adopt as a fair basis the volume of work turned out by the most skilled and dexterous tender, nor will it be fair to determine the measure of reasonable efficiency by the work of the least skilled and dexterous operative. The mean average of the two extremes, however, should be a fair index to the efficiency that may reasonably be expected; or possibly the average of this medium with the highest point of efficiency would afford a proper basis in determining the volume of work which should be turned out by each operative. Having determined the volume of work which should be turned out by a given center in say, an hour, it remains to divide the hourly expense burden of that center, plus the proportion of the tender's wages applicable thereto, by the number of units constituting a normal hourly output. The product will represent the cost per unit for expense burden and direct labor. This unit rate,

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multiplied by the number of units turned out during a month, or in connection with a given production order, will produce the total cost of expense burden and direct labor chargeable to the process or production order, as the case may be.

This method of distributing expense burden and direct labor by means of a standardized unit rate results in determining costs on an ideal basis; and if that ideal is attained in every instance and constantly throughout the year, there will be no undistributed burden to dispose of. But since the result depends so largely on the variable human factor, it follows that each job will be charged with the expense burden and direct labor that should suffice for it if the established standard of efficiency is lived up to, not with the actual expenditure in either respect. And, therefore, the cost of the job so determined will reflect an ideal or predetermined cost, based upon what should be accomplished, rather than the true cost. When this method is used the undistributed burden represents the net difference between the ideal and actual burden—some jobs costing more than they should, and others less.

It is obvious that this method is not as sound from an accounting standpoint as the hourly rate method, since it results in costs as they should be rather than in costs as they are; and also because it is entirely dependent upon the judgment of the person who establishes the measure of efficiency used in determining the unit rate—a matter in which no two persons might exactly agree. If predetermined costs are to be used there is very little use for a cost system, save to exhibit the difference between the predetermined costs and the actual costs. Such differences might point to glaring inefficiency; but the practical man would first question the basis for measuring efficiency; and it might be difficult to check up efficiency standards so that they would agree with those previously established, and also satisfy the management of their correctness.

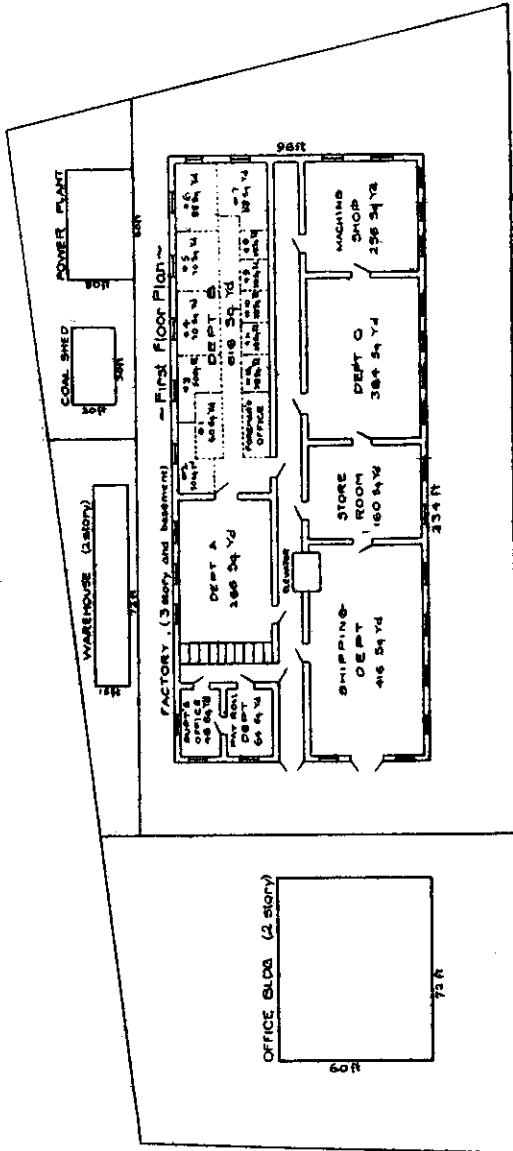


DIAGRAM SHOWING POSITION OF BUILDINGS AND LAND SPACE ALLOTTED TO EACH

In Department B is shown the floor space allotted to each production order
 as space for machines and benches
 as benches for machines
 as benches

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A. H. C. MANUFACTURING COMPANY

TRIAL BALANCE SHOWING THE BALANCES OF THE LEDGER ACCOUNTS ON
APRIL 30, 1913, BEFORE THE MONTHLY ADJUSTING ENTRIES ARE POSTED

Land	\$ 4,200.00	
Buildings	69,000.00	\$ 8,300.00
Reserve for depreciation of buildings		
Production machinery and equipment	48,000.00	12,740.00
Reserve for depreciation of production centers ..		
Power plant machinery and equipment	20,000.00	
Reserve for depreciation of power plant machin- ery and equipment		4,362.00
Main line shafting, hangers, belting, etc.	20,000.00	
Reserve for depreciation of main line		5,000.00
Machine shop machinery and equipment	12,000.00	
Reserve for depreciation of machine shop machin- ery and equipment		2,196.00
Small tools	2,650.00	
New work—machine shop (new machines in course of construction)	718.74	
Office equipment	8,080.00	
Reserve for depreciation of office equipment....		3,462.00
Goodwill	75,000.00	
Income-producing real estate:		
Land	5,000.00	
Workmen's cottages	36,000.00	
Reserve for depreciation of workmen's cottages..		7,200.00
Treasury stock	17,600.00	
Treasury stock donated (500 shares of common)		50,000.00
Cash	13,862.00	
Accounts receivable	184,838.00	
Notes receivable	26,254.00	
Notes receivable discounted		18,415.00
Interest accrued on notes receivable	116.00	
Finished goods	151,000.00	
Manufacturing (goods in process)	77,627.00	
Raw materials	236,000.00	
Fuel	426.00	
Oil, waste, grease, etc.	386.00	
Factory supplies and repair parts	3,762.00	
Interest prepaid on notes discounted	967.00	
Insurance premiums prepaid	357.00	
Office supplies	589.00	
Mortgages payable (5½%)		50,000.00
Accounts payable		42,000.00
Notes payable (discounted at bank)		75,000.00
Interest accrued on mortgages payable		458.33
Taxes accrued		710.28
Pay roll	38,000.00	
Power plant wages	48.00	
Superintendent's and foremen's salaries		88.00
Factory clerk hire	32.00	
Shipping department wages		27.50
Wages of cost accounting staff	116.00	
General office salaries	72.00	
Wages of watchman		
Receiving and warehousing wages	40.00	
Wages of storekeeper and assistants	12.50	
Machine shop wages		82.40

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Reserve for upkeep of grounds		26.80
" " repairs to office building		15.00
" " " " warehouse building		9.00
" " " " power plant building	27.00	
" " " " factory building		15.00
" " " " production centers		816.00
" " " " power plant equipment... ..	98.00	
" " " " main line		31.00
" " " " machine shop equipment.		2.14
" " " " workmen's cottages		73.00
Capital stock		500,000.00
Surplus		178,033.52
Fuel consumption	32.00	
Oil, waste and grease used		28.60
Office supplies used	26.24	
Moving ashes		2.97
Hauling inward	62.25	
Lighting	43.00	
Miscellaneous expenses of superintendence.....		14.22
" " " " pay roll department.	11.44	
" " " " shipping department.	19.50	
" " " " organization		25.00
" " " " machine shop		17.00
Cost of goods sold	276,487.00	
Sales		401,416.00
Selling expenses	15,827.50	
General administration expenses	10,437.00	
Interest on notes payable	985.00	
" " mortgages payable	687.50	
" " notes receivable		153.60
Income from sale of waste		76.40
Maintenance of workmen's cottages	1,107.09	
Income from workmen's cottages.....		960.00
Interest on capital		2,847.00
		\$1,364,603.76
		\$1,364,603.76

Sales for April, \$80,000.

Gross income from workmen's Cottages for April, \$250.

REQUIREMENTS AND QUESTIONS *

Requirements

(a) Set up a skeleton ledger account for each item included in the foregoing trial balance and enter its balance on the proper side. Post all monthly journal entries to the proper skeleton accounts, inserting brief particulars.

(b) Compile a trial balance.

(c) Compile a balance sheet (two-side form—fixed items first).

(d) Compile a profit and loss statement covering the month of April, 1913.

* Forms under requirements and answers to questions will appear in the next number of the JOURNAL.

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(e) Compile a summarized statement of production costs covering the month of April, 1913.

Questions

(f) Describe two methods which could be employed in handling the differences between the actual and the estimated variable expenses as disclosed by such accounts as fuel consumption, oil, waste and grease used, lighting, wages, reserve for repairs, etc.

(g) Would the difference between the debits and credits to estimated manufacturing expenses account show a debit or a credit balance in case the normal number of working hours during that month was considerably exceeded? How may that balance be disposed of?

(h) Should the aggregate number of hours worked by production centers during a month agree with the aggregate number of hours worked by operatives on production orders? Suppose the total time of operatives chargeable to production orders during a month was twice the aggregate hours worked by production centers during that month, what possible cause might produce this result?

(i) If during April the following production centers worked the number of hours given on production order No. 429 what would be the aggregate amount of charges on the cost sheet kept with that production order to cover expense burden exclusive of idle time?

Production Center No. A-3	—worked	3 hours	at .062
Production Center No. A-4	—worked	7 hours	at .1141
Production Center No. A-7	—worked	4 hours	at .0244
Production Center No. B-12	—worked	2 hours	at .2611
Production Center No. B-14	—worked	14 hours	at .0055
Production Center No. C-10	—worked	22 hours	at .082
Production Center No. C-11	—worked	25 hours	at .0012

(j) How does the aggregate of the above charges get into the general ledger?

(k) If, as a result of idle time in April, it became necessary to distribute by means of the "supplementary rate" \$835.47 to cover undistributed expense burden and \$1,719.54 to cover lost time of operatives—a total of \$2,555.01—what part of this total is chargeable to production order No. 429, assuming that the total hours worked by production centers is 96,420?

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(l) If the aggregate time of operatives charged to production orders during April amounts to 151,116 hours, how much should be charged to production order No. 429 to cover its proportion of the debits to estimated manufacturing expenses account if they are distributed on the man-hour basis, assuming the operatives worked the same number of hours as the centers?

(m) If the amount of direct labor charged to production order No. 429 amounts to \$20.00, how much should be charged to cover its share of manufacturing expenses if they are distributed on the man-rate basis?

(n) If the cost of materials charged to production order No. 429 amounts to \$12.00, how much should be charged to cover its share of manufacturing expenses if they are distributed on the basis of material and direct labor cost?

(o) What should the balance of manufacturing account represent after all monthly entries are posted?

Is it a controlling account? If so what is its underlying record and how is that underlying record reconciled with its controlling account?

(p) State briefly how the following costing data may be determined.

- Hours worked by each production center.
- Hours worked by each operative.
- Cost of additions to power plant building.
- Cost of repairs to production centers.
- Lost time.
- Cost of direct labor chargeable to the different production orders and standing shop orders.
- Cost of raw materials used.
- Fuel consumption.
- Cost of goods finished.
- Cost of goods sold.

(q) Prepare a diagram showing each operating account, for what it is debited, and into what account or accounts the aggregate of such debits is distributed.

SCHEDULES OF FIXED AND ESTIMATED MANUFACTURING EXPENSES

SCHEDULE I

	Annual	Monthly
LAND (TOTAL AREA 7854 sq. yds.):		
Taxes (estimated)	\$ 75.00	\$ 6.25
Upkeep of grounds (estimated)	125.00	10.42

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Interest on cost—\$4,200 at 5%	210.00	17.50
Total (\$0.0522 per sq. yd. per year, or .00435 per month)	\$ 410.00	\$ 34.17
DISTRIBUTION OF ABOVE EXPENSES:		
Office building—2,182 sq. yds.	\$ 113.90	\$ 9.49
Warehouse building—376½ sq. yds.	19.65	1.64
Power plant building—505½ sq. yds.	26.40	2.20
Factory building—4,790 sq. yds.	250.05	20.84
Total as above	\$ 410.00	\$ 34.17

SCHEDULE 2

	Annual	Monthly
OFFICE BUILDING:		
Land (2,182 sq. yds. at .0522)	\$ 113.90	\$ 9.49
Taxes (estimated)	240.00	20.00
Insurance	30.00	2.50
Repairs (estimated)	60.00	5.00
Depreciation (2% on cost—\$15,000)	300.00	25.00
Interest on cost—\$15,000 at 5%	750.00	62.50
Total	\$ 1,493.90	\$ 124.49
DISTRIBUTION OF ABOVE EXPENSES:		
Buying (1/10)	\$ 149.41	\$ 12.45
Cost accounting (3/10)	448.20	37.35
Selling (2/10)	298.68	24.89
General administrative (4/10)	597.61	49.80
Total as above	\$ 1,493.90	\$ 124.49

SCHEDULE 3

	Annual	Monthly
WAREHOUSE:		
Land (376½ sq. yds. at .0522)	\$ 19.65	\$ 1.64
Taxes (estimated)	97.00	8.09
Insurance	12.00	1.00
Repairs and upkeep (estimated)	36.00	3.00
Depreciation (2% on cost—\$6,000)	120.00	10.00
Interest on cost—\$6,000 at 5%	300.00	25.00
Total (chargeable to buying, receiving, warehousing, etc.)	\$ 584.65	\$ 48.73

SCHEDULE 4

	Annual	Monthly
POWER PLANT:		
Land (505½ sq. yds. at .0522)	\$ 26.40	\$ 2.20
Taxes (estimated)	114.00	9.50
Insurance	14.50	1.21
Repairs and upkeep (estimated)	72.00	6.00
Depreciation (3% on cost—\$8,000)	240.00	20.00
Interest on cost—\$8,000 at 5%	400.00	33.33
Total (chargeable to power cost)	\$ 866.90	\$ 72.24

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SCHEDULE 5

	Annual	Monthly
FACTORY (2,210 sq. yds.):		
Land (4,790 sq. yds. at .0522)	\$ 250.05	\$ 20.84
Taxes (estimated)	816.00	68.00
Insurance	80.00	6.67
Repairs and upkeep (estimated)	100.00	8.33
Depreciation (2½% on cost—\$40,000)	1,000.00	83.33
Interest on cost—\$40,000 at 5%	2,000.00	166.67
Total (\$1.92 per sq. yd. per year, or 16c per month)	\$ 4,246.05	\$ 353.84
DISTRIBUTION OF ABOVE EXPENSES:		
Superintendence	48 sq. yds. \$ 92.16	\$ 7.68
Pay roll department	64 sq. yds. 122.88	10.24
Shipping department	416 sq. yds. 798.72	66.56
Buying, receiving and storing..	160 sq. yds. 307.20	25.60
Machine shop	256 sq. yds. 491.52	40.96
Maintenance of centers	1,266 sq. yds. 2,433.57	202.80
Total as above	\$ 4,246.05	\$ 353.84

SCHEDULE 6

	Annual	Monthly
POWER COST INCLUDING HEAT:		
Space (power plant)	\$ 866.90	\$ 72.24
Wages of engineer, firemen and helpers.....	4,800.00	400.00
Fuel consumption	1,440.00	120.00
Lighting	60.00	5.00
Oil, waste, grease, etc., used	778.00	64.83
Moving ashes	30.00	2.50
Repairs and upkeep on equipment	600.00	50.00
Insurance on equipment, boiler inspection, and accident insurance	26.00	2.17
Taxes on equipment	167.00	13.92
Depreciation of equipment	1,000.00	83.33
Repairs to main line shafting, hangers and belting..	200.00	16.67
Depreciation of main line	600.00	50.00
Interest on power plant equipment	1,000.00	83.33
Interest on main line	1,000.00	83.33
Total (to be allocated as shown hereunder).....	\$12,567.90	\$ 1,047.32
DISTRIBUTION OF ABOVE EXPENSES:		
Estimated cost of heating	\$ 1,200.00	\$ 100.00
Power—machine shop	480.00	40.00
Balance, being cost of productive power to be divided by aggregate H. P. consumption of production centers, expressed in hours in order to determine power cost per hour....	10,887.90	907.32
Total as above	\$12,567.90	\$ 1,047.32

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SCHEDULE 7

	Annual	Monthly
SUPERINTENDENCE:		
Space (factory—48 sq. yds. at \$1.92)	\$ 92.16	\$ 7.68
Heat (superintendent's office)	36.00	3.00
Salary of superintendent	6,000.00	500.00
Foremen's salaries (exclusive of machine shop foreman)	15,000.00	1,250.00
Clerical help (superintendent's office)	2,200.00	183.33
Light (superintendent's office)	14.00	1.17
Office supplies (superintendent's office)	100.00	8.33
Depreciation of office equipment (sup't's office)....	72.00	6.00
Interest on office equipment	110.00	9.17
Miscellaneous	100.00	8.33
Total (chargeable to mfg. expenses)	<u>\$23,724.16</u>	<u>\$ 1,977.01</u>

SCHEDULE 8

	Annual	Monthly
PAY ROLL DEPARTMENT:		
Space (factory—64 sq. yds. at \$1.92)	\$ 122.88	\$ 10.24
Heat	48.00	4.00
Clerk hire	2,300.00	191.67
Office supplies	250.00	20.83
Light	12.00	1.00
Depreciation of office equipment	48.00	4.00
Interest on office equipment	110.00	9.17
Miscellaneous	100.00	8.33
Total (chargeable to organization)	<u>\$ 2,990.88</u>	<u>\$ 249.24</u>

SCHEDULE 9

	Annual	Monthly
SHIPPING DEPARTMENT:		
Space (factory—416 sq. yds. at \$1.92)	\$ 798.72	\$ 66.56
Heat	120.00	10.00
Wages of shipping clerk and assistants	3,400.00	283.33
Supplies other than packing supplies	200.00	16.67
Light	36.00	3.00
Insurance on finished stock	12.00	1.00
Taxes on finished stock	48.00	4.00
Miscellaneous	100.00	8.33
Total (chargeable to selling expenses)	<u>\$ 4,714.72</u>	<u>\$ 392.89</u>

SCHEDULE 10

	Annual	Monthly
ORGANIZATION (clerical and administrative expenses applicable to factory):		
Space (office building)	\$ 448.20	\$ 37.35
Pay roll department expenses	2,990.85	249.24
Watchman's wages	720.00	60.00
Cost accounting staff salaries	8,300.00	691.67
Office supplies (general office)	350.00	29.17
Heating (general office)	120.00	10.00
Light (general office)	72.00	6.00
Depreciation of office equipment	110.00	9.17

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Interest on office equipment	108.00	9.00
Proportion of officers' salaries	5,400.00	450.00
Miscellaneous	100.00	8.33

Total (chargeable to mfg. expenses).....	\$18,719.05	\$ 1,559.93
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SCHEDULE 11

	Annual	Monthly
BUYING, RECEIVING, WAREHOUSING AND STORING:		
Space (office building)	\$ 149.40	\$ 12.45
Space (storeroom in factory—160 sq. yds.)	307.20	25.60
Space (warehouse building)	584.65	48.73
Buying department salaries	6,000.00	500.00
Light (general office, warehouse and storeroom) ..	60.00	5.00
Taxes on raw materials and goods in process.....	86.00	7.17
Heating (general office and storeroom)	120.00	10.00
Insurance on raw materials and goods in process..	16.00	1.33
Wages—receiving and warehousing department....	1,400.00	116.67
Wages of storekeeper and assistant	1,500.00	125.00
Office supplies (general office and storeroom)	200.00	16.67
Depreciation of office equipment	110.00	9.17
Interest on office equipment	110.00	9.17
Hauling inward	1,200.00	100.00
Total (chargeable to mfg. expenses).....	\$11,843.25	\$ 986.96

SCHEDULE 12

	Annual	Monthly
MACHINE SHOP:		
Space (factory—256 sq. yds. at \$1.92)	\$ 491.52	\$ 40.96
Machine shop pay roll	9,500.00	791.67
Power	480.00	40.00
Heat	96.00	8.00
Light	78.00	6.50
Oil, waste, grease, etc., used	360.00	30.00
Insurance on equipment	8.00	.67
Taxes on equipment	166.00	13.83
Interest on equipment	600.00	50.00
Repairs to equipment	200.04	16.67
Depreciation of equipment	600.00	50.00
Miscellaneous	100.00	8.33
Total	\$12,679.56	\$ 1,056.63

DISTRIBUTION OF ABOVE EXPENSES:

Estimated proportion of above expenses applicable to new work	\$ 6,000.00	\$ 500.00
Balance chargeable against reserve for repairs to production factors	6,679.56	556.63
Total as above	\$12,679.56	\$ 1,056.63

SCHEDULE 13

	Annual	Monthly
MAINTENANCE OF PRODUCTION CENTERS:		
Space (factory building)	\$ 2,433.57	\$ 202.80
Taxes	552.00	46.00

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Insurance	180.00	15.00
Repairs	9,000.00	750.00
Depreciation	3,000.00	250.00
Interest on cost—\$48,000 at 5%	2,400.00	200.00
Total (chargeable to mfg. expenses)	\$17,565.57	\$ 1,463.80

SCHEDULE 14

	Annual	Monthly
MANUFACTURING EXPENSES:		
Maintenance of production centers	\$17,565.57	\$ 1,463.80
Power	10,887.90	907.32
Oil, waste, grease, etc.	1,200.00	100.00
Heat	408.00	34.00
Light	240.00	20.00
Superintendence	23,724.16	1,977.01
Buying, receiving, warehousing and storing	11,843.25	986.96
Organization	18,719.05	1,559.93
Total (see note below)	\$84,587.93	\$ 7,049.02

PREPARATION OF SCHEDULES

A separate schedule of expenses must be compiled for each production center (including all machines, benches, vats, mixing space, assembling space, etc., used directly in producing, assembling, and packing finished parts and finished products). If there are several machines of the same type a schedule of one of these machines serves for all of them since the rate per hour would be identical. Hence, if there are one hundred different production centers it might not be necessary to compile more than thirty schedules, assuming that there are several machines each of several types, or several benches of the same size, in a given department. Each department should be designated by a letter or number. Each machine, bench, etc., should be numbered, each number being preceded by the department letter or number. After all schedules of expenses of production centers are compiled, the aggregate total should agree exactly with the above total (\$84,587.93). If each annual total be divided by the normal number or working hours per annum, the quotient will represent the manufacturing expenses per hour of each production center.

The following schedule illustrates the method to be employed in compiling schedules for all the production centers. In this specimen schedule it is assumed that the normal number of working hours per annum is 2,700. If it is known that a given production center is worked only part of the regular time, then

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it is obvious that the estimated number of normal working hours per annum of that production center must be used as a divisor in determining the operating cost per hour. A production center might be operated quite infrequently, so that its normal running time would not exceed, say, 300 hours per annum. Obviously its hourly rate would be extremely high as compared with another machine whose normal running time was estimated at 2,700 hours. It is important to bear in mind that the hourly rate of each center must be computed on the estimated running time of that center, regardless of whether it is estimated at 300 or 3,000 hours per annum.

SCHEDULE 15

	Annual
PRODUCTION CENTER B-12:	
Space	\$ 23.04
Taxes	4.80
Insurance	1.50
Repairs	68.00
Depreciation	30.00
Interest	30.00
Power	60.00
Oil, waste, grease, etc.	12.00
Heat	4.00
Light	3.60
Superintendence	216.00
Buying, receiving, warehousing, etc.	72.00
Organization	180.00
	\$704.94
Total (\$.2611 per hour)	\$704.94