THESIS

A SUITABLE METHOD OF OVERHEAD DISTRIBUTION AT THE CONVERSE RUBBER SHOE COMPANY

Submitted by:
GEORGE R. WHITE COURSE XV

1920
Boston, Massachusetts.
June 2, 1920.

Professor A. L. Merrill,
Secretary of the Faculty,
Massachusetts Institute of Technology,
Cambridge, Massachusetts.

Dear Sir:

In accordance with the requirements for graduation, I herewith submit a thesis entitled "A Suitable Method of Overhead Distribution at the Converse Rubber Shoe Company". Competition is keen in the rubber industry, and it is important that costs be accurately obtained. Material and labor costs are relatively simple, but the overhead at the Converse Company is complicated, due to the variety of articles manufactured, to the variation of wages paid, and to the process of manufacture. The Company therefore desired to have an outsider investigate their plant and its system, to ascertain whether or not the present method is adequate; and if the method now used is found inadequate, to suggest the best system for their particular factory.
I desire to express my appreciation to Mr. Bommer and to Mr. Dillon, in the Cost Department of the Converse Company; and also to the foremen in all departments, for the valuable assistance and information given to me in carrying on this investigation.

Yours very truly,

George R. White
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OBJECT OF INVESTIGATION

The investigation treated herewith was made to determine "A Suitable Method of Overhead Distribution at the Converse Rubber Shoe Company", Edgeworth, Massachusetts. This concern employs 1600 workers, representing an investment of $1,100,000, and devoted to the fabrication of various grades, types, and styles of rubber goods. The articles manufactured consist of gum shoes, tennis shoes, artics, gaiters, lumberman's, boots, tires, and tubes.

Mr. S. W. Bommer, Cost Accountant at the Converse Rubber Shoe Company, requested that an investigation and examination be made of the plant and especially of their system of overhead distribution, with the idea of formulating and applying to the plant that system of overhead distribution best adapted to the Converse Company. Mr. Bommer considers the present method of distribution inadequate, being inaccurate in establishing unit costs in all departments. The accurate determining of these costs is absolutely essential, this necessity being emphasized by the keen competition prevalent in the rubber industry. While material and labor costs are more easily determined, the distribution of overhead is most complicated, due to the range of grades
and costs of the many articles produced.

In the following treatment of the problem, it has been the aim to evolve a simple practicable plan, and to sacrifice simplicity only in dealing with those departments where simple treatment is inaccurate. Keeping in mind the practicability of actual application by the Converse Company, improvements and adjustments to the present system are suggested rather than the installation of an entirely new method. The plan of improvement is hereby submitted, but no attempt has been made to obtain actual working rates and detailed statistics for the plant.
METHOD OF PROCEDURE

In order to secure an intelligent background for the analysis and development of the system best adapted to the Converse plant, a preliminary study was made of overhead distribution in general. The principal methods were investigated and compared, with special consideration for their relative merits, their application, and the conditions under which each should be applied.

These methods were found to be as follows:

1. Prime Cost Method
2. Productive Labor Cost Method
3. Productive Labor Hours Method
4. Machine Rate Method

After securing an intelligent background on the principles of overhead distribution, the writer, visited the plant consulting Mr. Bommer, and determined just what the subject was and its scope. Mr. Dillon, associated with Mr. Bommer, accompanied the investigator through the factory, giving him a general knowledge of the plant, departmental divisions, and operations.

An examination was then made of the plan of overhead distribution as carried out by the company in order to determine how the overhead items are at present distributed to departments, and then to the product.
After securing an insight into the present method of overhead distribution of the plant, tabulating the overhead items and obtaining the necessary data from the appraisal report as given by the Manufacturers' Appraisal Company, herewith appended, the new investigation was begun. This appraisal report gives the departments, their area, and building and equipment valuation. Each item of overhead was then studied separately, and recommendations made as to the best method of its distribution to both productive and non-productive departments. After this, the non-productive departmental expense was distributed to the productive departments. On the completion of this distribution, examination was made of each productive department to ascertain the kind of work done, hand or machine, number of employees, variation in wages paid, and whether the rates are on a straight time or piece basis.

Recommendations were then made for each department as to the best method of charging the product with the overhead expense.
Preliminary Information

The general investigation on overhead distribution showed that there are four standard methods, namely,

1. Prime Cost Method
2. Productive Labor Cost Method
3. Productive Labor Hours Method
4. Machine Rate Method

An explanation of each method follows:

1. Prime Cost Method:

The prime cost method is based on the principle that expense is incurred in proportion to the productive labor and material cost of the product. The burden charges are added as a percentage on total labor and material cost rather than on labor alone. This is the simplest method to take care of overhead, but not a good one, since overhead almost never has any direct relation to the value of the material used. Reduced to formula it could be shown as follows:

\[
\frac{\text{Overhead Costs}}{\text{Material Cost plus Labor Cost}} = \text{Percentage of the total material and labor costs to be charged to the article to cover overhead expenses.}
\]
For example, if, during a definite period, the amount expended for all direct material is $20,000, for direct labor $30,000, and for overhead expenses for same period $25,000, the actual determination is:

\[
\text{Overhead Cost} \div \text{Material Cost plus Labor Cost} = 50\%
\]

If material for an article is $10, its direct labor cost $5, and overhead rate 50% of the prime cost, the total production cost would be:

- Material Cost \(\$10.00\)
- Labor Cost \(\$5.00\)
- Overhead Cost (50% of $15) \(\$7.50\)
- Total Cost \(\$22.50\)

2. Productive-Labor-Cost Method

The productive-labor-cost-method is based upon the principle that indirect expenses are incurred in proportion to the cost of the labor involved. By this method, the overhead items are analyzed to determine the amount which belongs to each department, and the departmental overhead is expressed as a percentage of the direct labor cost in each department. It is very useful to pro-rate unassigned items of factory overhead to the operating departments of the plant when the data upon which to make a thorough analysis for distribution cannot be
readily obtained. Any errors which might result from this distribution would be slight in most instances, as they would be absorbed in the cost of the entire production of all departments.

This productive labor cost method seldom can be used for any plant as a whole, but can be used and will give accurate results in those departments for which it is adaptable.

As an example of its application, assume departmental direct labor for a definite period to be $16,000, overhead items for same period to be $14,000.

\[
\begin{align*}
\text{Overhead} & \quad \text{Productive Labor Cost} \\
14,000 & \quad 16,000
\end{align*}
\]

\[
\begin{align*}
\text{Overhead \%} = \frac{87\frac{1}{2}\% \text{ of } 1.60}{1.60} & = 1.40 \\
\text{Total Cost} & = 3.60
\end{align*}
\]

This method is convenient and simple. If the departments in which it is used carry men on the pay roll at a nearly uniform wage rate, and they all work under the same conditions, using substantially the same equipment, the application of the overhead method will be
quite accurate. Precautions must be taken not to use this method where high priced men work on cheap machines, or perform skilled work at benches or tables, and also where low priced men operate expensive equipment such as automatic machines.

3. Productive-Labor-Hours-Method

The principle of the productive-labor-hours-method differs from that just described only in that the amount of labor is measured by time and not by cost. The total burden of the plant, usually analyzed by departments, is divided by the number of direct labor hours in each, determining a rate per man-hour.

Reduced to a formula the principle is as follows:

\[
\frac{\text{Total Amount of Overhead}}{\text{Total number of Productive Labor Hours}} = \text{Rate per hour to be applied to the number of hours of work upon the product.}
\]

Using this formula, and assuming the number of working hours of direct labor to be 56,000, and the expense $14,000, the result would be:

\[
\frac{\$14,000 \text{ Factory Expense}}{56,000 \text{ Hours}} = 25 \text{ cents per hour to be charged to product for each productive hour of work spent on it.}
\]
The total cost of a single article discussed under this method would then be:

Direct Material Cost $ .60

Direct Labor Cost (5 hrs. @ 32 cents hr.) 1.60

Overhead Cost (5 hrs. @ 25 cents per hr.) 1.25

Total Cost $3.45

This method eliminates the objectionable features in the previous method which arise because men in the same department are paid different rates of wages, and burden applied according to the productive labor hours method fluctuates with the number of hours, regardless of the variation of the operators' wages. However, it takes no account of the variations in equipment which may be placed at the disposal of different workmen, and in that respect it fails for the plant as a whole. Where the operators, however, in departments, work under uniform conditions, it is very satisfactory.

4. Machine Hour Rate Method

The machine hour rate method contemplates the analysis of all the factors making up the manufacturing burden, in order that the proper overhead may be known for each department, and pro-rated to production centers within each department. This total burden so determined
divided by the standard number of operating hours a year, gives the machine-hour rate, which is used to charge burden to the cost of the orders in proportion to the length of time which each order uses the production centers. Reduced to formula this method is shown as follows:

$$\frac{\text{Total Production Center Burden}}{\text{Total number of Standard Operating Hours}} = \text{Machine rate to be charged to article for every hour of machine operation.}$$

The term "production center" as used here is defined as a manufacturing unit, or a group of units, performing similar operations and incurring substantially the same expenses per hour.

Under this method, assuming that an article passes through several machine processes, its overhead cost is arrived at by multiplying the hours of each process and adding together the separate totals thus obtained. Material and direct labor must then be added to the process cost to give the final factory cost.

This method can be used when all operations are performed by machines, but it cannot be applied to general bench work and miscellaneous forms of hand labor.

Under this system, the overhead not absorbed by the machines, due to their being idle, is known as "unearned burden". (Application to Converse Company see page 42)
The Present Plan of Overhead Distribution

The following is an analysis of the present method, covering:

(a) the actual overhead items, with the percentage of each to the total
(b) the distribution of this expense to the departments
(c) the distribution of productive departmental expense to the product

(a) The items of overhead for the fiscal year ending March 31, 1920, are:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Per Cent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interest</td>
<td>$72,000</td>
<td>15.8</td>
</tr>
<tr>
<td>2. Taxes</td>
<td>26,400</td>
<td>5.8</td>
</tr>
<tr>
<td>3. Insurance</td>
<td>16,800</td>
<td>3.7</td>
</tr>
<tr>
<td>4. Freight Inward</td>
<td>29,850</td>
<td>6.5</td>
</tr>
<tr>
<td>5. Power &amp; Heat</td>
<td>28,866</td>
<td>6.4</td>
</tr>
<tr>
<td>6. Light</td>
<td>2,785</td>
<td>.6</td>
</tr>
<tr>
<td>7. Labor-non-productive</td>
<td>198,562</td>
<td>43.4</td>
</tr>
<tr>
<td>8. Supplies</td>
<td>81,390</td>
<td>17.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$456,653</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

(b) The factory is divided into the productive and non-productive departments shown in the appended appraisal report. Each is charged with its material; labor; direct supplies; and its share of the over-
head expenses, interest, taxes, power and heat, light, machine shop, and printing.

The non-productive departmental expense is recapitulated to general manufacturing expense; that is, the total expense of each of these departments is posted to the general manufacturing expense account.

The distribution of the general manufacturing expense to the productive departments is made in the following manner:

For its share of the general manufacturing expense the charge to each productive department is determined by multiplying the total amount of this expense by the percentage of the productive labor cost in that department to the total productive labor cost of the entire plant. There is some error in the charge to each department made by this method, but since the articles manufactured pass through every department, each is charged with its share of this general manufacturing expense, eliminating any discrepancy in the unit cost of the article.
(c) After each department has been charged with its share of overhead, this expense is absorbed in the product by productive labor cost method. This is done as shown on page 6.
The following new plan of distribution has been formulated. It is treated in two parts: first, the distribution of overhead to the departments; and second, the distribution of departmental expense to the product.

In the first distribution, each item is considered separately, examined, and recommendations are made for its distribution to each department. No change is made in the present division of the plant into major departments.

1. **Interest** for the year ending March 31, 1920, amounted to $72,000 or 15.8% of the total. This covers interest on buildings and equipment. The interest on the buildings should be apportioned to departments according to the floor space utilized. The interest on equipment should be apportioned according to the value of the equipment.
2. Taxes for the year ending March 31, 1920, amounted to $26,400 or 5.8% of the total. This item is for building and equipment. This also should be distributed to departments according to floor space occupied and the value of equipment used.

3. Insurance for the year ending March 31, 1920, amounted to $16,800 or 3.7% of the total, a small item, but one which can be accurately applied. This insurance covers the building and equipment as well as employers' liability. The expense for building and equipment should be distributed on floor space occupied and value of equipment utilized, while that for employees' liability should be distributed on the number of workers in each department. The last suggestion is made because of the length of service determines the insurance paid to each. There is no relation between the insurance paid and the wages earned.
4. Freight inward for the year ending March 31, 1920, amounted to $29,850 or 6.5% of the total. This item, when analyzed, should be charged directly to raw materials and to new equipment as it comes to the factory. At the present time this expense is divided into equipment and material expense. The former is charged directly with its freight whether it stands in the storeroom or is placed in a department. The charge for raw material, however, is not so handled, but is considered a general manufacturing expense item. This is due to the fact that the invoice from the railroad might not be delivered to the factory for two months after the material has been used. As freight rates do not vary, and they are based on weight, every pound of raw material of each quality should be charged its freight expense at once. This should be done by ascertaining the average rate per hundred pounds for a year, and by charging raw material proportionately.
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Any amount which might be left over should be treated as a general manufacturing expense.

5. Power and heat for the year ending March 31, 1920, amounted to $28,866 or 6.4% of the total. The power is the larger expense of this item, and should be charged to departments by the power consumed in each, as is done under the present method. Most of the power is electric, bought from outside sources; Watt-hour meters should be installed on machines to determine the exact power consumed by each. Steam is generated for power in a power house at the plant. It is used in vulcanizers, curers for treating and curing rubber, and for heating purposes. The amount consumed by each should be investigated, and upon this information in the case of the vulcanizers and curers the various departments should be charged accordingly. Heat should be distributed on the volumes of air space in the various departments, or upon the number of square feet of radiation of the heating pipes.
Either method is very satisfactory, and as the latter is already in use, no immediate change is recommended.

6. Light for the year ending March 31, 1920, amounted to $2,785 or .6% of the total for the year, and is, of course, a very small item. Its distribution should be based upon the number of lights and the rated power in each department.

7. Non-Productive Labor for the year ending March 31, 1920, amounted to $198,562 or 43.4% of the total overhead. It includes all labor which is not charged directly to the productive departments. For this company, for the sake of simplicity, it should be analyzed as at present, and charged to the productive and non-productive departments in which it is incurred. The most accurate method would involve an analysis of each item making up the total. The labor analysis as carried at present is not adequate.

For example, a thorough study should be made of the superintendent's time.
Actual records or estimates, if absolute accuracy is not essential would show what portion of his time is spent with the various departments, and each department could then be charged with its share of the expense. Any time unaccounted for would be handled as a general manufacturing expense item.

8. Supplies for the year ending March 31, 1920, amounted to $81,390 or 17.8% of the total. This item includes all supplies for productive and non-productive departments. It should be analyzed in order to charge each department with the amount consumed.

The handling of the total expense in each non-productive department should be as it is at the present time; that is, these items should be recapitulated to the general manufacturing expense and pro-rated to the productive departments according to the productive labor cost in each.
Having determined the best method to charge each productive department with its proper share of the overhead, it now remains to determine the best method of charging the departmental overhead to the product. By examination, of each productive department, the following analyses were made. Based on these analyses, recommendations are made as to the best method of distributing the departmental burden to the product. That one of the four standard methods outlined on page 3 best adapted to each department will be applied.

The productive departments are:

- Grinding
- Cutting
- Light Making
- Heavy Making
- Sales Room
- Quarter & Cement
- Stitching
- Press Room (Heel)
- Varnish & Cure
- Day Packing
- Night Packing
- Cement Making
- Varnish Making
- * Varnish Storage
- * Machine Making
- * Tire Administration
- * Tire Expense
- Tire Preparation
- Tire Building & Making
- Tire Curing
- Tire Insp. & Finishing
- Tube Making & Curing
- Tube Packing & Store
- Selling Office
- Shipping
- Tire Selling & Shipping

* Not considered in thesis
The work done is assembling gum shoes, arctics, gaiters, and tennis shoes. All this work is done on a piece basis, and by hand labor. The ticket office regulates the amount of work done each day, and specifies the articles on which work is to be done. While there is no operation carried on for any prolonged period, each man's schedule calls for one article, such as tennis shoes, for two or three days, and then is changed to arctics or gaiters. In no day does a man change from making one article to another.

The equipment in the Light Making Department consists of tables and benches, of very small value. Women and men are both employed in this department, and the amount of work done and the wages earned are very uniform. There are instances where an employee might complete his day's ticket, and work on the ticket of an absentee. In that case the wage will vary, but these cases are infrequent. For this department, the best way to get the departmental overhead to the product is by the productive labor cost method. See page 6.
2. Heavy Making

In this department, the work is similar to that done in the Light Making Department, except that the work is heavier, and with exception of six women, all the work is done by men. The work done consists of assembling heavy arctics and gaiters, large sizes of tennis, all trimmed, lumberman's and boots, with an average of 5,000 pairs per day. There are one hundred and thirty one employees, of which number six women earn $24 per week, five teams of three men to a team earn up to $38. The remainder, however, earn nearly a uniform wage of $32. While there is a slight variation in the wages paid in this department, the number which is nearly uniform outnumbers those which vary by nearly six to one.

There is practically no machinery required for this work, all the work being done on a piece work basis and by hand.

It is therefore recommended that the percentage of productive labor cost method be used to distribute the overhead.
3. Sole Making

In the Sole Making Department, soles and buckles are assembled. There are eleven employees doing this work, all on a piece basis with the wage varying very little. The average wage is $24 although there is some variation due to employees working absentees' tickets.

The equipment used is tables and benches, and of very little expense.

Under these conditions, the best method is the percentage of productive labor cost method.
4. Quarter and Cement

In this department, all the tennis stock is cemented, all the work is done by hand, most of it on the piece basis. There are one hundred and sixteen employees, of which number during five months of the year, five earn $25 per week, for the balance of the year these earn $20, the same amount earned by all the remainder, with the exception of eighteen on day work, who earn $14 per week.

Then, too, in this department the women are not allowed to work any more than their ticket calls for, and while there are only five men employees, the variation is very little.

Under these conditions, the percentage of the productive labor cost method is accurate and should be used.
5. Heel Room

In this department, stock is brought from the grinding room, cut into heel blanks, trimmed by hand, put in molds, cured, trimmed by hand again, and buffed. There are four men on three heel presses, who earn $28.50 per week. On the presses there is 80 lb steam for curing and 1600 lb on a 10" Ram of Platon Hydraulic presses for pressing heels. There are also employed one trimer at $17.50, and two boys at $12.50.

For this layout of work it would be most accurate to figure out a machine-hour rate for the presses, but as it is such a small department, with such a small expense, simplicity seemed to be preferable to establishing this rate. The error will be very small on the total cost of each article, so it is recommended that the productive labor cost method be used in the Heel Room.

This department is going to be moved into new quarters in the building to be occupied by the Tire Department. It will be enlarged, and in all probability new presses will be installed. When this is done the department should be examined again. It is believed that the machine rate should then be used.
6. Cutting Department

In this department, all of the parts for the various articles are cut into their proper sizes and shapes. The sections into which it is divided are fabric cutting, outsole cutting, cutting uppers, cutting coverings.

The fabric cutting is done mostly by ten heavy clickers, one operator to each machine. In this section, there are eight men who cut the same material by hand. The wages earned are, on machines:

- 3 @ $50
- 2 @ 40
- 5 @ 32

on hand cutting:

- 1 @ $50
- 1 @ 40
- 6 @ 30

In the outsole section, there are three clickers and ten hand cutters. The wages earned are:

- 3 @ $35 for the machines
- 10 hand cutters $40
In cutting uppers, all of the work is done by hand, by fourteen cutters. These men earn $38 per week with very little variation.

In the cutting covering section, fifteen men cut by hand, four at $50, three at $30, eight from $35 to $40. Eight girls prepare the work for the cutters. These girls work on piece rate basis and earn $16 per week.

There are ten machines in this department, also a bias cutter for which the operator is paid $15 per week. This is a valuable machine, and a small clicker is also used to cut leather.

It is recommended that the heavy clickers constitute one group, the light clickers another, and the bias cutter a third. A machine rate for each group should be established. The overhead for each group should be proportionate to the floor space occupied.

The hand labor should be considered as a group. Wage variation is considerable, but the work is uniform and very little equipment is used.

Consequently, for this section the productive labor hours method is recommended. See page 8.
7. Varnish and Cure

In the Varnish and Cure Department, all of the shoes, arctics, gaiters, and boots, are cured, varnished, and powdered. There are seven heaters in which the dry curing is done, and which is taken care of by one man, who is paid $25 per week. There are, also, two steam cure heaters, which are taken care of by one man at $28 per week. The varnishing is done by six men, two men to two automatic varnishers, and two men on brushes doing the same work by hand. All of these men are paid a weekly wage of $29. One man is employed in this department powdering these articles at $24 a week.

The hand labor in this department is small as the work is done largely by the heaters and the automatic varnishers. Consequently, some method of overhead distribution which has nothing to do with labor should be used.

Since all of the articles manufactured go through this department, it is important to charge each one with the proper amount of overhead expense.

It is recommended that a charge for the heaters, grouped in two section, the dry heaters, and the steam heaters, be worked out, as well as a charge for the automatic varnishers.

It appears to the investigator that simpli-
city should be discarded for accuracy. At the present time, overhead is distributed as a percentage of the power expense, but it does not seem that this is accurate enough.

It is, therefore, recommended that a machine rate be used. See page 9.
8. Varnish and Cement

These departments are located outside of the factory itself in two sheds. All the varnish and cement are mixed in these sheds, in vats and heaters. There are three employees. These men earn the same wages practically, and work straight time.

Since the work, wages and equipment are uniform, the productive labor cost method is recommended for this department.
9. Day Packing

In this department, all the articles are trimmed and packed for shipment. There is little equipment, which consists of wooden racks, boxes, and tables. There are fifty two employees, thirty men and twenty-two girls. The men all work straight time, forty eight hours per week, six earning $25, and twenty four $22. Of the girls, eleven are day workers who earn $12, six are piece workers at $18.50, and five do piece work at $15. Those on piece rates vary only slightly in wages.

There is quite a variation in wages in this department, and as all of the work is done by hand, the problem comes down to the percentage of productive labor cost or the percentage of productive labor hours. The piece workers all finish within fifteen minutes to a half hour of an eight hour day. Under these conditions, the percentage of productive labor hours method is recommended.
10. Night Packing

This department occupies the same section as the Day Packing. The work is all done by hand, and on a straight time basis. It consists of bringing all the articles that have been varnished, cured, and dusted in the Varnish and Cure Department during the day to the Packing Department, arranging them on shelves for the day packers, and doing the trimming that might be necessary. There are seventy six employees in the department, earning nearly $25 per week, with very little variation.

Under these conditions, the present method of the percentage of productive labor cost is suitable, and is recommended for use.
The Grinding Department is the starting point of operations in the rubber industry. The raw materials come to the factory in bales of raw rubber of different grades in quality and value. This rubber is fed to the grinders by men after it is treated with the chemical formula used in the plant. It is ground and mixed similar to a batch of bread dough, and is then rolled into sheets, ready for the cutting department.

The grinders are run by electricity, and are arranged on shafts, whereby four to six are run by each shaft. The machines take different loads from the line, due to the grades of rubber and the operations which the particular machine is doing.

There are a hundred and eight employees in this department, and all work straight time, twenty of whom earn $26 per week, twenty two $32 per week, thirty five $24.50, fifteen $27.50, and twelve $22. This is quite a variation in wages, and the productive labor cost method now used is not suitable for this department. The machine hour rate should be used.
The method suggested is: divide the department into productive centers, the grinders on a shaft as a unit; the machines separately operated but performing the same work in another.

First, the hour rate for each group should be determined; next, that for each machine. The latter is done by apportioning the hour rate for the group to each machine on the relative values of the machines in the group.

The machines not so grouped, that is, machines which do individual operations should be given an individual rate, determined as the others, the percentage of their value to the total value of the machines in that department.
12. Stitching

In the Stitching Department, all the stitching is on tennis and gaiter stock. It is done by one hundred and forty employees. Of this number, one hundred are on electrically driven sewing machines, fifteen of whom are learning, and are on straight time, the balance being on piece work, with wages varying from $22 per week to $28 per week, varying from week to week. There are forty doing trimming, matching bands, and general helpers who earn $12 to $13 per week. There are fourteen rows of machines, each two of which are driven by an electric motor.

For this department, it is recommended that the hand laborers be grouped in one section, and the machines in another section. The total Stitching Departmental overhead should be apportioned to each section on the floor area occupied.

For the labor section, the percentage of the productive labor cost method should be used.

For the machine section, a machine rate for each machine should be used.
13. Tire Making

The Tire Making Department is now divided into sections, the stock preparation room, the making of beads, the making of flaps, the assembling of the tire, the inspection and finishing, and the repair.

The first three sections are grouped together in a production center, and the other three are considered separately. In the first production center, stock is prepared for the making of the tire.

In the Stock Preparation Room, there are two bias cutters, which cut the fabric into biased shapes in which form they are built into the tire. For these machines, machine rates should be set, the percentage of the total department to be figured on the area occupied. After determining the proper overhead to be applied for these three sections, with that charged to the bias cutters deducted, it is charged to the product by productive labor cost method.
In the section assigned for the making of the tire itself, the overhead for the section is based on the percentage of floor area occupied.

At present, thirty tires are being produced a day. When production becomes normal, the number will be increased to 200.

The work will be done by thirty hand builders, and one automatic builder. The hand builders will be on a piece work basis, but their wages will be uniform. The automatic builder is an expensive machine, and does not require the services of an expert operator. It is, therefore, recommended that the section be subdivided into one for the hand builders, and another for the automatic builder. The overhead should then be determined on floor space occupied.

For the hand labor section the percentage of the productive labor cost method is recommended, and for the automatic builder a machine rate.
In the section for Inspection and Finishing, its share of the Tire Making overhead is ascertained by the floor space occupied. Tires are inspected and finished. Finishing consists in removing the rough places on the tread by putting it on a finisher, and then on a painter. These two machines are operated by three men, are of equal value, and occupy the same floor space, so machine rate should be used, this rate to be the same for each machine.

In the repair section, there will be three employees, who will touch up all tires before they are shipped. They will be straight time men and their wages will be uniform. It is recommended to use the productive labor cost method in this section.
14. Tire Cure

The tires come from the tire making department to be cured. This is done in two large vulcanizers. The tires are placed on hooks attached to overhead trolleys, and are pushed by hand to tables where the iron core is removed and air bag substituted.

The core is again hung on a hook attached to the overhead trolley system and is returned by hand pushing to the making department. The tire is then hung on hooks on another trolley and pushed to the table of rollers, leading to the vulcanizers.

There are forty iron molds on these tables into which the tires are put. All these molds are pushed along the rollers, are pressed under a hydraulic press, and then are passed to the vulcanizers. At the present time, the tires are kept in the vulcanizers for three hours, when they are removed and another batch put in.

The department is running day and night. There will be approximately ten men on the day shift and ten on the night shift. These men will work straight time until piece rates can be accurately set.

It is recommended that the vulcanizers absorb all of the overhead for this department as they perform the actual results in the department. A machine rate should be used.
15. Tube Making

The rubber comes from the Grinding Departments in rolled sheets. It is rolled on rods, wrapped in cloth, powdered, and cured in a steam vulcanizer. This work is done mostly by hand, with the exception of the wrapping of the cloth on the tube and the wrapping of the cloth after it has been removed from the tube. This department has not started operations on a large scale as yet, but within a few weeks two hundred tubes a day will be turned out. The wages have not been set but Mr. Skinner, the planning man for this department, stated that the work will be done on a piece work basis, with a very little variation in wages.

On the floor above the tube making department is a storehouse for tubes. This departmental labor, and overhead, should be charged directly to this department.

For distribution of the overhead, it is recommended that the vulcanizer be considered as a production center, and a machine hour rate be applied, the overhead being the floor space occupied. For the balance of the department the productive labor cost is recommended.
General Expense

This item comprises all the expenses that cannot be charged, after analysis, directly to Productive or Non-Productive Departments. This does not include unearned burden which arises from idle equipment using the machine rate for overhead distribution. This last item is not part of the manufacturing expense, and should not be treated as such. Neither does it include any item chargeable to Administration and Selling Departments.

General expense is recommended to be distributed to productive departments by the percentage of labor cost methods, that is, the percentage obtained by dividing the productive labor cost in each department by the total productive labor, is multiplied into the total general expense, and the amount obtained is added to the overhead charged directly to that department.
The burden not absorbed by the machines due to their being idle, is known as unearned burden. It is not a charge to be added to the cost of the article, but it must be taken account of in the selling price. These items are separated so that the efficiency inside the plant can be shown, and the efficiency of the business outside the plant is shown. The reason for delays will then be examined, and will be eliminated wherever possible. This unearned burden must be subtracted from gross profits to give the net on the articles.

It is the belief of the investigator that this unearned burden not absorbed in a month should not be carried over to the next month for absorption. It should be handled as a loss, and in no case as a cost to be charged to the production cost of any article.
Nicholson and Rohrbach.............."Cost Accounting"
Clinton H. Scovell ..............."Cost Accounting and Burden Application"
Clinton E. Woods ..............."Unified Accounting Methods for Industrials"
Sterling H. Bunnel ............."Cost keeping for Manufacturing Plants"
A. Hamilton Church ..........."The Proper Distribution of Expense Burden"

For concreteness and examples, reference is made to Nicholson and Rohrbach; for theory and simplicity, to Scovell; and for a chart to show the entire distribution of overhead, to departments, reference is made to Woods.
**REPORT AS ISSUED BY THE MANUFACTURERS’ APPRAISAL COMPANY**

Valuation of Building Occupied and Equipment Used by Each Department

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<th>DEPT.</th>
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<th>PER CENT</th>
<th>BUILDING VALUE</th>
<th>EQUIPMENT VALUE</th>
<th>TOTAL</th>
<th>AREA</th>
<th>PER CENT</th>
<th>BUILDING VALUE</th>
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**TOTAL** | **3,500.00** | **3,500.00** | **7,000.00** | **7,000.00** | **14,500.00** | **14,500.00** | **14,500.00**
### Productive

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* Not considered in thesis.