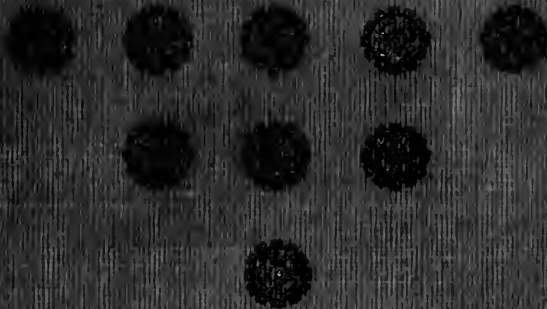


# Organizing a Factory



CE Woods





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# ORGANIZING A FACTORY

AN ANALYSIS OF THE ELEMENTS IN FACTORY ORGANIZATION, A PRESENTATION OF THE FUNDAMENTAL PRINCIPLES OF FACTORY MANAGEMENT, AND A DESCRIPTION OF THE METHODS TO BE USED IN EVERY DEPARTMENT OF FACTORY OPERATION

BY  
C. E. WOODS, E. E., M. E.

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THE SYSTEM COMPANY  
CHICAGO—NEW YORK  
1905

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## PUBLISHER'S PREFACE

American business men hold that the only way to learn to do things is to do them. This opinion has had much truth and fact to justify it, but it has been undergoing a marked transformation in the past decade. For men are coming to realize that, although no one can learn to do a thing by merely being told how it is done, such precious knowledge greatly facilitates his learning how to do it when once he gets into practical work. It affords him a strong foundation, barren and useless in itself, but a firm basis upon which to build the structure of business experience. Book learning, abstract knowledge, is like a fertilizer: it does not, of itself, produce anything, but it stimulates growth and advance when the live seed, practical experience, is instilled in the soil of work.

There is another feature in modern commercial life which has stimulated the output of business literature. Association for the accomplishment of common purposes is having an always greater impetus, and it has been accompanied by another kind of co-operation—the give and take of business ideas and knowledge.

In other words, business men are realizing that no one man can know all; that every man can make a profitable exchange by giving his knowledge and ex-

perience for that of others. For while he gives the knowledge of one man, and that without taking anything away from himself, he receives in return the ideas and information of many. The business principle, "that exchange is the best which gives both parties the largest possible profit," has been found as successful in the exchange of knowledge as of commodities.

These two tendencies in modern commercial life have led to the projection of the "Business Man's Library," of which this book is the second volume. The foregoing analysis of these tendencies also serve to point out the purpose of the whole series and of this second book. It is to tell the "how" of things: the technique of commercial operations, the specific processes and actual methods necessary for the accomplishment of certain work. And this all is told, these processes are described and these methods discussed, by business men actually engaged in this line of work—men who have performed these acts, who have originated and used these methods, who know because they do. This series of books is intended, therefore, to teach the beginner the fundamentals and detailed methods of practical business operations, and to give him who has been long in the harness new ideas for application in his own business.

The subject taken up by the second book of the "Business Man's Library" is factory organization. Before the factory or works can run to advantage, before



any manufacturing business, great or small, can be placed upon a correct basis, the fundamental principles of factory organization must have been applied. These fundamental principles have never before been brought together in comprehensive form so as to constitute a basis for a complete study of factory methods. In this work may be found both basic principles and time-tried, specific methods for all departments of the factory, however complex.

A short sketch of the working history of the author of "Organizing a Factory" will be of interest, as showing particularly that the right man was selected for this work. Mr. Wood's technical engineering education was secured at the Boston Institute of Technology. After graduation he took up at once the practical side of plant operation, entering the service of the Westinghouse Company. Later he was connected with the Pope Manufacturing Company, the Pennsylvania Reaper Company, and at present fills an important position with the International Harvester Company. With these important industrial organizations his work has never been of routine, but always of a constructive character, to originate and plan, to develop and contrast—often a difficult task when some guide exists—but, far more difficult when the trail has not even been blazed. Always a student of industrial organization, by education and experience he was enabled to secure the broad view, the thorough training, and the adequate grasp so necessary to the factory expert.

The engineering experience necessary to produce a work of the character of "Organizing a Factory" is so rarely found, and so valuable when secured, that any step in the dissemination of this knowledge is an important event in the history of industrial organization and engineering. Knowing that the factory manager of the present day realizes the value of the information along this line, and always keeping in mind the accuracy demanded in its preparation, it is hoped that this book will not fail to be of exact service to those for whom this volume is designed.

THE PUBLISHER.

## PREFACE

In revising and rearranging the series of articles written for "System" so that they might be published in book form, the writer has endeavored to enlarge them sufficiently to make the work complete, and to establish such a continuity and relation between them as to lead the reader on in sequence, step by step, in such a way as not only to enable but cause him to gather a comprehensive understanding of the questions involved.

The publication is not intended as a panacea for all industrial ills, but rather as an educational factor that will benefit alike both employer and employe, and possibly enable them to apply means to their own individual ends that will be of mutual and material benefit.

The work in no instance is hypothetical, but rather is the result of practical applications made by the writer in his every day work for the larger industrials, and is published now in book form with the hope that it will serve the purpose for which it was intended, by leading to a better administration and accounting thereof, on the part of all who may come into its possession.

C. E. WOODS.



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## CHAPTER I

### THE NECESSITY OF SYSTEM AND NEW METHODS

Nowhere in the world of business at the present moment are conditions and methods changing more rapidly than in the work shop and factory itself. The application of new methods of processing, the invention of new tools, and the use of new combinations of cutting steels, are some of the things that in themselves are revolutionizing not only factory practice, but the character and skill of the labor employed; which results in a tendency toward a vast increase in output per capita. These things are in turn all forcing new methods and ways into industrial administration.

Factories today are being run less and less by the authority of experience only, and more and more by the authority of figures and facts. The superintendent and manager of long experience and intuitive knowledge only is forced to make room for the younger man, of less experience, perhaps, but who modernizes his work by the jurisdiction of figures alone.

And the modern accountant in all this combination is no longer simply the recorder of generalities, but a scientific organizer who purposes his work as much for organization and administration as he does for accounting. Ordinary book accounting as of old no longer fills the need, for book accounts do not show maximum possibilities; they only apply to what actually may have been done; they are simply a record of

facts without means of comparison. No accurate methods of determining costs even could be obtained by the old methods of keeping accounts.

Three things must always be obtainable in a modern accounting system: what has been done, what is being done, and what could be done, both as to volume of output and costs for manufacturing same. The necessity of this has brought about new systems and methods of accounting amounting to almost mathematical surgery.

The factory, considered as a thing by itself, is a living, breathing, moving being, which has an anatomy, peculiar to itself of course, but which can, nevertheless, be analyzed in its every function. And it is right here that old and new methods differ in accounting. The modern and scientific accountant no longer takes an already existing condition in factory practice and applies a method of rendering accounts for it; he first *insists* as far as possible on a proper departmental organization and relation, both as regards the movement of a product through the factory from raw material to finished stores or units, and as regards authority from the management down to the last man who is to be possessed of authority. Having accomplished this, he then takes the body industrial and classifies it into members and organs, and applies an accounting system that forces each and every one of these members and organs to function properly and render a correct accounting of itself.

It is by such methods, and by such methods alone, that the managerial mind is enabled to grasp and interpret the whole body, and not some portions of it to the exclusion of others, which has invariably been the fault of old methods of administration. For, almost



without exception, the tendency of every manager in the past has been in either one of two directions, sometimes both—"along the lines of least resistance," or in such directions as particular tastes or past experience would nearly always, sometimes unconsciously, lead him.

New methods analyze the anatomy of a business so closely that not the smallest detail or sub-detail of an item escapes its pro rata amount of attention. Old methods, for instance, paid little if any attention to the details of single operations on a part, or even to the individual part considered as a whole in the construction of a unit of production; neither did they take cognizance of the progress of work through the shop: but the modern manager or accountant considers every movement of material and every operation performed on that material as carefully as a bank looks after its cash balances.

It is true, as has often been pointed out, that all factories are not alike in detail, but it is also true, as has *not* always been pointed out, that the principles in the construction of an accounting system as used by one manufacturing institution should apply to another; the detail may vary, but not the principles.

What is needed is to provide a system whereby the management can view the body industrial under his charge as a whole without being prejudiced in any one direction, either by personal preference or solicitation from those under him; a system, the principles of which will be so flexible that administration becomes what it should be—almost automatic in its day to day action, in which no contraction or expansion of the business can take place without at once affecting all correspond-

ing relations. This is not to say that any one man would or should have sole charge of every detail connected with and required in the business. It does mean, however, that every department can be brought into such relation with all other departments that **Manager and Departments** the administration itself, or the acting manager, is practically the head of every department in the business and acts as such in the absence of the head appointed by him, and that the absence of any one or several heads to a business could not in any wise cripple its general efficiency as a whole.

To what can be attributed all this change in managerial and accounting necessities? It had its origin simultaneously with the consolidation of kindred interests into what are commonly termed "Trusts." The inefficiency and inaccuracy of old methods of accounting became immediately apparent when outside expert accountants commenced to review individual industrials for the purpose of placing valuations upon them to furnish a figure which would guide a syndicate in its purchase of same. Fictitious valuations and profits became so numerous that accountants were forced to devise new ways of analysis, and this in itself developed possibilities of accounting that hitherto had not been thought of. And the creation of industrial trusts, or mergers, in its turn, has also created a new demand in the qualifications required of managers and superintendents. The old superintendent or manager finds himself no longer the sole authority in his particular vocation; his requisitions and desires will only be granted when backed by proof of figures.

In other words, an entirely different condition of régime is gradually spreading itself over the industrial world, bringing with it demand for talent that is scien-

tific in its methods. Unfortunately, this is obtainable only in a very limited degree, at the present time.

**The Trust Régime**                      Managerial and executive work has never yet reached the dignity of a science or even of a profession; the artisan in industry is far better equipped in this respect, for he is molded by an educational process into a scientific worker at some particular trade and becomes a master at his art when he can set into activity causes that will produce predetermined effects—for this constitutes science in anything.

Compare this with commercial man's education today, which consists mainly of an accumulation of individual experience and judgment rather than a scientific understanding of the broad principles of organization, manufacture and commerce: it points clearly to the reasons as to why desirable business talent is not obtainable. Our educational systems have not anticipated the rapidly changing conditions in the industrial world to anything like the extent that that world itself has. Ultimately a commercial education will receive the same dignity in its various branches as does an engineering or legal profession, and business management and executive work will be equally as exacting in its execution.

**Dearth of Scientific Managers**                      The concentration of large interests has already recognized the need of all this, but at the present time scientific administration falls far below what the new régime requires, for the real scientific industrial and commercial system is as yet incomplete. The whole industrial world is still dealing with effects rather than causes. This applies not only to the handling of labor but in a large measure to commerce, which has been only too often

instanced by premature and unnatural growth, not only in individual corporations but in consolidated trusts as well.

Every effort at the present moment is being made by the so called trusts to modernize their business at all points, and to this end their agents everywhere are on the lookout for talent that can help them reach the desired end, better salaries and better futures are the incentives offered, and from this one fact individual corporations have as much to fear as from the direct competition of the market. For the tendency of trusts is not so much to reduce market prices in competition as it is to reduce costs of production and marketing by securing and holding the necessary talent, thus leaving individual competition incompetently officered for the conflict.

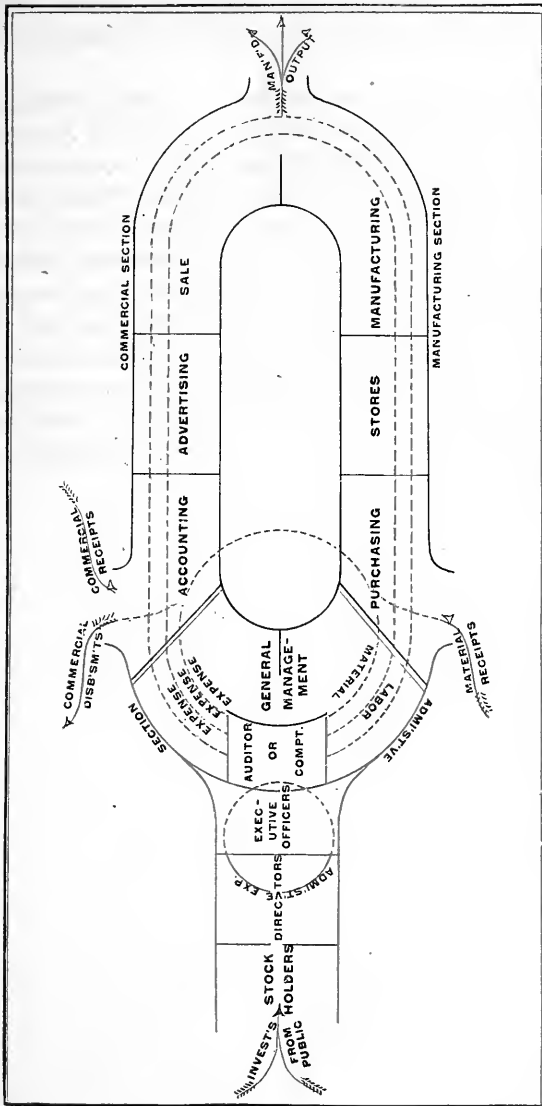
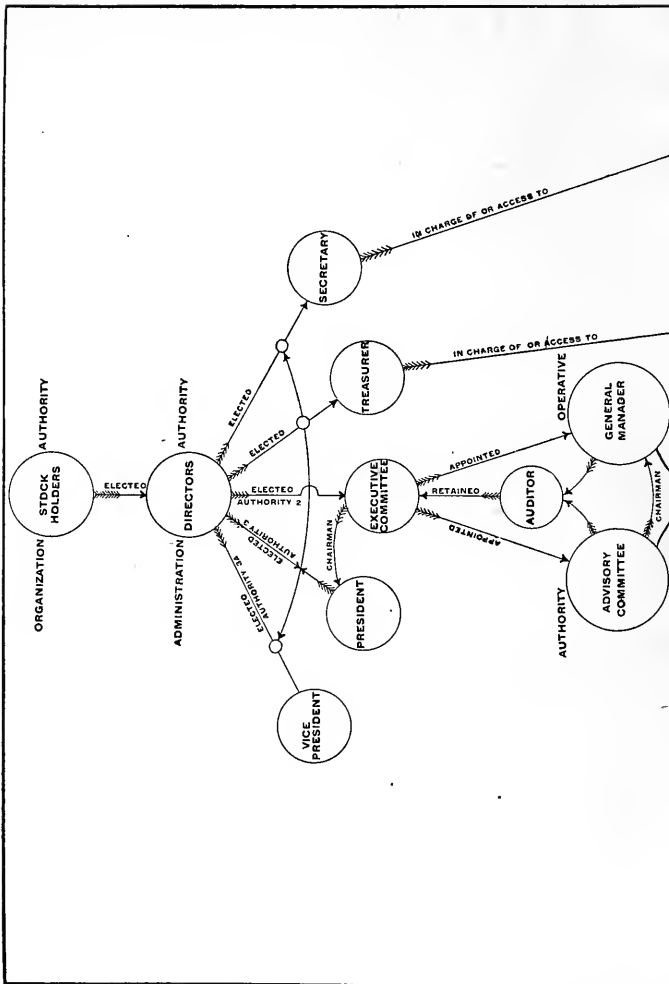


FIGURE I. The Prime Organization Element of an Industrial Body

ORGANIZING A FACTORY



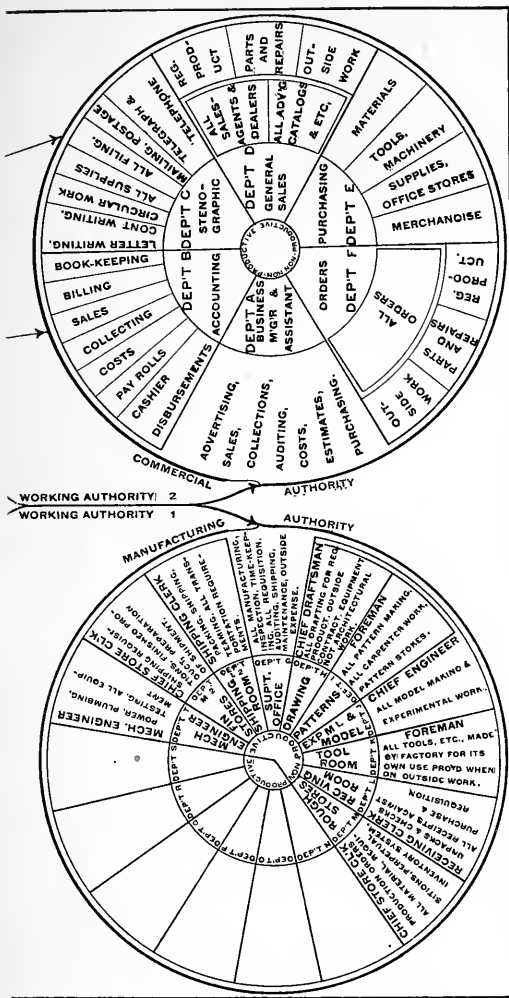


FIGURE III. Shows the Segregation of an Industrial Body into Authorities and Departments. This chart shows the absolute division between the commercial and manufacturing ends of the business emphasized in the accompanying discussion and the authority lines connect the various departments in these two divisions with the governing authorities. In each case the number and formal name of each department is in the apex of its triangle, the various detailed duties that come under it are grouped beyond; the productive departments in the manufacturing section are left empty, because their work will vary with the kind of factory under consideration—each factory carries the same non-productive departments

ORGANIZING A FACTORY

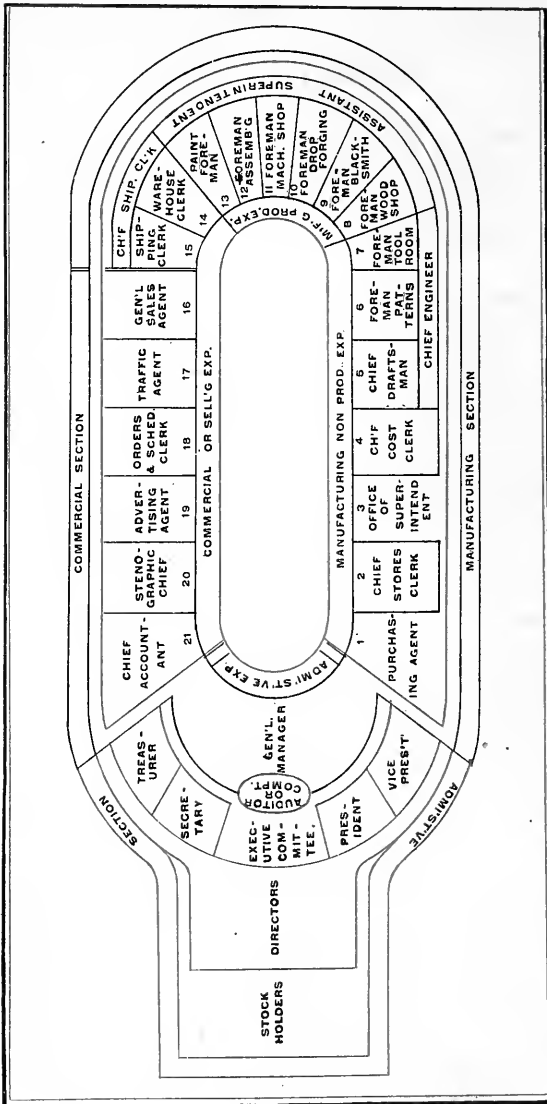


FIGURE II. The Prime and Working Authorities of an Industrial Body



## CHAPTER II

### THE ORGANIZATION ELEMENTS AND AUTHORITIES OF AN INDUSTRIAL BODY

A man makes two distinct steps to reach a given end:

First: He acquires knowledge concerning the thing in question.

Second: He applies that knowledge to the accomplishment of some definite purpose.

The first step is analytical and comparative in its scope; the second is creative and constructive in its purpose, and whether a man maps out a professional or a business career for himself, this rule prevails. The surgeon must study the body physical before he can operate upon it: its organization, in general and in detail, must occupy his first attention. The architect must learn the physical details of materials and their correlation in strengths and usage before he is qualified to design a structure. The same principle applies to all engineering professions, and, as a universal law, must also apply to business, and especially to manufacturing industrials. A factory with all of the various departments and authorities which go to make up the existence and control of the body industrial has an anatomy as clearly defined as has the body human, and is usually healthy or diseased in exact ratio to the governing power of the latter.

The first interest centers wholly upon organization; without an understanding of this, one cannot be qualified to administer to the wants of the body indus-

trial, whether to keep it healthy or to relieve it of disease.

The aim of organization, literally defined, is:

First: To systematically unite individuals into a body purposed to work together for a common end.

**Aims of Modern  
Industrial  
Organization**

Second: To unite in reciprocal and concrete relations and duties.

Third: To bring into systematic connection and co-operation parts of a whole.

Fourth, and specifically as applied to an industrial body: To prepare for the transaction of business by electing and appointing officers, committees and authorities over divided and subdivided parts of a whole business so that the duties of each shall correlate and co-operate with all.

These definitions show the first necessity of commercial or industrial organization—i. e., co-operative working by the head of each and every department. Any organization that is not so working is diseased, which, unfortunately, is often the case.

The writer has found, in analyzing and diagnosing organization and accounting work, that charts can express more on one page than is sometimes expressed in several chapters of writing, and has been the author and originator of many methods of charting industrial expressions. It is necessary, as a first step, for analytical and other purposes, to make a chart expressing all of the relations governing the organization of a business so as to show the very foundation upon which all authorities, accounting, and business transactions are based and conducted. There have been more failures scored both personally and financially for lack of these very elements in a business than by reason of any other one thing. As well try to build a house without a foun-

dation as to try to conduct a business, especially a manufacturing business, without proper organization.

The actual manufacture of material into a specific product is a sort of digestive process which must have a functioning organization purposed to meet the required ends, just as the human body has, and it is governed by similar conditions. It must also be directed by a specific intelligence and must have internal and external avenues of correspondence to keep it alive; and, like a living organism, must adhere to the eternal economy of things and show a profit by its activities or it cannot progress.

To exemplify this in a simple way, the writer has laid out Figure I, showing the prime elements composing the anatomy of an industrial body.

**Elements in Industrial Organization**      One does not have to draw on the imagination very far to make a comparison of this anatomy with that of man. It has its mind, will power, and brain to direct it, as indicated by the stockholders, directors and executive officers, a heart which keeps in flow the circulating medium internally; and avenues of correspondence with the outside world which furnish to it the very elements of existence.

This chart shows first, that the stockholders are simply elements belonging to the general public who have made an investment for some specific purpose; second, that immediately after this, the election of directors sets into action the first internal factor in the body, which is then divided into different functioning powers by the election of executive officers.

The final circulation of the business is kept active by the auditor or comptroller and is divided into four factors, viz.: Administration, Labor, Up-keep and Material Expense, the dotted lines within the oval indi-

cating to what extent this circulation enters into the organization as a whole. Labor permeates through all departments, Material not extending beyond the purchasing and accounting departments; while Up-keep expense permeates through all departments and is composed—as indicated by the second dotted line within the oval, of both labor and material. As Administrative Expense is but a local circulation of expenditure in the Administrative Section, it is indicated by the line so dotted.

This chart also shows what the avenues of correspondence with the outside world are, incoming correspondences consisting, first, of the stockholders who make an investment; second, the material receipts; third, the commercial receipts.

The outgoing correspondences are, commercial disbursements in payment for material received and manufactured output which comes back in the form of commercial receipts.

The least number of prime elements to which a manufacturing business can be reduced and retain a proper functioning power is also indicated. In the Manufacturing Section, it is Purchasing, Stores and Manufacture. In the Commercial Section, it is Accounting, Advertising and Sales, with a general manager at the head of and connecting the two. No matter how small a business, it must have this much of an anatomy. No matter how large it may grow, its ultimatum is simply the subdivision of these prime elements into extended functioning powers.

We now come to Figure II, which is one of the most interesting and valuable charts made by the writer in his work for the larger industrials. While it is reduced here to the simplest possible expression, it

at the same time contains all of the elements which govern the laying out of an organization of any magnitude. This is the Chart of Prime and Working Authorities, showing exactly where each authority is related to the others and how far each authority may extend in the business.

The writer has retained in this chart the administrative, commercial and manufacturing sections in the position as exhibited in Figure I, and **Authorities for Industrial Body** has separated these different sections into specific departmental divisions for the purpose of showing how the authorities governing different departments are related to the industrial body as a whole.

Departmental division is a necessity oftentimes not well understood, and means much more than a mere division of authority. It is necessitated by the fact that different methods of procedure in the manufacture and marketing of goods require widely varying experiences with the authorities that govern them; so that the division of a business into departments is controlled by two elements, viz.: The character of the labor it is necessary to employ, and the character of the material processed. Therefore, in order to know the proper division of a manufacturing business into departments it is necessary to first trace the essential processing of material from a raw state to a finished product by progressive steps, and then lay off the departments along this line of travel in accordance with its differences in the elements above designated.

In Figure II we see in the Administrative Section that the stockholders control the directors and that their paths of authority do not extend beyond this. We then see that the directors control the executive

officers and form themselves, or a part of themselves, into an executive committee, and that the paths of authority for both the directors and executive committee are identical, but that they do not extend beyond the line which separates them from the space occupied by the general manager. It also shows that the general manager is accessible to all of the executive officers. This chart further shows the exact position of the auditor or controller of the company as closely identified with the board of directors, all the executive officers and the general manager; but that his office does not extend beyond that. It is an isolated dotted circle, which indicates the independence of this office as regards the work pertaining to it.

Coming now to the general manager's path of authority, we see that it extends entirely around both the Manufacturing and Commercial sections and that all departments coming up to the dotted line are directly answerable to the general manager for the conduct of their duties.

In Department No. 1 the purchasing agent is the first division into sub-authority, whereby the chief stores clerk, Department No. 2, is under the purchasing agent and communicates only with the manager through the former.

Department No. 3, office of superintendent, has a path of authority extending under the general manager as far as the Manufacturing Section goes, and sub-authorities under him of chief engineer, assistant superintendent and chief shipping clerk, under whom the business is again divided into sub-authorities, as indicated by Departments No. 5 to No. 15 inclusive.

The writer has found this method of procedure in

charting organization most effective, as the lines of authority can be exactly and definitely set and extended into any number of sub-divisions of authority that a business may require.

The prime distribution of expense is another interesting grouping. This shows, first, the confines of the **Functions of General Manager** administrative expense; second, the manufacturing non-productive expense; third, the manufacturing productive expense; fourth, the commercial or selling expense.

This method of procedure is so flexible in a chart that it can be divided up to meet the requirements of any business.

One point to which attention is called in connection with this chart is the fact that while the shipping and warehouse are under the authority of the superintendent, their expense is a commercial or selling expense, the details of which will be studied later in the Accounting Charts.

The laying out of such a chart as this is the very foundation for all administration and accounting required, and when laid out after this method and given the consideration due to any specific business, it clears up more questionable points and avoids more disputes regarding authorities and necessities than any method that has ever before been devised. It is wonderfully effective in this respect because of the very simplicity employed in its construction, and once laid out a copy should be placed in the hands of everyone having authority in a business.

The writer uses similar charts for making records in many ways. The actual Organization Chart employed for any specific business has each department space filled in with not only the names of the heads of

the departments, but also the names of all sub-authorities that the head has under him; so that the Organization Chart shows not only what is exhibited as fundamental here, but also the entire personnel of an organization above the ordinary labor employed.

In most instances the application of new ideas has to be made to already existing plants, and in analyzing such for the purpose of determining most economical production, as well as a system for keeping costs and records, it must always be borne in mind that the first desideratum is the movement of product from raw material to finished units, irrespective of any geographical departmental conditions or locations already established, as it is only by this means that possible rearrangements and locations are attained.

**Administration  
and Accounting  
Chart**

With such a chart as Figure II arranged on such a basis, i. e., with departments put in sequence through the manufacturing section, in accordance with the different movements required in the processing of material, it becomes a very easy matter then to take geographical condition into consideration and arrange them in such a way as to make the movement of product manufactured continuous in one direction.

This, of course, cannot always be carried out in already existing plants, but the writer has been able to make some wonderful reductions in costs on this point alone.



## CHAPTER III

### DEPARTMENTAL AUTHORITIES, DUTIES AND RESPONSIBILITIES

Having laid out the general chart of organization by dividing it into authorities, and establishing the lines of its beginning and termination, it must be followed up still further by carefully laid out written instructions to each department head. In other words, a written set of rules governing these authorities should be carefully compiled in detail.

To illustrate this, I will reproduce here a set of such rules as I have laid them out for a number of factories so that the reader may become not only thoroughly conversant with the method, but also with many general details of importance which would apply to any manufacturing business—although, of course, no one set of rules in all their details would apply to every business.

The division of a business into departments, and their authorities would be of little value unless followed up by such specifications as would enable every authority to thoroughly understand his duties and responsibilities.

In this I do not propose to go farther up than the General Manager, as the duties of Committees, Directors and higher authorities would be foreign to this work. I will only say that a clear understanding of the relation between the General Manager and an Executive and Advisory Committee is essential.

**Relation of  
Higher  
Authorities**

The General Manager usually has limitations set upon him as to expenditures and obligations or contracts that he shall assume; before executing any exceeding these he must have the sanction of the Advisory Committee. And the Advisory Committee stands in exactly the same relation to the Executive Committee. That is to say, a General Manager may have supreme authority in expenditures and obligations to perhaps \$10,000.00. An expenditure exceeding that amount must be passed by a vote of the Advisory Committee. The Advisory Committee, in turn, has jurisdiction up to, say, \$25,000.00. Exceeding this the matter must be passed upon by a vote of the Executive Committee, which, acting as the representative of the Board of Directors, has no limitation set upon it. In case no Executive Committee exists, this applies directly to the Board of Directors. But where a corporation has a large board it has been found most effective to utilize the services of an Executive Committee, elected from the Directors by themselves, to act in their place.

In very large corporations there are often other committees organized, as for instance, Committee of Finance, Committee on Sales, Committee on Improvements, and so on, but they are usually short termed and elected for some specific purpose, while Executive and Advisory Committees are a permanent part of an organization.

General Manager, under the direction of the Executive and Advisory Committees, is in full charge of all the company's commercial and manufacturing affairs, as indicated in Figures I and II, and is usually assisted in the larger corporations by two competent deputies: first, a Business or Assistant Manager; and, secondly, a

Superintendent or Works Manager. The authorities of these two men in the business are distinctively separated one from the other; the former is connected solely with the business or commercial affairs of the Company; the latter has sole charge of the producing or manufacturing end of the business.

Specifically, the points that require the attention of a General Manager are:

1. Rentals, depreciations, special machinery for contract sales and by order of the Executive Committee, the purchase of real estate, buildings, equipment and extensions.

2. Banking arrangements, notes, discounts, special credits, inventories, balance sheets, contracts, taxes.

3. Fixing of employes' bonds' insurance, fire, sprinkling, and watchman's service.

4. Creation of card, cost, accounting, and department systems.

5. The appointment of all offices and officers under Manufacturing Authority.

6. Distribution of all mail matter, and creation of systems for recording, filing and mailing of same.

All contracts and all purchases out of the order of regular requirements come directly under a General Manager's administration, whether they are for machinery for the plant, or for the filling and executing of sales contracts, or for items not manufactured by the Company but sold by it in conjunction with its regular production—such as machinery, supplies, and accessories. This last authority is exercised only in case the purchase is of a specific nature from time to time; where supplies and accessories are carried constantly in a merchandise account, they are purchased through the regular channels by the Purchasing Agent.

It is the General Manager's duty to compile and arrange the sale prices of all products manufactured in the business, to arrange for and supervise the compilation of all the inventories from data which shall be furnished him by the heads of each different department through their respective channels, the arrangement of which should be in such a way as to check itself with the Auditor's financial report.

The general system of bookkeeping adopted must be provided for by the General Manager in such a way as to harmonize with whatever system of keeping costs and other records that he may introduce into the business. It must be a system that, in connection with the monthly reports and costs system, will best exhibit the constant expenditures and receipts in such a way as to clearly indicate *progress* or *retrogression* in the business and *how* and *at what point it exists*.

In many companies a Business or Assistant Manager is appointed whose duty is specific in its nature.

Business or Assistant Manager, under the direction of the General Manager, has full charge of all office work that especially pertains to the commercial end of a business, is responsible to the General Manager for all the departments coming under his supervision, and must at all times consider himself as the General Manager's deputy.

Aside from taking care of the general and specific correspondence coming to his office, looking after the details pertaining to the various departments coming under his direct charge, the three most important duties of the Business Manager, and the real purpose of his office are: first, the promotion of sales; second, the

collection of accounts; and third, the auditing and record keeping of all correct commercial business.

In consequence the Business Manager passes on all requisitions for material; after having passed on these, he renders them to the Purchasing Agent of the Company. He also passes on deliveries covering all purchases; in other words, he investigates the time and periods at which the various requisitions call for material, and from his knowledge of requirements and sources of supply, sets the time of delivery that money may not be unnecessarily tied up in such items.

Further, he passes on all bills payable, and renders them over his signature to the accounting department, that disbursement may be made over his voucher. In this manner, times of delivery and payment of bills can be regulated and balanced, and the carrying of surplus stock avoided or the making of a premature investment of money in materials and supplies easily checked.

As the Purchasing Department comes under the Business Manager, it is his duty to keep himself fully posted regarding the demand for all supplies used in the business, and to constantly confer with the Purchasing Agent regarding them, in order that an excess of purchases is not made of any item or items, and that items are bought at lowest prices.

Especially is it his duty to see that all monthly auditing of the Company's business is properly done for review by the General Manager and Board of Directors at such times as are set by them for such investigation, and to compile all items belonging to his departments and administration for the rendering of inventory by the General Manager.

The Business Manager has no authority to change

any system of book, record, cost of filing, as installed by the General Manager, nor has he the authority to contract for the purchase or disposal of anything *not* under him, except the General Manager shall by special instructions so direct; but he is responsible for the maintenance of the discipline and operation governing the departments under the régime created by the General Manager. He should constantly confer with the General Manager concerning all departments under his charge.

One point should be emphasized here. The Business Manager should not have any direct authority over the Superintendent, as the latter is responsible to the General Manager in exactly the same sense that he himself is, and should be a person competent to act directly in the discharge of his duties, as the head of the manufacturing end of the business, just as the Business Manager is at the head of the commercial end of the business. The same relation should pertain vice versa, otherwise the efficiency of these authorities will be impaired and unnecessary confusion often arise.

General Accountant, under the direction of the Business Manager, has charge of all bookkeeping, billing, petty cash, and all statements and financial records covering the Company's commercial and factory business. He has under his charge all bookkeepers, assistant bookkeepers, bill clerks, cashiers and other help employed in this department; he has charge of all pay rolls as per times account rendered by the Superintendent and Business Manager for all help employed in the factory, and for all help employed in the office (the time account of latter should be kept separate under the Business Manager).

**Bookkeeping—  
Labor and  
Authority**

The General Accountant has no authority to amend or change the system of accounting, as installed by the General Manager, and no authority in any other department except his own. He should, however, have full and complete access to all details that interfere with or pertain to the Company's accounting of any nature, in order that the rendering of his monthly statements may be clear in every detail, covering the commercial, factory and private Company accounts. The Accountant has no authority to make disbursements except over properly audited vouchers. All accounts collectable by the company should be enforced by the Accountant up to the point where legal assistance is required; at this stage the Business or General Manager will take up the issue direct or through the Corporation Counsel of the Company.

All help employed in this department is responsible to and hired by the Chief Accountant, and placed under such bonds as the General Manager shall require. His own bond is fixed by the General Manager direct.

The character of help employed, the calendar condition of the books, and the workmanship of the accounting are the sole responsibility of the General Accountant.

In many companies the General Accountant holds the office of Treasurer, which is a most excellent idea, as it not only gives his office authority, but gives him great power in the enforcement of his duties in relation to the public, imparts more dignity to his presence in the office, and strengthens his interest in the business. To hold his office, he need not necessarily be a director or even a stockholder, although it is much better if he is both a stockholder and director.

Inasmuch as this is a very important office it

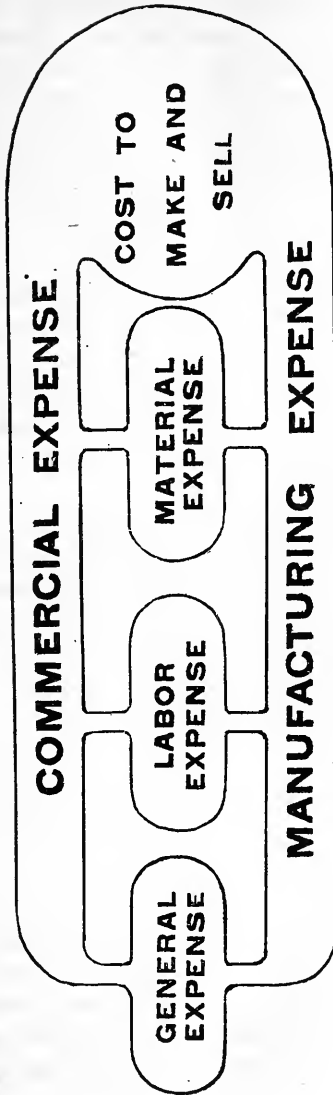
should have most careful consideration in the person selected to fill it as regards experience, character and disposition; for he comes first in line for promotion to Business Manager, and thence to General Manager.

Chief Stenographer, under the direction of the Business Manager, has full authority in the employment of all labor and clerical work required in the department of correspondence; he has charge of all the filing of correspondence of whatsoever nature which comes in this department and is responsible for its safe-keeping and proper filing.

All stenographers employed in the offices come entirely under the Head Stenographer's authority, and, as required for dictation throughout the various departments of the business, are furnished at the option of the Head Stenographer—according as they may be occupied or otherwise. By this means any stenographer becomes sufficiently familiar with the business to be available for any department—a great convenience when the stenographic work of departments is irregular. In addition to this, it throws a safeguard around the correspondence of the office by breaking the continuity of work in any one department for any one stenographer; in plain words, no one stenographer will become too well acquainted with the Company's secrets or internal affairs, and dismissal will carry no apprehension to the Company on this score. Nearly all large concerns, not using phonographs, now employ this method, the only exception being where private secretaries act as stenographers for some of the officials.

All materials used in this department, classified as stationery, must be bought upon requisition of the Head Stenographer by the Purchasing Agent, and a





**PRIME EXPENSE DIVISION.**

FIGURE IV. The relative positions and distribution of these prime expenditure divisions of a factory

ORGANIZING A FACTORY

A-LABOR

FROM		TO																						
		NON-PRODUCTIVE					PRODUCTIVE					GEN'L. INFORMATION												
DEPT. HEADS	No. %	ASST. HEADS	No. %	CLERK	No. %	TIME KEEPS	No. %	DAY WKS.	No. %	FORE. MEN	No. %	DAY WKS.	No. %	PIECE WKS.	No. %	GRAND TOTAL	No. %	TOTAL	No. %	No. %	No. %	No. %	No. %	No. %
DEPARTMENTS																								
PURCHASING																								
STORES																								
SUPTS. OFFICE																								
COST																								
DRAWING																								
PATTERN																								
TOOL ROOM																								
TOTAL																								
WOOD SHOP																								
BLACKSMITH																								
DROP FORGING																								
MACHINE SHOP																								
ASSEMBLING																								
PAINT																								
TOTAL																								
WARE-HOUSE																								
SHIPPING																								
SALES																								
TRAFFIC																								
ORDER & SHED																								
ADVERTISING																								
STENOGRAPHIC																								
ACCOUNTING																								
TOTAL																								
COMMERCIAL OR SELLING EXP'TS.																								
TOTAL																								
GRAND TOTAL																								
ACCOUNT NO'S																								
A-1																								
A-2																								
A-3																								
A-4																								
A-5																								
A-6																								
A-7																								
A-8																								
A-B																								
TOTAL																								
100																								

FIGURE V. The distribution of the subdivisions of one of the three prime expenditures divisions

B - MATERIALS												
PROCESSING MATERIAL				OFFICE SUPPLIES				FACTORY SUPPLIES				
PROD.	EQUIP'T	CONST'N	TOTAL	STAT'N'Y	PRINT'G	OFFICE EQ'PT	TOTAL	OILS	FUEL	TOTAL	GRAND TOTAL	
B-1	B-2	B-3		B-4	B-5	B-6		B-7	B-8			
C - GENERAL EXPENSE												
ADM'ST.	TAXES	INS.	DEPREC'N	PATENTS	ADV'NG	LIGHT	HEAT	REPAIRS	LABOR	MATERIAL	TOTAL	SUM'Y TOTAL
C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10			
D - PLANT BETTERMENTS												
SHOP MADE						PURCHASED						
BUILD'GS	MACH. TOOLS		SMALL TOOLS		TOTAL	TOTAL	TOTAL	MACH'Y & TOOL	POWER EQ'P'T	TOTAL	GRAND TOTAL	
LABOR	MAT'L	LABOR	MAT'L	LABOR	MAT'L	LABOR	MAT'L					
D-1	D-2	D-3	D-4	D-5	D-6			D-7	D-8			

Figure V (Continued). A continuous sheet showing the two primes B, and C and the "investment" section D. The remaining prime A, is on the preceding sheet

PARTS KEY CARD									
FACTORY NO.			CARD NO.						
NAME OF PART			HEADING NO.						
KIND OF MATERIAL			DRAWING NO.						
AMOUNT OF MATERIAL USED ON MODELS			PATTERN NO.						
			DIE OR JIG NO.						
NO. & NAME OF OPERATION									
NO.	NAME	NO.	NAME	NO.	NAME	NO.	NAME	NO.	NAME
1		10		16		17		18	
2		11		17		18		19	
3		12		18		19		20	
4		13		19		20		21	
5		14		20		21		22	
6		15		21		22		23	
7		RECEIVED IN OFFICE		22		23		24	
8		DATE		23					
9		FILLED OUT BY		24					
		DATE							

FIGURE VI. The Parts Key Card, which contains the information concerning each part of the completed unit

proper account rendered by the Head Stenographer in return for them. This account includes a daily report of the number of letters, packages, and parcels mailed, with the number and denomination of postage stamps used in this department.

The Head Stenographer has charge of and is held responsible for the condition of all machines, desks and other appliances used in this department, and renders all requisitions for repairs required. All such work is charged to the proper account of expenses incurred in this department each month.

In addition to this the Head Stenographer has charge of all regular supplies used in the office of whatsoever nature, including all blanks, bulletins, catalogues, literature, postage stamps, and so on, and delivers them only on proper requisitions from the other departments. This constitutes what might be termed the office stores, the inventory and maintenance of which devolve upon the Head Stenographer.

When regular office literature of any kind is becoming low the Head Stenographer must notify the Business Manager, who at once proceeds to take up the matter with the General Sales Agent, from whom the production of this literature emanates. If the same literature is to be used over again, a requisition is passed on to the Purchasing Agent for making of contract with the printers. The same procedure applies to all stationery.

Postage stamps, however, should be obtained through the Cashier of the Accounting Department, or from the General Accountant, who will then be able to make proper distribution of the expense charge. Negligence of this one item alone is costing many concerns hundreds of dollars annually.

General Sales Agent, under the direction of the Business Manager, has full authority over the employment of the salesmen, the making of their salaries, the passing and allowing, or rejection of all traveling expenses incurred by them, and the arranging of all representation for the Company on a commission basis. But he can make no permanent contracts with dealers that are binding, unless they have been approved by the General or Business Manager.

All prices made by him for apparatus must be standard prices, confined within such circle of contract as will be furnished by the Business Manager. If out of the regular method, terms of payment and deliveries must be subject to approval.

All photographing of apparatus for office record, advertising or catalogue purposes is also under the charge of this office.

This office does not carry with it any authority to make sales for the company of any apparatus or supplies not listed as standard product or regular supplies, nor does it carry with it the authority to make contracts for the sale or delivery of any auxiliary machinery, such as engines, except subject to approval by the General or Business Manager.

The General Sales Agent has full charge of all advertising contracts for journal, magazine or any periodical advertising, and of the compilation and issuing of all factory advertising literature, such as catalogues, bulletins and price lists. The accounts of the latter, as distinguished from periodical advertising, must be kept entirely separate. No single contracts can be made by this office for periodical advertising ex-

ceeding a certain fixed sum in amount and a fixed period of time.

All contracts for office literature must be passed through the regular avenues for purchase, and all accounts contracted for by this office must be passed through the regular avenues of auditing before payment can be made.

The reason for putting all photography, cut-making and advertising under this department is because it belongs exclusively to the expense of making sales, and because a thoroughly competent General Sales Agent should be a man thoroughly versed in the art of advertising. Therefore, should an advertising man be employed expressly for such work, he should come under the authority of the General Sales Agent, as his salary is really an expense chargeable to sales.

The importance of this office to any company should provoke a liberality of spirit and policy in excess of any other one department, for on the successful exercise of this department depends in a large measure the success of the business. Good salesmen are not always good in other qualities, and a General Sales Agent should always give such things due consideration.

Purchasing Agent, under the direction of the Business Manager, has full authority in the purchase of regular and standard supplies and material for the Company, and for all machinery and for all power supplies as coming in regular form over properly audited requisitions. The Purchasing Agent, however, has no authority to purchase anything except what he knows to be such requirements from experience, except by direct instruc-

**Purchasing—  
Labor and  
Authority**

tions from the Business or General Manager. Anything out of the regular requirements, such as auxiliary machinery for sales contracts, building material, real estate improvements or complete buildings, must have the personal audit of the Business or General Manager, before authority is vested in the Purchasing Agent to exercise his office.

All purchases of any magnitude should be made only after receiving bids from several sources on the same requirements, and then the purchase must be placed with the lowest bidder, all other things being equal.

It should be the Purchasing Agent's duty to keep a complete and indexed reference file of catalogues and price lists of each and every thing used and purchased by the company in connection with its business, and a private card system covering all prices and discounts on them. The latter should be kept in conjunction with his regular card system of quotations which should be separate from his card system covering purchasing orders. Further, all confidential prices and quotations on the cards should be kept in symbol, the key held only by the Purchasing Agent, the Business Manager, and the General Manager, thus preventing any collusion between minor employes and the representatives of other companies.

All requisitions for material and supplies and minor purchases, must have the audit of the Business Manager, before being executed by the Purchasing Agent, and all requisitions for machinery or equipment must have the General Manager's audit before purchase is made.

Chief Order Clerk (sometimes Chief Engineer, and sometimes the head of the order and schedule depart-



ment), has entire charge of the issuing of all production orders for shipping to the factory, as per sales orders handed him from the sales department or management, and is responsible for the proper classification of these orders into regular products, parts and repairs, merchandise account, or outside contracts. Whether goods are already in stock ready for shipment, or are to be made up as per order does not concern the Chief Order Clerk, except in so far as time of delivery is concerned. All production orders issued to the factory for the making up of stock goods must pass through the hands of the Chief Order Clerk—they pass directly from the General or Business Manager to him and then the Superintendent. Notification of all shipments by the Shipping Clerk come direct from the Chief Order Clerk, are O. K.'d by him in accordance with his original order, and passed to the accounting department for the rendering of an invoice. Where shipments are made in installments covered by one shipping order number, the responsibility for the getting out of the order does not cease with the Chief Order Clerk until the entire shipment is completed, after which all responsibility on his department ceases.

Where a Chief Engineer is employed, as in an automobile or any other business making a constant demand for drawings and engineering work, the draughting room and the model and experimental room should come under his direction. In such case, all orders for production of any kind must first pass through his hands, be checked, and have drawings and bill of material attached to them by him, unless the necessary drawings are already in the factory. In that event notation of this fact must be made on the order and bill

of material before they are passed by him to the Superintendent. In some lines of work, the office of Chief Engineer would not extend beyond the model, experimental and draughting room, and sometimes not beyond the model room.

The management will always have to regulate the office of Chief Engineer in accordance with the necessities of the case. Where a Chief Engineer is not employed at all, the draughting room comes directly under the General Superintendent, and all drawings before going into the factory for execution must bear the signature of his approval.

Superintendent, under the direction of the General Manager, has full charge of the manufacturing end of the business. Independent of the regular workings and department organization of the factory, the Superintendent has directly under his charge all timekeeping and all inspection of work in factory, which is in no way under the charge of any departments or foremen of departments; that is, all inspection of work must be directly looked after by the Superintendent, or such clerks or inspectors as he shall deputize in his place. This is done that there may be absolutely no collusion between the foremen of the various departments and the inspectors who pass on the work produced under the various foremen's supervision.

The Superintendent is responsible for all requisitions made for material, machinery and supplies, for all requirements and requisitions for the arrangement and allotment of work throughout the factory, and their execution on time in accordance with the General Manager's orders.

He has sole responsibility for the class, character

and quality of the labor employed throughout the factory, and the discipline under which this labor is maintained. He has full and complete authority in the appointment of all foremen and deputies employed under his charge.

As the Superintendent is the connecting link between the manufacturing end and the commercial end of the business, he should always be prepared for conferences on any matters pertaining to the whole business at a moment's notice. To do this his office must be constantly posted and up-to-date regarding all conditions of material, supplies and work under his charge, in order that he may estimate the time required for the execution of any construction under consideration, and be prepared for steps of an extraordinary nature that might be needed for the fulfilling of any contract out of the usual order.

The Superintendent is responsible for the execution of all shipments as per order of main office, and must be thoroughly posted and have data compiled relative to transportation for all requirements demanded by the business of both intake and output. This includes the complete schedule of freight rates to all points of distribution, and the obtaining of all special rates for any special requirements.

The office of Superintendent pertains strictly to the producing end and not the creating end of the business, consequently he is in no way responsible for the designs or working of apparatus built, further than its compliance with specification and drawings delivered him as approved by the General Manager, except in so far as he himself shall design or improve for the General Manager.

It is the Superintendent's personal duty to see that

all insurance requirements are maintained, that a proper fire service is incorporated, and that all necessary watchmen and watchman's devices are provided.

He must carefully keep watch of the service being obtained from the equipment, that the machine tool wage may be kept as near standard as possible by a proper distribution of the work throughout the factory.

Specifically, his duties are: first, production; second, delivery of production; third, safety of property. These three form the prime captions for his thousand and one duties.

Mechanical Engineer (usually the Assistant Superintendent), under the direction of the Superintendent,

**Factory Power and Testing** is responsible for the conditions, operation and maintenance of all primary power units, such as the boiler, pumps, engines and all their auxiliary machinery, generators, storage batteries, all motors used for driving apparatus and machinery throughout the factory.

He has charge of all engineers, firemen, oilers and watchmen, and is responsible for all plumbing and sanitary arrangements. Further, in some kinds of business, the Mechanical Engineer has direct charge of all labor in connection with the testing of the product, which shall be delivered to him from the assembling department, and returned by him to the assembling department.

He is responsible for all supplies relative to the units under his charge, such as coal, oil and waste, and makes all requisitions on the Superintendent for same.

All drawings and designs for factory extensions, plant enlargements, factory arrangements and provisions come under this office, as do all railroad provisions and connections, coal storage, water supply, and so on.

This department is responsible for the appurtenances used for moving machines around the building, does the handling of *all* Shop Carrying throughout the factory, and has charge of all floor men. It is on this department that all the other departments depend largely for the taking away of their products, placing of work and tools in position, and delivering work from one tool to another. Consequently, this department must be considered in the light of an auxiliary department to all the other producing departments, as it acts as a medium for collecting the work from all the other departments and uniting them into one unit. Therefore it is the duty of the foreman of this department to expeditiously and faithfully exercise every requisition on his department whether coming from the Superintendent direct, or by an arrangement of the Superintendent with the foremen of the other departments to pass requisitions without his audit.

However, this department is isolated from all others, and a separate account must be kept of all work done by it; but, as a whole, it must be considered on the same basis as the tool room department, and the foreman must be invested with authority to act independently in taking care of requisitions for services in this department.

Chief Engineer or Master Mechanic, as the case may be, under the direction of Superintendent, is in charge of the experimental work. This department must be entirely isolated from all other departments in the factory, as its sole purpose is for the developing by experiments items that may form a product for sale, the only exception would be model work done for outside parties

**Experimental  
Labor and  
Authority.**

on a contract, in which case the receipts would be an earning by this department to credit against its general expense. Where model and experimental work is done in the tool room, as is sometimes the case, the charge must be distinctly for experimental work and not be confounded with the general expense belonging to tool room charges. If the models after they are perfected should be sold, the model room should be credited with this amount as against its expense, as often a little care and study of experimental and model work on the part of the management would enable a large portion of this work to be finished into an actual product that can be sold, instead of going, as is often the case, entirely to the scrap heap—in which case the output should go into regular product account, and be credited to this department exclusively.

Chief Draftsman, under the direction of Superintendent, or Chief Engineer, as the case may be, must be a man thoroughly qualified, technically, mechanically and mathematically, to have charge of the making of all drawings required in the factory. It is the duty of the Chief Draftsman to number, classify and file all pencil sketches, tracings and ink drawings, to keep a proper record of all negatives used for either photographs or blue prints, and to keep a proper record of all blue prints made either from drawings or negatives.

It is the strict duty of the Chief Draftsman to personally check over all drawings made in the drafting room, and ascertain that they are correct, before they are printed and issued to the factory for work to be executed from; neither the Superintendent or Chief Engineer assume any responsibility in this respect. All requisitions for material and supplies for the drafting

**Drafting—Labor  
and  
Authority**

room must be made directly on the Superintendent, and all timekeeping of this department must be kept by the regular timekeeper and separated from all other departments.

Receiving Clerk, under the direction of the Superintendent, has charge of all goods received by the factory; he must unpack goods, make proper preservation of packing materials and lumber for future use, check over entire receipt in detail, and hand memorandum of receipt to Superintendent. The latter immediately forwards them to the main office for checking against the original purchase of invoice accompanying them.

Immediately upon the completion of the unpacking and checking over all goods, they must be delivered to the Chief Stores Clerk with name of consignee, date of receipt and point of shipment attached. They then pass to the charge of the Chief Stores Clerk.

Under no circumstance is the consignors' invoice to be given to the Receiving Clerk to check from, as this too often leads to check marks on the invoice without a count of the goods.

His memorandum of receipt contains an account of all items and statements, and must be compared with consignor's invoice in the main office entirely independent of the Receiving Clerk. This method insures absolute certainty regarding the correctness of the amount and quality of the goods received.

Chief Stores Clerk, under the direction of the Superintendent, has full charge and authority in the factory stores, which are classified under three divisions: finished, semi-finished, and rough stores. The chief of these departments is responsible for all stores and supplies of

**Receipts—Labor  
and  
Authority**

**Factory Stores  
—Labor and  
Authority**

finished, semi- and unfinished product. He has charge of all assistants and storesroom clerks, and must render all receipts to the office for the entire intake and output of the factory materials and supplies. All requisitions for supplies must be made by the Chief Clerk to the Superintendent, and must in each instance be accompanied by an inventory of goods on hand at the time of requisition.

The Chief Stores Clerk has under him all stock clerks, stores clerk and inventory clerks, and has charge of all finished stocks, such as completed machines or parts of machines that can be used and shipped for repair work, which themselves constitute a finished product, until required in the assembly room. In other words, there should be two divisions in the stores room department of material: *rough stores*, constituting raw material which is used to produce *finished stores* as made by the factory; and *finished stores*, which constitute all work done by the factory after completion, and all purchases of supplies or parts which are ready for assembling or filling of orders without the requirements of labor in the factory.

The Chief Stores Clerk is solely responsible for the maintenance of a perpetual stores inventory system, and for the keeping it posted up to date. Immediately upon receipt of goods, the items must be posted on cards covering such items, before goods are placed in storage position.

All job tickets for work must be made out by Chief Stores Clerk from each bill of material received and sent to the Superintendent with his requisition for parts required. The tickets are then given by the Superintendent to the foremen of the various departments,



who distribute them to the men in their departments whom they desire to do the particular operations.

Shipping Clerk, under the direction of the Superintendent, has charge of all shipments made by factory, and is responsible for the direct acquisition of all data relative to means of transportation by wagon, car or boat. He is responsible for all material used for packing purposes and making of shipments, and must render requisitions for them to the Superintendent. He cannot receive them from stores supplies until audited as above.

He is held responsible for all errors in shipment and for all delays after goods have been delivered to his department. All shipments made must be in accordance with written instructions and requisitions, and must be correctly written on shipping clerk's memorandum. The Shipping Clerk has no authority outside of this department. He must make all requisitions for additional help, when insufficient help is in the department, directly through the Superintendent. He cannot take men through any of the foremen.

No shipment can be made until final orders from the Business or General Manager are received by the Superintendent after shipment is ready; in actual practice this means that the main office must be notified of completion of an order ready for shipment and return final shipping orders before actual shipment is made of any goods.

The original productive order marked "*shipping*" must remain in force until a complete shipment of all the items contained thereon has been made. When goods covered by one order are shipped on installments, memorandum of shipments bearing the order number

must be made out to notify the main office, until the last shipment, when the original order must accompany the memorandum.

Foreman, under charge of Superintendent, is responsible for all machines, dies, jigs, and any special tools classed as tool room property. He  
**Tool Room—**  
**Labor** has all the labor in this room directly  
**and Authority** under his charge, and is responsible for all materials received from Company's stores for use in this department.

This department is an exception to all other departments, inasmuch as work is arranged between foremen of all other departments and this one, but can be arranged by the Superintendent so that all requisitions issued by such departments will be honored by it without his audit. This arrangement lies entirely in the hands of the Superintendent. All timekeeping of this department comes under the head of General Timekeeper; but it must be kept entirely separate from other work so that all work done in the tool room may be charged to the department for which it was done, or to a productive charge when items are made for sale.

The Foreman of tool room must understand that his department is for the benefit and necessities of all other departments, but not under them, and that each requisition must have attention in its order of issue and receipt as near as possible. He must exercise great care to see that each piece and each operation on each piece is properly headed on the workman's job ticket, so that a proper distribution of expense may be made from these tickets.

All jigs, dies and special tools made for the use of the factory are a subject of general expense, and must be charged to it—not, as is often done, to plant better-

ment, or equipment increase, for such items have absolutely no market value and are worthless beyond the direct application for which they were designed, which makes them liable to become obsolete any time. The distribution of such expense is made to cover such a period of time as work will be manufactured from any special jigs or dies. If for a single job, that job must bear the entire expense; if for parts of a regular product, the expense should be distributed over such a period of time as will correspond to their life, or until the manufacture of the part is discontinued and they become obsolete. The usual method is to charge 50% of the cost of the first year, 25% the second and 25% the third year.

All separate departments are under a Foreman, who is under the Superintendent. The foremen are responsible for all the Company's tools and machinery in their departments, for all labor employed, and for all materials taken from stores. They have a certain amount of authority over requisitions for making tools, as required by them for their departments; but the tool room must not be considered as any one of theirs exclusively, but as being for the benefit of the entire shop.

It is each Foreman's duty to see that his men and tools are provided with work; idleness of tools will be no more excused than will idleness of men, when there are any orders that these tools can be worked upon. Therefore, it is one of his most important duties to lay out and arrange the distribution of his work in such a manner that there will be no idleness of either men or tools, and he will be held solely responsible for this feature. It is his duty to further see that this department is kept clean and orderly, and under no circum-

stances to allow a congestion on the floor of material or partly finished work.

All time slips of any nature whatsoever must be checked by foremen before work is passed into inspectors' hands. All numbers governing work must be placed on time slips when they are issued to workmen with his part of the work; it is the Foreman's duty to place the clock or check number on each man's cost time slip and distribute them when received from Superintendent.

All requisitions for workmen must be made on the Superintendent, as no Foreman will be allowed to hire his own men.

MACHINE & MACHINE TOOL RECORD CARD		CARD NO.
FACTORY NO.	CO. SERIAL NO.	
NAME OF MACHINE	LOCATION	
SIZE NO.		
NAME OF MAKER		
PURCHASED FROM		
DATE OF PURCHASE		
ORIGINAL COST	FREIGHT & INSTALLATION COST	
TOTAL ORIGINAL COST	ANNUAL INTEREST @ 6%	
ESTIMATED LIFE	TOTAL COST TO RETIRE	
ANNUAL DEPRECIATION	PRESENT VALUE	
HOUR RATE	IN, OR OUT OF USE	
CONTEMPLATE USING FOR		
	ALL COUNTERSHAFT MUST BE INCLUDED IN INSTALLATION COST	

FIGURE VII. Machine and Machine Tool Record Card, of great value in connection with a perpetual inventory system

## ORGANIZING A FACTORY

PATTERN RECORD CARD		CARD NO.
FACTORY NO.		
NAME & DESCRIPTION		
	IN FACTORY NO.	
DATE MADE	FROM DRAWING NO.	NO. OF PATTERN
WORKS JOB NO.	PARTS NO.	TO EXPENSE CHARGE
FLASK NO.	FLASK SIZE	FOLLOW BOARD
KIND OF MATERIAL	COST OF MATERIAL	
COST OF LABOR	TOOL COST	GENERAL EXPENSE
TOTAL COST	PRESENT VALUE	DATE
IN OR OUT OF USE		
FILLED OUT BY		
DATE		DATE
RECEIVED IN OFFICE		

FIGURE VIII. Pattern Record Card, showing what facts are to be known concerning patterns for stock record purposes

DIES & JIGS & SPECIAL TOOL RECORD CARD	
FACTORY NO.	CARD NO.
DESCRIPTION & NAME	
DATE MADE	IN FACTORY NO.
FOR PARTS NO.	FOR JOB NO.
KIND OF MATERIAL	TO EXPENSE CHARGE
COST OF MATERIAL	POUNDS WEIGHT
TOTAL COST	COST OF LABOR
TOTAL ORIGINAL COST	GENERAL EXPENSE
IN OR OUT OF USE	PRESENT VALUE
IN STORAGE NO.	DATE
FILLED OUT BY	
	RECEIVED IN OFFICE
DATE	DATE

FIGURE IX. Dies, Jigs and Special Record Card, which complete the equipment inventory record

DRAWING & TRACING CARD										
CARD NO.			DRAWING NO.				NEGATIVE NO.			
TITLE										
PENCIL SKETCH										
DATE	MADE BY	TIME HOURS	RATE PER HOUR	COST			FILE NO.	DISPOSITION		
				FIRST	ALTERATIONS	FINAL		OTHERWISE		
TRACING										
INK SKETCH										

FIGURE X. Drawing and Tracing Card, on which is kept a complete record of all drawings and their value



## CHAPTER IV

### THE ACCOUNTING OF EXPENSES AND COSTS

I do not propose to lay out or provide here for a complete accounting system, but rather to show the dependence of accounting on organization, the inseparableness of the two and the foundations upon which factory accounting must be built together with the principle involved in the gathering of costs, and to further show how *independent of bookkeeping* in its general sense, cost accounting really is.

The first consideration in the organization of an accounting department is a prime division of costs; the second consideration is their relative position in and distribution over the business as a whole.

In the broadest sense, expenditures have but three prime divisions, which are clearly illustrated in Figure IV. As here indicated, they consist of General Expense, Labor Expense and Material Expense, the sum of which gives, as shown, the Total Cost to Make and Sell.

General Expense, in the broadest sense, means all expenditures that cannot be directly charged to cost of production.

Labor Expense means the cost of any and all labor employed in a business excepting its administrative labor.

Material Expense, in this division, is any form of material that is purchased by a company either for processing into a product for sale, or as supplies for operating a plant, or as office supplies.

In other words, these three divisions of expenditure are the least number to which the expenses of a business can be reduced, but, as a prime, each of them is subject to many subdivisions as may be required to cover an itemized classification for any particular business.

Referring to Figure IV, it will be noticed that these three primes flow into two separate channels—one, Commercial Expense; the other, Manufacturing Expense—and that these two avenues of expenditure then join in a final summary of “Cost to Make and Sell.”

It is pertinent to emphasize here the necessity of a complete separation between commercial and manufacturing expense. It is absolutely necessary to know, first, what it costs to produce goods ready for sale, and, second, what it costs to sell them; because a works manager or superintendent may manufacture goods at a cost of production in every way favorable for most successful competition, yet the business may be a dividend-making failure because of excessive expenditures required for marketing the goods. The latter is a condition for which the factory or manufacturing authorities would in no way be responsible.

This is a point which the writer advises every manufacturing institution to give most careful consideration; it often may mean much more than at first would be apparent. In the first place, it places responsibilities for two entirely different functions in a business directly where they belong; in the second place, the administration required for these two elements is broadly different in its nature; in the third place, the cost of making goods in a manufacturing business

should be separated from selling expense and profits by as sharp a dividing line as is the purchase price of goods in a mercantile business. And in the fourth place the manufacturing end of the business should be allowed to participate in the actual making of profits, which should be termed the manufacturing profit; that is to say, if it costs \$50.00 to manufacture a unit it should be charged to the Sales Department at, say \$55.00, the credits for all profits above that to belong to the Sales Department, and the credit for all profits under that to belong to the Manufacturing Department. The desirability of this is obvious. In the first place

<b>Where to Charge Expenses</b>	it establishes the strongest kind of an incentive for a superintendent or works manager to reduce his costs and so increase his showing of profits. In the second place it makes prohibitive the cutting of prices by the Sales Department below a point at which there is no profit, and establishes for the Sales Department a standard price from which to work, so that they will never undertake the sale of goods unknowingly as regards costs; in other words, it establishes a sort of competition in the making of profits between the manufacturing and sales departments, each of which has a common basis to work from.
---	---

The prime divisions of costs, as shown by Figure IV, are the foundation upon which any accounting system must be built; and it is the care and consideration in making a distribution of the subdivisions of these primes that furnishes information by which a business is made successful of otherwise. And in this distribution is probably one of the most troublesome and least satisfactorily understood questions in connection with a manufacturing business. The proper organization

and arrangement of this distribution is as much of a necessity as is departmental organization and arrangement, and, when done properly, must incorporate the physical organization of the factory as a part of its composition. One of the most satisfactory methods of reaching this end is that devised by the writer, as exhibited in Figure V, which he has always made his second step in the work of factory organization and cost accounting.

It is impossible to give on a sheet the size of this book a perfect representation of how this distribution is made, but Figure V conveys in a manner sufficiently clear the idea of the operation of this system.

There is, in this two-page chart, one complete section, "A," Labor, and the three heads, "B," Material, "C," General Expense, and "D," Plant Betterments, constituting a continuous sheet, which gives the three primes, "A," "B" and "C," with a certain number of subdivisions, which, as before stated, constitute the entire expense of a business.

But there is a further expenditure always, as indicated by "D," Plant Betterments. This is an expenditure which is not an expense, inasmuch as every outlay made for such items as are indicated brings an asset to the company. Consequently it is an investment and not an expense.

Of Labor, it is necessary to know two quantities as related to the prime—first, that labor which is nonproductive; second, that which is productive. The writer has found so much misconception of these two terms that a brief explanation will not be out of place here.

Productive Labor, sometimes called Direct Labor, is that labor employed in a plant, whose efforts are

directed solely to processing material into a product for sale.

Nonproductive or Indirect Labor is that labor which is employed in a plant, whose efforts are not applied to the processing of material into a product for sale.

This division should be strictly lived up to for the reason that the opportunity for lessening costs on a given output and equipment lies altogether in the nonproductive labor. To produce a given output requires exactly so much productive labor, and this cannot be varied except by a very small percentage. The amount of nonproductive labor employed on a given output and equipment is, to a great extent, a question of administration, and consequently is subject to a much greater percentage of variation than is productive labor.

In the large sheets used by the writer for Expense Distribution, of which Section "A," Figure V, is an illustration, is made an exhibit of all the information required about a business, so far as expenditures and their distribution go.

First, labor is divided into productive and nonproductive, while under these two subheadings is arranged the classification of labor, as shown by Department Heads, Assistant Heads, Clerks, and so on; Nonproductive, Foremen; Pieceworkers and Day Workers, Productive. Of course, in actual practice, this classification must be arranged to meet the requirements of any particular business. The nonproductive foremen might come under "Department Heads" or "Assistant Heads," but as in nearly all factories there are some productive foremen, space should be provided for them.

It should now be noticed that the arrangement of

the departments is exactly in confirmation of Organization Chart, shown in Figure II, in the preceding chapter, showing by groups here as well as there just what departments belong to manufacturing expense, divided into productive and non-productive departments of a factory, and also just what departments are chargeable to selling expense.

This method of distribution then shows just what the expense of each one of these departments is as regards authorities, clerks, and other workers, as well as common labor; hence any change in the organization, either by increase, decrease or abandonment, exhibits itself in the next succeeding report, as do also any changes in the number of men employed. In other words, this method of distribution always keeps the organization alive and subject to consideration, attention and care.

This method of distribution goes yet further. In addition to showing the exact expense of any class of labor employed in any one department, it gives a total of the nonproductive labor, as well as a grand total of both, for each department, bringing all of the organization heads or authorities into one column, day workers and pieceworkers into their respective columns, so that the footings are—first, the totals, and then the grand total for any individual department; second, the total for any class; third, the grand totals, both in vertical and horizontal columns, the latter two making a cross-checking system, which summarizes into the same set of figures in the lower right-hand corner.

This system gives the total nonproductive labor, the total productive labor, and again the total nonproductive and productive department expenditures in a

factory, and then the total commercial or selling expense. All of these data are presented on one sheet.

**Classification of Labor** In other words, this sheet makes a complete classification, distribution and recapitulation of all the labor employed in a factory, for whatever time period it may be necessary to make an exhibit of.

But this is not all. The classification under "Productive" and "Nonproductive," designated in the bottom horizontal line as "A-1," "A-2," "A-3," and so on, are the charge account numbers. That is, they show the classification and the charge accounts for the regular ledger entries, and are made up as follows: Any department number, in combination with any classification number, constitutes a charge account; i. e., "4—A-3" would be all clerks employed in the cost accounting department; "3—A-3," all clerks in the superintendent's office; while "8—A-6" would be all foremen in the wood shop; or "8—A-7," all pieceworkers in the wood shop; or "8—A-8," all the day workers in the same department. And so on, for any department or class of labor that it is desired to separate into charge accounts. The plan of distributing labor, devised by the writer, has given more satisfaction to accountants in general than anything of a similar nature that has been adopted in years, and is proving of inestimable value to the executive ends of a business.

The writer has, however, carried this method of distribution much further than a mere application to labor, as shown briefly by "B," Material, "C," General Expense, "D," Plant Betterments. "B" is separated into Processing Material, i. e., any kind of material bought, which can be processed. This is again subdivided into Product Material, i. e., any kind of material

bought with which to manufacture product for sale; Equipment Material, i. e., any kind of material bought for the purpose of making tools or machinery for the factory, as made by itself; Construction Material, i. e., any kind of material bought for building or real estate improvements. "B" is again divided into Office Supplies, as indicated by subheads under this; Office Equipment, meaning furniture, fixtures, and other articles; and then again into factory supplies, meaning waste, oils, fuels, small tools, or any other items which would belong to such classification.

"C," General Expense," has exactly the same arrangement, a general list of items being used to make the exhibit, giving a total for general expense and then a summary total for "A," "B," and "C," so that on a working chart each department will have a distribution made to it of all the items indicated in these three sections. Each department is charged with whatever belongs to it in the distribution. It should be borne in mind that the labor in "C-9," however, and the material in "C-10" must be deducted from "A-5" and "B-2" or "B-3," as the case may be, when making distribution of "C" over cost of production. Otherwise, these items would appear twice.

This last caution also applies to shop-made plant betterments, as whatever expenditures are made by a plant on itself for betterments must go as a credit against any expenditures made under "A," "B," and a pro rata amount of "C."

This brings up a point on which many manufacturers seem to be at a loss, and that is that any self-made plant betterment such as, for instance, the making of a machine or tool by a factory for its own use,



should be a matter of capital stock, that is, the department making such a tool should be credited with so much output, in which case the factory has become its own purchaser instead of making an output for outside sale. In other words, instead of placing a contract for betterments with outside contractors, they would have contracted with themselves and the credit should be carried accordingly. First, the factory should be credited with so much output; second, the purchase should be charged to capital stock as an investment the same as though it were purchased outside. I have in so many instances seen work of this nature charged up erroneously to general expense that I have thought it opportune to emphasize the facts as they should be on this point.

## CHAPTER V

### ANALYSIS OF DIFFERENT METHODS OF PAYING LABOR

The absolute necessity of a Cost System for ascertaining the cost of producing goods in any factory, and the necessity of dividing these costs into the cost of labor, cost of material, general factory expense and general office expense, has become a fact too well established to need comment here. It is an element that contributes more to the success of any manufacturing business than any one other outside of the administration itself, and should have every consideration at the hands of any manager who wishes to be successful.

So called Cost Systems are almost as numerous as factories, most of which have been installed without any idea as to the prime principles which cover the collection, tabulation and retention of costs, and it is pertinent to review here in brief the various principles available, in such a way as to show the strength or weakness of each individually, and thus obtain a premise for the compilation to follow.

There are many ways by which the costs of production may be made to make themselves manifest. Day labor is, of course, the oldest method from which costs are computed, and one which makes the labor cost of a product dependent entirely on the honesty and skill of the workman. Its weakness lies in the fact that a manufacturer has no established labor cost on the product which can be maintained, as it is subject to a constant

Day  
Labor and  
Costs

variation in accordance with the honesty and skill of the labor he employs.

The whole question of cost on production has largely grown out of dissatisfaction with this method of paying labor, and the desire for some means which would establish the labor cost at a permanent point, and at the same time stimulate the labor employed to an increased effort. For many years this has been covered by what is known as the "Piece Work System," one that does not reduce the wage cost per piece of output, but does increase the amount of product manufactured with a given amount of labor and manufacturing equipment.

The governing feature in the piece-work system is a good and proportionate reward to labor for increased effort on its part, and a corresponding penalty if this effort is not made, in the shape of a proportionately smaller wage. It established also a fixed price on the labor cost of work, making the estimated cost exactly what the actual cost will ultimately be. The weakness of the piece-work system lies in the fact that invariably the time comes, no matter how the price rate may have been computed, when the wage earned is too high for the labor employed, and rate cutting becomes necessary; which in itself introduces a third penalty of an inverse nature, and one which is somewhat disastrous, and which, broadly speaking, makes the piece-work system carry a penalty for doing poorly—in the small amount of wage earned—and for doing overly well—when too large a wage is earned—the rate-cutting made necessary in the latter case resulting in the partial or whole cessation of further speed effort on the part of the employe, which in turn affects equipment speed, and cost

Piece  
Work  
System

proportionately, thus in a way defeating one of the objects which it was desired to accomplish. The above are the prime facts for consideration in the piece-work system, and it is believed cover the situation exactly as it is, without prejudice for or against it, and are facts which should have most careful consideration on the part of any manager, either when he is about to establish a piece-work price, or when he is about to resort to rate-cutting. To quote Mr. Halsey on piece-work will best bring out some facts as given in a lecture by him, Feb. 7, 1902, in which he says:—

“No man knows what he can do under an incentive until he has tried it. The workman in saying that he cannot ‘make wages’ at the piece prices offered when piece-work is first introduced, is entirely sincere but he is nevertheless mistaken. All experience shows that when the test comes the increase of output under the incentive of piece rates is far beyond what anyone—manager or workman—would have believed possible. The output mounts up and the wages with it, and the employer soon finds that he is paying an extravagant rate of daily wages—an extravagant rate being understood as a rate materially in excess of what it would be necessary to pay another workman for doing the same work, he having the first man’s experience before him. The employer submits to this for a time but the wages continue to increase and ultimately he is driven to his only recourse—he cuts the piece price. This is an immediate announcement to the workman that the promises of piece-work are false. He was told that he would be paid a certain rate per piece, but he finds that to be true up to a certain limit only. The workman, again under compulsion, accepts the new price, but unless he is very dull, he has learned a lesson. If he is very dull

it may require a second cut to enforce this lesson, and this second cut, either on the price of his own work or on that of some fellow-workman, is soon forthcoming. The lesson is that if he pushes his production to a point which raises his earnings beyond a certain more or less clearly defined limit the direct result will be a cut in the piece price. Perhaps new men come in or the old ones are given new work to do—the result is the same. If any one is so unwise or so unfortunate as to do a large amount of work he is at once punished for it by having his rate cut. Such cuts from the workman's standpoint have one result—he is compelled to work harder than before but he earns no more.”

In theory, the facts stated above are all, to a greater or lesser degree, true, but in practice such extreme conditions are found only when, **Premature Adoption of Piece Work** first, due study and consideration have not been given to setting of piece rate in the first place; second, where the management is inexperienced in handling the piece-work system; third, in an old factory where a new work is being developed and a piece rate is set before a sufficient accumulation of experience has been collected from which to determine a piece rate. In factories experienced in handling of piece-work it has been found not always advisable to make the desired cut all at one time but to make it moderate, step by step, until it has been reduced to the necessary point. In this way, confliction with, or dissatisfaction on the part of labor never exists to any such degree as Mr. Halsey suggests. But when, farther on, he says:—

“The workman, of course, looks upon these cuts as an exhibition of pure hoggishness on the part of the employer. While the employer may take undue ad-

vantage in this way, the fact remains that if he does not make the cuts he will eventually do it from necessity, for it can be shown that these cuts are an integral part of the piece-work plan, which can no more be operated without them than a wind-mill can be operated without wind, and for the reason that as the years go by, the whole tendency of prices is downward. There are, of course, periods of advancing prices, but they are short-lived, and are nothing but the incoming waves of the receding tide. The tendency through a series of years is downward and this must be so. It may also be said that this is what industrial civilization is for—to make things cheaper. The whole industrial world is engaged in a ceaseless effort to reduce costs in order to reduce prices, and with so much effort it would be strange if there was not some success. With this future of falling prices before him no manufacturer can contemplate paying the same piece rates ten years hence that he does today. In normal times most manufacturing enterprises are conducted on a small margin of profit, and with a future of falling prices before him, no manufacturer can continue to pay materially more per piece for his work than his competitors pay. The simple fact is that uncut piece rates lead to rates of wages which, under the conditions of competition between manufacturers, cannot be maintained.”

He strikes the true philosophy of the relation between output and labor, for it is a fact that the tendency of everything manufactured is toward a reduction in cost, but his argument must apply to any method of paying labor. The accumulation of experience on the part of labor and the introduction of new methods of tooling, handling, etc., from time to time, are bound to increase

**Necessity  
of  
Reduction**

ency of everything manufactured is toward a reduction in cost, but his argument must apply to any method of paying

the output per capita of any plant in existence, while the maximum wages per capita can never exceed some certain or established limit. Therefore, in day-work, piece-work, or the premium plan of paying labor, the ultimate issue of any product must be a reduction in the cost of labor to produce it.

We now have to consider a proposition which has been under considerable discussion and one that seems to have both its advocates and enemies, and which is known as the "Premium Plan" for paying labor; a plan that would seem to have in it the true economics of manufacture, as it embraces the following points: the lowest possible wage per unit of production; incentive for the labor to maintain the highest equipment output; *any increase of wage decreasing unit cost both, in wage and equipment cost.*

In piece-work we have seen that the wage price per piece is constant and unvarying, except when rate-cutting is resorted to. In other words, the workman receives the full benefit of the increased output on the wage side of cost which he usually sacrifices through over-zealousness in the form of a cut.

Any employer can afford to increase the wage of his employes provided a proportionate increase in output is secured, and if in connection with increased output and an increased wage paid for labor, the cost per piece for both labor and equipment is at the system for paying labor that would be thoroughly practical and desirable in every way, and this is exactly what the Premium Plan purports to accomplish. The higher the wage paid, the less the cost per piece for both wage and equipment.

This is obtained by setting a time limit on a piece

of work which shall be from a day pay basis, and a division made between employer and employe of any wage saved by the lessening of the time limit on any given piece of work. Under this plan, there is no possibility of rate cutting taking place, except by mutual adjustment between the employer and the employe due to some new method of procedure in manufacture, and

its only weakness would seem to be in the fact that the system is one that offers rewards for increased effort on the part of the employe, without subjecting him to any penalty for not making increased effort, inasmuch as the time limit is practically a guarantee for a certain day's wage, but this in itself has one virtue, as it leads to less contention among the employers in the installation of a cost system. Mr. Halsey's own illustration exemplifies the plan very nicely.

"To gather the exact workings of the plan, assume a concrete case. A workman is paid (say) \$3.00 per day and produces one piece of a kind per day—that is in 10 hours. He is told that he will continue to be paid his \$3.00 a day as before but that if he will reduce the time on the piece he will be paid in addition to his wages a premium of ten cents for each hour saved. If he reduces the time by an hour that hour represents in money value a gross saving of thirty cents. Ten cents of this amount is paid to him as a premium, leaving the remaining twenty cents in the employer's possession—this sum making itself manifest in the reduced cost of the work. If the workman goes on reducing the time in which the piece is made, the same process is repeated, each hour saved resulting in an increase in the workman's wages of ten cents and in a reduced cost of twenty cents. In other words, the wages go up and the



SLIP NO. \_\_\_\_\_ DEPARTMENT \_\_\_\_\_ KEEP THIS SLIP CLEAN. FORM NO 9,  
 TO EXPENSE CHARGE \_\_\_\_\_  
 DATE ISSUED \_\_\_\_\_ DATE FINISHED \_\_\_\_\_

**WORKMANS COST TIME SLIP.**

USE ONE SLIP FOR EACH JOB OR OPERATION

STOCK ORDER NO.	SHIPPING ORDER NO.	MODEL NO.	HEADING NO.	PIECES	DRAWING NO.	PATTERN NO.	DIE OR JIG NO.	OPERATION NO.	BILL OF MATERIAL NO.	HOUR STARTED	HOUR STOPPED	HOUR TRANSFERRED TO SLIP NO.	OPERATION OR KIND OF WORK	TIME LIMIT PER																									
DAY OF MONTH AND HOURS TIME																																							
DAY OF MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL	GAIN	LOSS	OVER-TIME	RATE			
MANS TIME																																							
MACHINE TOOL TIME																																							

WORKMANS NAME \_\_\_\_\_ CLOCK OR CHECK NO. \_\_\_\_\_ KIND OF MATERIAL \_\_\_\_\_  
 MACHINE TOOLS NAME \_\_\_\_\_ NO. \_\_\_\_\_ WEIGHT OR MEASURE \_\_\_\_\_ COST \_\_\_\_\_  
 DEFECTS ACCEPTED BY \_\_\_\_\_ HOURS LABOR \_\_\_\_\_ COST \_\_\_\_\_  
 THIS WORK INSPECTED AND FOUND O. K. \_\_\_\_\_ HOURS TOOL TIME \_\_\_\_\_ TOTAL COST \_\_\_\_\_  
 \_\_\_\_\_ INSPECTOR \_\_\_\_\_ COST OF ONE \_\_\_\_\_

Figure XI. The Workman's Cost Time Slip

## ORGANIZING A FACTORY

## MONTHLY TIME RE

G. T. = GAIN TIME ON PREMIUM WORK.

L. T. = LOST " " " " " "

## DISTRIBUTION OF JOB

FACTORY NO. \_\_\_\_\_

EMPLOYEES NAME AND CLOCK OR CHECK NO.	KIND OF TIME	1 ST.			2 ND.			3 RD.			4 TH.			5 TH.	
		HOURS TIME	SHOP ORDER NO.	TO EXPENSE CHARGE	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.
	R. T.														
	G. T.														
	L. T.														
	O. T.														
	R. T.														
	O. T.														
	R. T.														
	G. T.														
	L. T.														
	O. T.														

FIGURE XIII. From serving for the monthly record

R. T. = REGULAR TIME ON DAY WORK.

O. T. = OVERTIME ON DAY WORK.

## MONTHLY TIME RECORD

## DISTRIBUTION OF JOB

FACTORY NO. \_\_\_\_\_

MACHINE NAME AND NUMBER	KIND OF TIME	1 ST.			2 ND.			3 RD.			4 TH.			5 TH.	
		HOURS TIME	SHOP ORDER NO.	TO EXPENSE CHARGE	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.
	R. T.														
	O. T.														
	R. T.														
	O. T.														
	R. T.														
	O. T.														
	R. T.														
	O. T.														
	R. T.														
	O. T.														

FIGURE XIV. From serving for the

CORD OF LABOR.

R. T. = REGULAR TIME ON DAY WORK.

O. T. = OVERTIME ON DAY WORK.

NUMBERS & EXPENSE.

MONTH ENDING. -----

FORM NO. 13

28 TH.			29 TH.			30 TH.			31 ST.			TOTAL HOURS WORK PER MONTH	RATE PER HOUR	TOTAL EARNINGS PER MONTH	GRAND TOTAL OF MONTHLY EARNINGS
S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.				

of Time Labor and Non-productive cost on any job

CORD  
OF MACHINE TOOLS.

STANDARD TIME PER MONTH FOR MACHINE

TOOLS 166 HOURS.

NUMBERS & EXPENSE.

MONTH ENDING. -----

FORM NO. 14

28 TH.			29 TH.			30 TH.			31 ST.			TOTAL HOURS WORK PER MONTH	RATE PER HOUR	TOTAL EARNINGS PER MONTH	GRAND TOTAL OF MONTHLY EARNINGS
S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.	S.O. No.	T.E. CHG.	H. T.				

monthly record of Machine Tools

## ORGANIZING A FACTORY

DATE	<b>DAILY</b>		FORM NO. 10.
			DEPT.
<b>PIECE WORK CHECK</b>			
ON COST SLIP NO.	SHOP ORDER NO.	MODEL NO.	
WORKMANS NAME		CLOCK OR CHECK NO.	
MACHINE TOOLS NAME	NO.	TO EXPENSE CHARGE	
NO. RECEIVED	NO. REJECTED	NO. RETURNED	
NO. ACCEPTED			INSPECTOR.
A. M. IN	OUT	P. M. IN	OUT TOTAL HOURS

FIGURE XV. Daily Piece Work Check

DATE	<b>DAILY</b>		FORM NO. 11.
			DEPT.
<b>DAYWORK CHECK</b>			
ON COST SLIP NO.	SHOP ORDER NO.	MODEL NO.	
WORKMANS NAME		CLOCK OR CHECK NO.	
MACHINE TOOLS NAME	NO.	TO EXPENSE CHARGE	
A. M. IN	OUT		
P. M. IN	OUT	TOTAL HOURS	
O. K.	TIME KEEPER.		

FIGURE XVI. Daily Day Work Check

costs go down simultaneously, to increase the wages of the latter, and the remainder going to reduce the cost to the former. This is shown in the accompanying table, which, for purpose of illustration, is extended until the workman has doubled his output, in which case the (wages) cost of the work has gone down from \$3.00 to \$2.00 while the workman's earnings per day have advanced from \$3.00 to \$4.00.

THE WORKINGS OF THE PREMIUM PLAN.

1	2	3	4	5
Time consumed, hours.	Wages per piece, dollars.	Premium, dollars.	Total cost of work = col. 2 + col. 3, dollars.	Workman's earnings per hr. = col. 4 + col. 1, dollars.
10	3.00	0.	3.	.30
9	2.70	.10	2.80	.311
8	2.40	.20	2.60	.325
7	2.10	.30	2.40	.343
6	1.80	.40	2.20	.366
5	1.50	.50	2.00	.40

“There is, of course, a considerable gain to the employer due to the increased production from a given plant, since the secondary costs of production—the expense items which make up the burden and which must be added to the cost of labor and material in order to obtain the ultimate true cost—are increased but little in consequence of the intensified production.”

One thing is obvious, and that is, that every possible consideration and study must be given to the establishing of the time limit, as it must not be too low or too high. If a man can do a certain piece of work in four hours, and the records of a factory for quite a period of time show this to be a fact, a time limit not

greater than two and one-half or three hours should be established, and any time over be divided between the employer and the employe on such basis as found desirable, though usually it has been found most satisfactory to make the division an even one; half the saving going to each, the employer getting the greater benefit of the two by the reduced equipment cost per piece.

**The  
Time  
Limit**

Comparatively speaking, wage by piece-work exceeding a certain limit must be cut by the employer to preserve equilibrium, the moral effect of which is to kill any further alertness on the part of the employes to maintain or increase speed of production, and as before stated, carried with it two contrary acting penalties.

While the Premium System may not be as direct in its intensification of production as the piece-work system, it certainly seems more permanent in its effect; much more equitable in its distribution of cost saving as between employer and employe; and further it seems to be governed by true economical principles in manufacture, and is now employed in many of the factories of the largest industries of the country.

Another system that has had considerable attention, is known as the "Differential Piece Rate System," in which the piece price starts off at a comparatively low figure. That is to say, for a given amount of work per day the wage earned on piece-work would be much less than would be paid if the laborer was working by the hour or day for the same amount of work—the purpose of which is two-fold. First, to stimulate activity toward increased effort on the part of the employe, and second, to attach a penalty for too great an effort on his part if the workmanship is inferior. The method is to set

**Differential  
Piece Rate  
System**

a price for the amount of work that is to be done in a specified time, exceeding which the price is raised per piece not only for the work done in excess of the limit set, but for the entire contract or number of pieces both under and over the limit. The result claimed for this by those who have tried the system is less immediately incentive on the part of labor to establish speed than in the direct system, while the penalty, if the workmanship is inferior but passable, is greater,—as in this case the piece price is not raised though the amount of work done per day has exceeded the limit set. Good workmanship, however, results in high average pay to the labor, but without any reduction in wage cost per piece; the aim being the attainment of an extremely low equipment cost per piece by causing the labor to raise a large output in production.

The weakness, if any, in this system, lies in the fact that absolute prior certainty must be arrived at regarding the cost of production relative to labor and also ultimate machine capacity, as a mistake in this would result in the complete failure of the system—in one case discouraging the worker by having set an unattainable limit, and on the other hand, by the setting of a too easily attained speed of production, necessitating rate cutting, or what amounts to the same thing, increasing the amount of work done in the same limit of time.

This review of the various methods employed for setting a labor wage brings us face to face with a condition much to be desired, but which had never been realized, until the writer solved the question; and that is a cost system applicable to a wide range of products as made in different factories, or by different factories under correspond-

**A New  
Cost  
System**

ing varying conditions; also a cost system which would further have its blanks and forms so perfected as to be used on any and all of the methods above described for paying labor.

Up to the present time, the introduction of the Premium Plan has been rather uncertain, owing to the lack of any prior uniformity in collecting costs from which to establish a time limit, which is one of the vital factors in the whole system. But in the present system an entirely new arrangement has been effected, the first of its kind by which these time limits can be established on a day pay basis, and afterwards piece-work or a premium plan introduced without in any way changing the system already in vogue or the blanks and forms used. As a matter of fact, this system is designed so that all of the blanks and forms can be used for either

<b>Time Limit on Day Pay Basis</b>	day work, piece-work, or premium plan of paying labor; an advance in cost keeping of unusual importance and inestimable
--	---

value when one considers that in nearly every factory it is absolutely necessary to establish either piece-work or a premium plan on all or part of the items manufactured, and also that the nonproductive labor of the factory is always on a day pay basis. The value of the following system in carrying all classes and conditions of labor on the same forms and blanks making it possible to change from one method of paying to another any time it may be found desirable or necessary to do so, will be fully appreciated by those who have had experience in an endeavor to create a cost system that would be satisfactory in such respects and meet all the varying conditions mentioned.



## CHAPTER VI

### DEPRECIATION OF TOOLS AND ITS RELATION TO COST

Ask any foreman of any machine shop how he keeps track of the depreciation on machine tools and equipment.

If he does not frankly admit that he has no accurate system of keeping such records, the chances are that he will answer boldly that he figures the annual depreciation at "10 per cent."

There is no good reason why 10 per cent should be accepted as a basis for figuring the depreciation other than that it is the figure that most manufacturers have arbitrarily accepted for years past. It is assumed that 10 per cent is a fair estimate of the annual depreciation on machine tools. Accordingly "10 per cent" is the reply you will probably get to your inquiry from the foreman who feels that he must answer "something."

One of the first points for consideration in arranging the general organization of a factory, and especially its accounting systems, is the consideration that it will be given to depreciations. Notwithstanding the many differences of opinion on this point, it bears directly on the cost of production. Depreciation, especially on machine tools, is as much a part of the direct cost of production as are labor and material ordinarily called "flat" costs.

I do not know of one single item that has been more confusing to managers and superintendents than this one. Many small factories do not write off any depre-

ciation whatever on their machine tool equipment, but carry their initial values on their inventories from year to year. Others write off a certain percentage each year, usually 7½ or 10 per cent. But this is obviously wrong, as there is certainly no equity in charging off a straight percentage for the entire equipment of machine tools in a shop when it is evident that some of these must be used greatly in excess of others and should have a corresponding depreciation charge. A lathe, for instance, used but one week in a month would have an actual life four times as long as one used every working day, and this is a condition that prevails to a greater or less degree in every factory. Such a method writes off a specific sum without any regard to the actual amount of wear and tear on a machine and offers no way of figuring correctly the cost of production in any one department, when that department is making a complete product in itself.

Machinery that is used directly in the manufacture of goods for sale should be considered in the same light as labor, inasmuch as a machine tool, as a productive factor, is nothing more or less than a substitute for hand labor, but, unlike such labor, is an asset of a company, subject to interest on the investment required for it, and also to a depreciation charge in proportion to the amount that it is used per annum.

To arrive at a proportionate and proper appreciation charge of machine tools, a wage should be established for them that will enable them to pay for themselves in direct proportion to their usage. To establish such a wage, the known or estimated life of a machine tool must first be given, which, broadly speaking, is as follows:

**Antiquated  
Methods  
Common**

**A Wage  
for Machine  
Tools**

High-speed machines, ten years.

Medium-speed machines, fifteen years.

Large and slow machines, twenty years.

The years are assumed to be composed of 2,000 hours each, which is about 166 hours a month, or an average of six and four-tenths hours a day of twenty-six working days a month.

The above, in general, applies to power equipments, either steam or electrical, and a depreciation charge can be carried on them in the same way, if desired.

On such a basis it becomes apparent at once that a machine tool is enabled to retire itself pro rata to the time worked without regard to actual years in service. To establish an hourly wage for any machine tool, we must take into consideration the amount of interest due on the investment itself, and distribute this in such a way that we may have a uniform hour rate for the entire period of time required, as the complication of setting a different hour rate for each year to correspond with reductions brought about by principal and interest credits is altogether undesirable.

To illustrate this: If a machine costs \$100 and we wish to retire it in one year, it would have to earn \$106 on a six per cent interest basis in 2,000 hours. If we wish to retire the same machine in two years, we would have \$6 interest for the first year. The reduction of a \$50 earning on the first year would leave \$50 to be earned for the second year, on which there would be \$3 interest, the total amount to be earned on the machine being \$109 for two years or \$54.50 a year, which would amount to an hourly wage of .027 cent per hour.

It is on this basis and for this purpose that the accompanying depreciation tables have been computed by the writer. These tables are carried up to values of

\$1,500 for twenty years, and, of course, any value in excess of this may easily be found by adding the proper amounts together. For instance, \$2,000 should be twice the amount of \$1,000 or \$3,000 should be twice the amount of \$1,500, and so on indefinitely.

To find the amount to be earned annually for any given cost, or any number of years up to twenty, take the figure representing the known cost in the left-hand column, follow this line to the right until it intersects the required number of years, which figure will show the amount to be earned annually for that number of years, and includes all interest at six per cent.

**How  
to  
Handle Tables**

the figure representing the known cost in the left-hand column, follow this line to the right until it intersects the required number of years, which figure will show the amount to be earned annually for that number of years, and includes all interest at six per cent.

Likewise in the table of wage an hour for machine tools, the intersecting point of years and amount indicate the wage to be earned hourly to earn the sum given in that number of years, based on 2,000 hours a year, including all interests.

The foregoing explanation, it is believed, will clear up all doubt as to the fact that the creation of a fund for the replacement of machine tools which are subject to depreciation to the extent of their full value in a certain given time is also as much a charge to cost of production where such tools are used directly on the production of goods for sale as is the labor employed to operate these tools. And like labor, it must be divided into both productive and nonproductive cost elements of a business.

Expenses chargeable are derived from two factors:

First, the depreciation of a tool itself in accordance with its life.

Second, the upkeep of the tool, which consists of all the expense attached to its active elements of operation, i. e., the making of all cutters or cutting tools that are

subject to daily and constant wear during the process of manufacture.

A full complement of miscellaneous tools for each machine tool should be a living asset in the inventory, but no machine should ever be inventoried for more than one complement of these miscellaneous tools, as constant wear and tear on them is a subject of upkeep expense, as before stated.

From this it is readily understood that the expense attached to the depreciation of a machine tool is chargeable to production cost in the same ratio that labor is when used in the manufacture of a product to be sold, and is chargeable to non-productive cost in the same ratio that labor is, when so used. Consequently all time slips used by the men should bear spaces in which may be recorded the time of the tool as well as the time of the man. It will also be seen that upkeep or maintenance is chargeable to nonproductive or overhead costs exclusively, the gauge to all of which is the amount of time worked.

There are other factors that are brought into life by this method of dealing with machine tools that are almost of as much value as the foregoing. By keeping time on machine tools in the way outlined, the records show not only where and how fast the fund for replacing tools is derived, but also show the exact age of the tool. A machine may have been in a factory five years, and yet be only three years old in service, or it may have been in the factory but three years and be four or five years old in service. Collectively, such a record from a factory shows at the end of each month how well the entire equipment of the factory has been employed, and thus enables the manager to point out ex-

actly how work can be best distributed to make the investment earn the greatest possible revenue. In many instances it will prevent additional investment for new equipment by pointing out what portions of the equipment are most often idle. In a factory there is no more excuse for idle tools than there is for idle men, and many a manager, for lack of proper data regarding his equipment, has been forced into buying new machine tools when twenty-five per cent of those he had were idle.

The method of keeping these records is very simple, and is explained very fully in sections covering the description of record sheets.

A vast amount of inquiry among various manufacturers and users (the details of which will not be gone into here) has shown the foregoing tables of life for the active units used in a factory to be a safe guide to go by in considering depreciations. The amount of salvage to be obtained after the life of a unit has expired can be relied upon as it is given here, but it must be understood that the percentage given is on the original cost and does not include any labor or material that may have been afterwards added. That is to say, all of the original cost, including countershafting, freight and installation, must be included, but not any changes that may afterward be made.

Many will undoubtedly say after reading the above that they have many machine tools that are out of use more or less of the time which will make it difficult to apply such a method, but this is just exactly where the method is most needed, as it shows up what and where and in what ratio the equipment of the plant is being used. Others will bring up the argument that machine tools

**Real  
Age of  
Tools**

**Uses of  
Depreciation  
Tables**

are often thrown out after having been in service a comparatively short time for the reason that improved tools are bought to take their places and that this method of writing off depreciations can not be made to apply. This depends altogether on what disposition is made of the expense of the machine or tool discarded; some manufacturers prefer to write it off in full and charge the loss direct to expense for current year. But obviously this is not fair. If a tool has been in service three years, and is then thrown out because of imperfections, three years' depreciation should then be written for a credit to this machine. Then whatever it is sold for as junk or as a second-hand machine should be credited to it, and in case of a substitution, the balance charged to the cost of the new machine, as that is precisely what it has cost to put the new machine in the factory. This will then distribute the burden of this expense over the life of the new machine. Unless this method is adopted, the loss on the old machine must go to profit and loss. If for any reason the latter method is preferable, the expense of the new machine will be exactly what it cost and depreciated accordingly.

There is another condition attached to this method of writing off depreciation of no inconsiderable value besides depreciating a machine in proportion to its use. By using an hour wage the expense of depreciation is distributed in the only equitable way possible over the product made. Parts that require an expensive tool or much tool time thus have a perfect division of their pro rata share of this expense placed upon them, which figured down to individual operations often results in a change in price.

**Tables Show  
the Actual  
Cost**

Further, it is the only method for determining of

what actual value the machine has been, and what portion is a direct loss in case it is discarded and all written off at once. There are instances where managers have tried to consolidate with depreciations on tools other items of expense, such as power and repairs, and put the total into an hourly or daily wage basis. But this is obviously wrong, as it practically puts the whole charge of these items into a general expense fund, rather than a portion of it into a sinking fund for the renewal of machinery when it is worn out. The nature of this depreciation and of obtaining a fund for renewals is so specific in its nature that it should not be confounded with any other expense.

In pro-rating the power of a factory over machine tools for the purpose of arriving at a charge an hour for such power, the whole matter should be the subject of a separate charge account. This should again be subdivided into that portion actually used by each machine as compared with all the power lost or absorbed in transmission devices. That is to say, the friction load of an engine of the power that it takes to run a factory when the machine tools are not operating should be pro-rated in the shape of a general charge rather than in the shape of power.

But this is a subject foreign to this subject and will not be dwelt upon further in this chapter.



## CHAPTER VII

### A COMPLETE ANALYSIS OF THE ELEMENTS OF A COST SYSTEM

To devise and arrange a factory cost accounting system it is necessary to know just where to commence. And this knowledge is the result of a study of the general conditions in that particular plant under consideration.

From this starting point can be formulated a comprehensive chart or series of charts, that will give a complete anatomy by which to express a manufacturing business in its every detail. By these charts, also, we can dissect or diagnose every movement of the product manufactured and the authority that controls these movements from raw material to finished units—a fact which most cost accounting systems have completely ignored.

To systematize and discipline a manufacturing plant, as well as its departmental organization, is almost wholly within the province of cost accounting. As a matter of fact, there is no other instrument by which these necessities to a plant can be reached successfully. The great error in most systems has been in trying to make a cost system fit already existing conditions too closely. This always results in fragmentary work and results. To be successful, a factory cost accounting system must be a unit as complete in itself as is a unit covered by either some mechanical or governmental expression, for it pertains to both elements.

The first chart required, as the skeleton for our

physical expression, draws all of the various departments in a plant, as is illustrated in Figure II. But to arrive at this in a proper way, the product manufactured must be analyzed. This analysis must show :—

**Analysis to  
Secure the  
Skeleton**

First, the units as a whole.

Second, the parts of each unit, and

Third, the operations on each part of each unit.

For it is only by this that we can find out how to divide a plant into departments and then how to relate these departments one to another, so as to give the most progressive movement possible to the product manufactured.

Raw material at one end and finished product at the other is always the governing principle in factory organization, if cost for shop transportation and expeditious handling by productive labor is to be considered. Modifications to this are, of course, made in case large parts are made and shipped without assembling into a complete unit at a factory, or when parts are manufactured and shipped without assembling at all. In such cases the departments which make such a part can be considered as a plant in itself, and the part in its relation to such department or departments may be considered a complete unit in itself. All of this, however, does not alter the classification and relation of the part to the business as a whole.

Therefore, of a part we must know (Figure VI) :  
 First, its name; second, its model number; third, its own number; fourth, its drawing number; fifth, its pattern number; sixth, its flask number; seventh, its die or jig number (one or all as the case may be); and eighth, the number and description of all the operations required to make

**Facts Concern-  
ing Each  
Part**

it a completed part, together with the kind and measure of material used, and the number of individual parts required to make the completed unit for which it is designed. All of the different parts required for a completed unit should be classified under its model number. The necessity of this will become apparent when the method employed for collecting costs is explained.

With the above information in hand, it is not difficult to study out the best and necessary departmental divisions for a progressive movement of the product to be manufactured. All important in this is the location of rough and finished stores; each department and each location of stores should be numerically and alphabetically arranged for classification and identification.

The next step in the preparation of a cost accounting system is the classification and numbering of all the machine tools and equipment, jigs, dies, etc., and also all of the power units and equipment. For in this lies great value in connection with a perpetual inventory system, saving a vast amount of time each year, and at the same time giving correct value, minus depreciations.

Therefore, of machine tools (Figure VII) and power equipment, we must know: First, name of machine; second, maker's serial number; third, size number; fourth, catalogue number; fifth, from whom purchased; sixth, date of purchase; seventh, original cost; eighth, freight and installation cost; ninth, total cost; tenth, estimated life; eleventh, present value, in all or part, as the case may be; and a list of all accessories that would form a live inventory, as this data not only has to do with what is known as the perpetual inventory, but also with costs of production.

**Inventory  
of  
Equipment**

The same applies to all patterns, jigs, dies, for purposes of perpetual inventory and classification.

On patterns we must have (Figure VIII); First, name of pattern; also description if necessary; second, date made; third, from drawing, number made; fourth, for parts, number made; fifth, flask number; sixth, flask size; seventh, follow board; eighth, kind of material; ninth, cost of material; tenth, cost of labor; eleventh, tool cost; twelfth, overhead cost; thirteenth, total cost; fourteenth, date and present value; fifteenth, number of pattern.

On dies, jigs and special tools (Figure IX), we must have: First, name, also description, if necessary; second, number of itself; third, parts number; fourth, kind of material; fifth, cost of material; sixth, cost of labor; seventh, tool cost; eighth, total cost; ninth, date and present value.

If these items are all carried out as above, it not only gives a complete record of them, but makes a complete inventory for the life of any of the articles enumerated, as nothing remains to do each year but write off on the record cards depreciation in proportion to their life, except when they are thrown out and retired entirely by either abandonment or substitution. Thus this forms the first work to be done in preparing a factory cost accounting system and what is known as a perpetual inventory system—although, literally speaking, the latter is a misnomer; but as this comes under record-keeping, we will not attempt to go into it here.

The final form (Figure X) is self-explanatory, except, perhaps, it is necessary to observe that the back of the card is used for carrying inventory of valuations of these drawings from year to year, thus putting these items into the machine tool classification.

PARTS COST CARD.										FORM NO. 12
FACTORY NO. _____			CARD NO. _____							
HEADING NO. _____		MODEL NO. _____		PARTS NAME _____						
KIND OF MATERIAL USED _____			LABOR _____			MACHINE TOOL _____				
No.	OPERATION.			TIME	RATE	COST.	TIME	RATE	COST.	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
TOTALS										
										FORWARD.

FIGURE XVII (obverse). The Parts Cost Card, showing a complete statement of cost

			LABOR			MACHINE TOOL.			
No.	OPERATION			TIME	RATE	COST.	TIME	RATE	COST.
FORWARD.									
TOTALS.									
LIST PRICE				GRAND TOTAL.					
DISCOUNTS.				MATERIAL COST					
NET PRICE.				OVERHEAD EXPENSE					
FILLED IN BY.				TOTAL PARTS COST.					

FIGURE XVII (reverse). The Parts Cost Card

PRODUCTION ORDER NO. _____ SHIPING STOCK.				<b>BILL OF MATERIAL</b>						
LATEST TIME OF SHIPMENT, _____				NO. _____						
				ISSUED BY _____						
NO. OF PARTS REQUIRED	TO EXPENSE CHARGE	HEADING NO.	NAME OF PARTS	DRAWING NO.	PATTERN NO.	DIE OR JIG NO.	KIND OF MATERIAL	NO. OF OPERATION REQUIRED	GOES TO DEPT.	ISSUED TO FOLLOWING SLIP AND CLOCK OR CHECK NUMBERS ON DATES GIVEN THERE ON AND BELOW

FIGURE XII. The Bill of Material which is issued in the

<b>STORES RECORD FROM _____ TO _____</b>										<b>FORM NO. 82</b>
BIN NO. _____			RACK NO. _____			SHELF OR FLOOR SPACE NO. _____				
ARTICLE _____										
SPECIFICATIONS _____						MATERIAL _____				
STANDARD _____						SPECIAL _____				
MAXIMUM TO BE CARRIED IN STOCK _____						MINIMUM TO BE CARRIED IN STOCK _____				
ORDERED	DATE _____									
	FROM WHOM _____									
	MEASURE _____									
RECEIVED	DATE _____									
	FROM WHOM _____									
	SHOP ORDER NO. _____									
GIVEN OUT	MEASURE _____									
	PRICE _____									
ON HAND	DATE _____									
	ENTERED BY _____									
	OFFICE RECORD, POST EVERY 4 WEEKS									

FIGURE XXII. A detailed card for a specified time on which are posted receipts and deliveries of stock

<b>DESCRIPTION OF ARTICLE</b>												<b>FORM NO. 30</b>
<b>RECEIVED</b>				<b>GIVEN OUT</b>				<b>GIVEN OUT</b>				
DATE ORDERED	DATE INVOICE	FROM	QUANTITY	DATE	DEPT.	QUANTITY	BALANCE	DATE	DEPT.	QUANTITY	BALANCE	

FIGURE XX. The first of the cards on which the Chief Stores Clerk records stock on hand

		<table border="1"> <tr> <td>NAME</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>MODEL NO.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>SERIAL NO.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>						NAME						MODEL NO.						SERIAL NO.						FORM NO. 7	
NAME																											
MODEL NO.																											
SERIAL NO.																											
DATE _____																											
RETURNED AFTER OPERATION No.	ISSUED FOR FINISHING TO SLIP No.	QUANTITIES AND DATES, AS FINISHED	REISSUED FOR ASSEMBLING TO SLIP No.	WEIGHT OR MEASURE OUT	WEIGHT OR MEASURE IN	AMOUNT USED	AMOUNT SPOILED	AMOUNT GOOD	MATERIAL PRICE	TOTAL COST	COST OF ONE																

Superintendent's office before work on an order is begun

			FORM NO. 31		
STORES RECORD FROM _____ 190 TO _____ 190					
BIN NO. _____		RACK NO. _____		SHELF OR FLOOR SPACE NO. _____	
ARTICLE _____					
SPECIFICATIONS _____				MATERIAL _____	
STANDARD _____				SPECIAL _____	
MAXIMUM TO BE CARRIED IN STOCK			MINIMUM TO BE CARRIED IN STOCK		
RECEIVED	DATE				
	FROM WHOM				
	SHOP ORDER NO.				
DATE	MEASURE				
	FROM TO				
GIVEN OUT	MEASURE				
ON HAND	DATE				
	MEASURE				
		ENTERED BY _____			

FIGURE XXI. A detailed card for a specified time on which are posted receipts and deliveries of stock

## ORGANIZING A FACTORY

SEE FILE NO. -----		CARD NO. -----	
<b>APPLICATION FOR POSITION</b>			
APPLICANT'S NO. -----		190	
NAME -----		TOWN -----	
COUNTY -----		STATE -----	
NOW EMPLOYED AT -----		TRADE -----	TIME AT TRADE -----
AS -----			
AGE -----	WHERE EMPLOYED LAST -----	WHY RELEASED -----	HOW LONG THERE -----
MARRIED -----	EDUCATION -----	WHERE -----	REFERENCES -----
SINGLE -----			
RELATIVES IN FACTORIES -----			
NATIONALITY -----		U. S. CITIZEN -----	
LANGUAGES SPOKEN -----			
UNION OR NON-UNION -----			

FIGURE XVIII. The card bearing detailed information of the application for work

<b>RECORD OF WORK SPOILED</b>											
DATE											
PARTS NO.											
COST											
<b>REMARKS</b>											
DEPT. -----											
SEE FILE NO. -----		CARD NO. -----									
<b>EMPLOYEE'S RECORD CARD</b>											
NAME -----						APPLICANT'S NO. -----					
ADDRESS -----						FILE NO. -----					
POSITION -----						WORK -----					
DATE FIRST EMPLOYED -----						CHECK OR CLOCK NO. -----					
NATIONALITY -----						U. S. CITIZEN -----					
TRADE -----						RATE PER -----					
						AGE { MARRIED SINGLE					
CHANGE OF WAGES	DATE										
	RATE										
DATE QUIT -----						CAUSE -----					
DATE DISCHARGED -----						CAUSE -----					
TRANSF'D TO	DEPT.										
	DATE										

FIGURE XIX. Employee's Record Card. Record of Work Spoiled Card



## CHAPTER VIII

### THE MACHINERY OF COST GETTING

A practical cost system must not only give the cost of a unit as a whole, but to be effective it must also give the cost of each part, and the cost of each operation of each part.

The reasons for this are obvious. A plant manager must know exactly where a reduction in the cost of a product can be made, in case competition is too close or dividends are unsatisfactory. If competitors in the same line can at any time undersell him, one of two things is evident: They are either manufacturing their goods cheaper, or they are doing business without profit. Consequently any method employed for collecting and tabulating cost on a product must be such as will reveal just where it is possible to reduce the cost of manufacture by changing the method of tooling, the method of handling, the method of assembling, or even the design of the part itself. As pointed out before, this is especially necessary in those elements that go to make up nonproductive costs.

Further, a cost system to be effective must be systematized in such a way as to permit of the use of any or all different methods of paying labor that may become necessary. In other words, the system must be such that, after a few weeks paying of labor by the day or hour, the facts relative to the cost per piece or per operation can be obtained so accurately as to enable the adoption of either piece-work at so much per piece, or

the premium plan of paying by establishing the time limit per piece.

A system for keeping cost in such detail will enable a plant manager to tell, definitely and with surety, prices for repairs. It also gives him, in connection with a proper bill of material or specification sheet and a stores record of material, an absolute key as to the amount of stock required to make up any special contract or sheet order. Thus in figuring estimates on work he can make them with a certainty regarding profits, and in making purchase of material for them he can do so without over or under buying. This certainty can be reached in no other way and is a thing of no small importance in itself.

The several groupings in a cost system and the several items that compose each group must be arranged in such a way that the latter shall be tabulated not only for use in connection with the cost system, but shall also be in the form of what is known as a perpetual inventory. By this means the value of power, equipment, machine tools, small tools and et ceteras of such nature can be readily ascertained at a moment's notice. This plan, in conjunction with proper methods of handling material and stock, composes what is practically known as a Perpetual Inventory System.

The first desideratum in the devising of a system as set forth in Chapter VII for collecting costs in the analysis of items to be manufactured. These items must have due consideration in the draughting or sample room, where they are divided into parts and the number of operations required on a piece of raw material to make it earn the name of part. They should then be classified on a card, as in Figure VI, to be used for

reference by the Superintendent, Stores Clerk and Cost Clerks.

Each one of these parts must be given a heading number to distinguish it from all other parts—for instance, in the manufacture of harvesting machines, take a wheel. There are many sizes and kinds of wheels, but "Wheel," as the name of a part, should always have the same number. Thus No. 22 would always mean a wheel, no matter what kind of a wheel it might be; while H22 or M22 would indicate the model or specific kind of a wheel that was to be covered. This Parts' Key Card has also on it, as indicated, the drawing number, the pattern number, the die or jig number, the kind of material that is used and the amount required, the model that the part is used on, and the name and number of the operations required to make a piece of rough material into a completed part. This card is the first step in the compilation of a cost system, as from it all the necessary numbers and names are obtained with which to mark job tickets, bills of materials, and other forms, as may be required. It serves no purpose beyond this, being precisely what its name indicates—a Key Card, one of which must be made out for every piece or part manufactured in a factory.

The next step is the matter of records for patterns, dies, jigs, special tools and machine tools, as indicated by Figures VII, VIII, and IX. The items specified on these cards are so self-explanatory as hardly to need detailed description. They serve three purposes; first, they serve to make a complete reference record regarding the several items they cover; second, they serve as a perpetual inventory; and, third, in connection with the Machine Tool Record Card, they indicate at a glance

Accu-  
rate  
Record

the hour rate to be charged for the hourly wage to be earned by any machine tool.

Too much importance cannot be attached to the exact filling in and recording of all items that are to be covered by these cards. They should be filed in such a manner as to be immediately accessible for the purposes for which they are designed, one complete set for the main office, one for the Cost Clerk, and one for the Storekeeper.

We now come to what is really the vital part of a cost system—the methods and forms used for the primary collection of the costs on labor and material, commonly termed “flat cost.”

Whenever it is proposed to build anything, whether it is a house or a machine or railroad, the first thing that has to be done is to make an estimate on the amount of material that will be required. An architect in his specifications always furnishes what is called a “Bill of Material,” from which contractors figure their estimates. In connection with cost systems an entirely new feature covering this same has been introduced by the writer. Whenever a production order is issued to the manufacturing end of a business from the main office, it does not carry with it a bill of material. Consequently the latter must be made up by the Superintendent, or whomever he may deputize, before a requisition for the purchase of material to cover the production order can be made. The method as adopted by the writer is to make this bill of material a permanent record in connection with the production order, and to further make it a record of the progress upon the work required on the material it represents. Upon it is also placed such necessary information as is required for

filling out the workman's cost time slips, job tickets, and so on, as shown in Figure XI.

This bill for material is made out in duplicate (Figure XII). One copy is retained by the person who makes it out originally; the other is given to the Chief Stores Clerk, together with a copy of the production order which it covers. The original filing in this bill of material takes it up to the column that shows to what slip and clock, or check number, the items are issued by the Stores Clerk. After that all records made on this bill of material are made in the departments of the stores clerks.

In the first column are placed the number of parts required; in the next column the expense charge to which they belong, which is taken from the key furnished by the monthly distribution sheet (Figures XI, XIII and XIV). The third column is the heading number as recorded on the Parts' Key Card; the next is the name of the part from the Parts' Key Card; then, following in succession, are the drawing number, the pattern number, the die or jig number, the kinds of material, the number of operations required—all from the Parts' Key Card.

The department to which the part is to go is filled in by the routing department or Chief Engineer, as the case may be, and checked by the Chief Stores Clerk, or his assistant, when he gives out the material to the department store clerk. Then comes a column which records the time slip number, and the clock or check number of the workman, to whom the part or parts, represented on the same line, was delivered.

The next column is for the purpose of fixing a record of the parts on which work may be temporarily

stopped. To illustrate, if a part should have ten operations, and at the end of the fifth operation it became necessary to stop working on that part for a while, the Stores Clerk must be notified of this fact. He then enters it in the next column "Returned After Operation," accordingly. In some instances material in this semi-finished condition is to be returned to the storeroom. In other instances it will not, especially in connection with heavy castings or a large quantity of pieces.

When work is again taken up on such parts as have been stopped, the fact is noted in the next column. The following column is for recording the quantities and dates as finished. That is, if 1,000 parts are to be made, and they are finished in installments of one, two or three hundred, it would be so noted in this column. It is at this point that material passes from rough stores into finished stores. The next column is where finished stores are given out for the purpose of assembling. Where stock is given out in bulk, such as steel rods, bars, brass stock, sheet metals or liquids, the quantity is entered in the next column. After the work required from that quantity has been done, what remains is indicated in the next column, while the following column shows the actual amount that was used. The three succeeding columns are for the purpose of making deductions of cost on this material.

A careful study of this arrangement is required, as it is purposed for other conditions in connection with the workmen's cost, time slips and daily checks.

After the Chief Stores Clerk has been given this bill of material, it can readily be seen that he has no license to make requisitions on the purchasing department for material in excess of the amount called for on

the bill, except in case the stock for any particular parts is below the minimum standard amount to be carried on hand. The amount on hand is always given on his requisition for purchase.

The minimum and maximum amounts of stores to be carried should be standardized as early as possible, and constantly recorded on the cards used to indicate the receipts or deliveries of stock. In this way, as stated before, over or under buying of stock is impossible.

For the filing of these bills of material, a center post with swinging doors of a suitable height should be made for the sub-stores' clerk. The bills should be filed on each side of these swinging doors. In this way, each bill of material is accessible in a moment's time, and can be filed in regular order, as issued. Each bill of material, after it has been received by the Stores Clerk, must remain in full force until all the work on the material it represents is either completed or entirely abandoned.

A requisition form should be used for stock and material that does not enter into a product for sale, such as may be required by the draughting room, tool room, experimental and model room, or for any general supply needed throughout the factory or office. This form corresponds to the bill of material.

We now come to Figure XV, the Workman's Cost Time Slip, a form that can be used in several ways, and for either day work, piece-work, or for premium work. Each slip has a serial number, as will be noted, and then, following consecutively, shop order number, stock order number, shipping order number, model number, number of pieces that are being made, drawing number, pattern number, die or jig number, operation

number, bill of material number. The operation and kind of work being done is also indicated.

One slip is to cover each operation on any part. All of the foregoing numbers, with the date of issue, must be filled in on the slip from the bill of material by the Stores Clerk, or his assistant, which then accompanies his requisition to the Foreman for the work that is to be made in the factory in accordance with the bill of material they represent. When the Foreman receives these slips, he or his clerk fills in the workman's name, clock or check number, machine tool name or number, to which he wishes the slip to go.

The workman then has all the information necessary to enable him to proceed with the work. He knows, in addition to the shop, stock and shipping order numbers, what drawing number or operation number he wants, what die or jig number he may require and so on. The amount of time that is saved in this will more than pay for the use of this slip by enabling the workman to immediately get what he wants without having to run around for such information, as is so often done.

Upon the receipt of this material, the workman fills in the "hour started" work column, and then records each day the number of hours consumed in the operation represented on the number of parts that are given him to work with, the total number of which is given in one column. If the work is being done under the premium or differential piece or piece-work system, columns are provided for gain or loss of time. If, on the operation, the man works overtime by day work, a column is provided for that. The rate is given for any method of paying, as is also the time limit per piece or quantity.

Use of  
Time  
Slip



Now there are two methods of handling this slip. It can be retained by the workman until the operation it covers for any number of parts is completed. Then he himself can enter his time on it, turning in daily day work check (Figure XVI) until the work on the cost time slip is completed; or, after the first day's work, this can be turned in to the cost keeper, who fills it in from the daily day work check or daily piece-work check (Figures XVI and XV), if it is found more desirable to do it this way.

This form serves two other important functions. First, it serves as a voucher that a man should have the material which he wants to work with, and indicates to the Stores Clerk exactly what the material is for, so that in keeping a record of the work as it progresses, he knows what workman is on any individual part in the factory, and just exactly what quantity of material he is licensed to take out of stores. Secondly, it serves as a receipt when material and work is passed on from one workman to another. Whoever receives the rough material for the first operation has his name recorded on the bill of material. When this operation is done, it is passed on to another workman, who must become responsible for the slip of the workman preceding him by signing his name on the line "Defects accepted by." The value of this is that it brings into action the law of self-preservation and makes a sort of self-inspecting system, as the second workman will not sign this slip without being reasonably sure that both the material and workmanship that he is receiving are O. K. This continues from one operation and workman to another until the part is finished. If the slips are given after the first day's time to the cost keeper, they must be re-

**Auxiliary  
Functions of  
Workman's Slip**

turned to the workman upon completion of the job, for the signature of the next succeeding workman.

After the operation is completed, the total cost is entered up on this slip on the lines indicated. Thus, by the use of this slip, in connection with the bill of material, we have a short cut to all the flat, or labor and material, costs. Ten operations on any part will call for ten slips which, filed together, give a complete analysis of all the operations for that part. The parts on these ten slips are then transferred to the Parts' Cost Card (Figure XVII), on the foot of which can be entered the material cost from the bill of material, together with the overhead expense, making a complete statement of the cost of every part manufactured in the factory.

Any number of complete units that it is desired to manufacture can thus be grouped together, and the cost collected on the total allotment without any bookkeeping or record making other than the bill of material and the workman's cost time slip in connection with the daily checks. So, were it desired to manufacture twenty thousand bicycles, or one hundred automobiles, they would go into the factory under a production order number covered by one bill of material, to which upon completion would be added all of the workmen's cost time slips; these would give the exact flat cost of the entire allotment. These cost time slips are all designed for filing in binders. Hence upon the completion of any order, they compose a complete record book of costs, to which should be attached the bill of material belonging to them.

This method of collecting costs, by a proper recording of the numbers and conditions, as provided for on

the bill of material and the workman's cost time slip, enables any part or operation to be traced to the exact source where it was made or performed. Thus, in case of mistakes, errors or bad workmanship, the Superintendent or management can unerringly trace the party responsible for it.

As fast as the cost time slips and workman's daily tickets are turned in from the factory to the cost keeper, they should be classified under two prime headings: First, shop order number, covering the whole job; second, parts heading number. This classifies all of the operations belonging to each part of all the parts on any one shop order. This makes a very simple method of procedure for keeping a record of the work. Not only does it throw up the record after the work is finished, but it also gives the cost of the work as it progresses from day to day and its stated progress and nearness to completion. It makes, not an estimated condition of the work, but an actual statement concerning it.

So far as nothing but the actual collection and recording of flat, or labor and material, cost is concerned, the forms grouped referred to are all that are necessary, as they in themselves, individually and in their relation one to another, constitute what would ordinarily be a complete cost system. But, as before stated, costs are of two kinds, productive and nonproductive; consequently these forms must lend themselves to the collection of the nonproductive materials, supply and labor element of the factory, as well as the productive costs.

They must also harmonize with such forms as are necessary for the moving of the product from point to point in the factory, by means of production orders, shipping orders, and so on. Further, they must consti-

**Additional  
Functions**

tute, in connection with all the forms used in the manufacturing business, one of the strongest elements for maintaining discipline and general system throughout the factory.

After having collected the workmen's time slips and checks daily, it becomes necessary to provide two recording sheets—one for labor and another for machine tool time.

Figures XIII and XIV are an exposition of forms in detail. First is Form XIII for recording labor. In the first column the employe's name and clock or check number are placed in the two spaces provided. The next column indicates the kind of time under which he is working. R. T. means regular working time on day work or piecework; G. T. means the time that is gained over this on the premium plan.

To illustrate: If a man is working on the premium plan, where nine hours constitutes a day, nine hours is put down in regular time. If the man has gained on the work done for that day, say two hours, it would be put down opposite G. T., indicating that the man had made eleven hours' time that day, two of which were to be divided between himself and the company on whatever basis may have been established. On the other hand, should he work nine hours, and not accomplish in the nine hours as much as he should, or, in other words, should he fall short of this limit of two hours, it would be indicated in the column opposite L. T.

° O. T. is for overtime work, where one and a quarter or one and a half wage is paid for all overtime. This is entered up on this sheet from the workman's daily time ticket or cost time slip. This method saves an immense amount of time in making up payrolls, as they

are virtually made up by each department daily.

In addition to hours worked, the shop order number is recorded, and the expense charge under which the man is working. In this way a complete record of the expense distribution is made directly in connection with the man's time and the shop order number under which he is working, for either productive or nonproductive labor. This space also provides a further convenience for such departments as the drafting room, experimental or model work, tool room, or other nonproductive departments. If a man is working on regular time—that is, day work, G. T., L. T. and O. T. can be scratched for any one day, and four different job shop order numbers or expense charges indicated in the same space. Such a necessity often arises, especially in the departments enumerated, as the men are frequently changed from one short job to another under entirely different shop order numbers belonging to an entirely different expense charge.

This sheet is provided for continual record for thirty-one days, with summaries, as will be noticed in the last four columns covering it.

This sheet also serves another purpose. It makes an absolutely perfect comparative record of the time consumed on any operation or job in the factory, so that after day work has been in vogue for a while, from its record, piece-work or premium work can be accurately established.

It gives a comparative record of the time consumed by different men on the same class of work, and a complete record of each individual man for comparison from day to day or month to month. This form of recording labor, as devised by the writer, is entirely new in connection with cost systems, and has been found by

**Time Sheet  
as Record  
and Payroll**

him to be one of the most satisfactory forms ever conceived for making such records.

Further, this sheet answers every requirement for a payroll sheet, as at the end of each week or two weeks, a man's time can be footed up and his pay envelope made out from same. The day terminating each week or pay day should be filled in with red ink, so that the division of the monthly record into pay days may always be apparent at a glance.

Figure XIV is a similar record sheet for the wage earned by machine tools to cover their own depreciation, in accordance with Chapter VI. The name and number of the machine is indicated in the first column. The next column indicates the kind of time: regular time means a full day's work, overtime the amount of time the machine works over the regular day's work on any particular day. Instead of having an overtime charge, two expense charges or job numbers may be given for one machine tool in the same day. It is found on the average that these two are all that are necessary. Should the work in the factory be of such a nature, however, that the machine tools are constantly changed from shop order to shop order during the day, this form can be made up with four spaces, the same as Figure XIII. But this will rarely be found necessary.

Like Figure XIII, Figure XIV is provided for continuous record for a month, with summaries at the end, so at the end of each month it shows a comparative daily record of all the machine tools in a factory—a comparative monthly record with a summarized statement of the amount of earnings for each individual machine tool for that period of time.

As stated in Chapter VI, the standard time for a

machine is 166 hours per month. From the total number of hours per month, we can always ascertain whether a machine is working full or over time. At the end of several years of this record we can determine exactly what is the age of a machine in actual service without reference to calendar time—a thing of no small importance when the time comes that it is desired to dispose of machine tools.

This record also shows exactly what is being accomplished with the machine tool equipment of a factory; how many of the tools are busy, and how many are idle. By watching it the Manager or Superintendent is enabled to determine whether he has the work distributed to the best advantage in the factory or not, and whether the investment for such tools earns all that it possibly can. It will further indicate any necessity in a growing business for the purchase of new machine tools. Requisitions by foremen or superintendents are often made for new equipment, when twenty-five per cent, perhaps, of the equipment they have is idle.

It is now apparent that an entire collection and distribution of all active costs, both productive and nonproductive, can be made and distributed without bookkeeping or ledger accounts, excepting in summary form.

## CHAPTER IX

### LABOR RECORDS AND CLASSIFICATION

In addition to keeping a record on the costs of labor as set forth in the preceding chapter, there are some other conditions in connection with labor that it is absolutely necessary to record from time to time and also regularly, either daily, weekly or monthly, as the case may demand.

First, are the applications made for positions as illustrated on card, Figure XVIII? These cards should all carry a card number as pertaining to themselves, a file number in which a file of correspondence relative to this particular applicant should be placed, together with the applicant's number, which number should always be used in corresponding with an applicant. Other information as given on the cards is self-explanatory.

For the employment of all artisan labor, clerks, etc., this card covers an abundance of information. Officers and high salaried men usually come under a different consideration, which oftentimes requires more searching inquiry than this card furnishes, although these cases, as in any and all labor employed, should be registered on one of these cards.

The card shown in Figure XIX immediately comes into life upon the engagement of an applicant from card Figure XVIII, and is the summarized record of a man from the time he is employed until he leaves the employ of the company. This card should carry on it the same file

**Applicant's  
First  
Record**



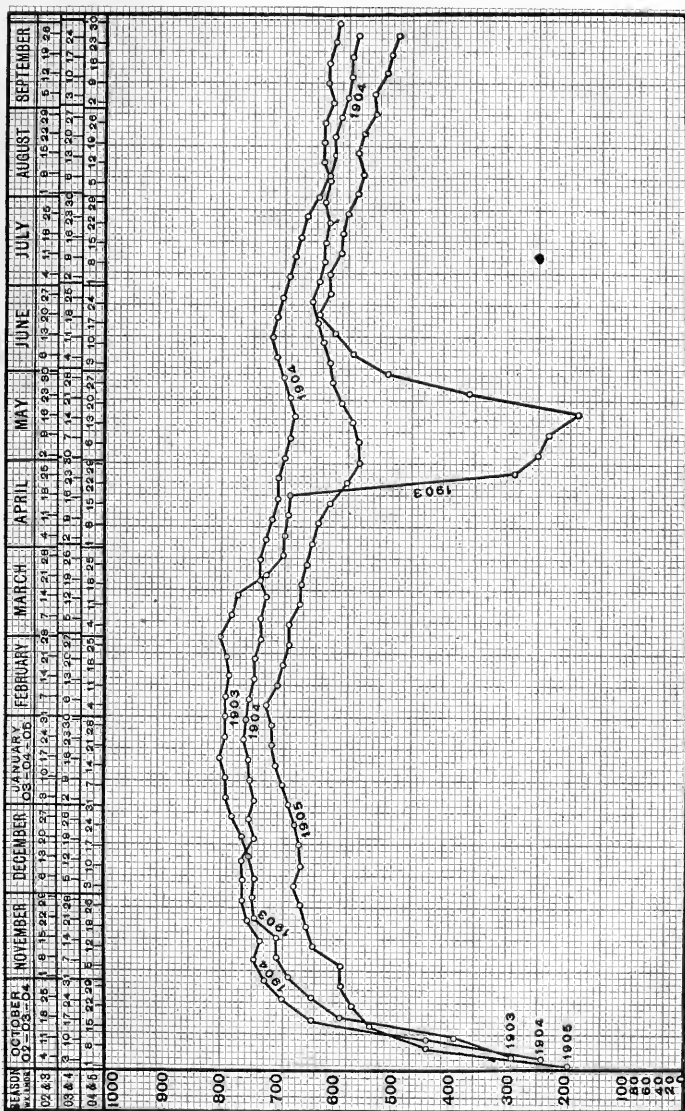


FIGURE XXVII. Comparative Labor Chart, seasons 1903, 1904 and 1905 factory labor only

ROUGH STORES LEDGER							
RECEIVED							
DATE	ARTICLE	FROM WHOM RECEIVED	STORES REQUISITION NO.	BIN NO.	RACK NO.	SHELF OR FLOOR SPACE NO.	THEIR INVOICE DATE

FIGURE XXIII. The Rough Stores Ledger Card on which receipts and must balance

FINISHED STORES AND MERCHANDISE LEDGER							
RECEIVED							
DATE	ARTICLE	FROM WHOM RECEIVED	FOR STORES REQUISITION NO.	BIN NO.	RACK NO.	SHELF OR FLOOR SPACE NO.	THEIR INVOICE DATE

FIGURE XXIV. The Finished Stores Ledger Card which performs ex stores

SMALL AND HAND TOOLS LEDGER									
RECEIVED									
DATE	ARTICLE	FROM WHOM RECEIVED	QUANTITY RECEIVED	SIZE OR QUALITY	THEIR INVOICE NO.	OUR REQUISITION NO.	COST	DATE	TO WHOM DELIVERED

FIGURE XXV. A Stock Ledger Card for small hand tools. The three

GENERAL SUPPLIES LEDGER						
RECEIVED						
DATE	ARTICLE	FROM WHOM RECEIVED	QUANTITY RECEIVED	SIZE OR QUALITY	THEIR INVOICE NO.	OUR REQUISITION NO.

FIGURE XXVI. The Stock Ledger on which is kept record of all gen

FORM NO. 33								
GIVEN OUT								
QUANTITY RECEIVED	TO WHOM DELIVERED	QUANTITY DELIVERED TO SHOP	QUANTITY DELIVERED TO FINISHED STOCK	BALANCE IN UN-FINISHED STOCK	BALANCE IN SHOP	TOTAL BALANCE ON HAND	NET COST	INVENTORY VALUE

delivery of all stores must be posted—the “Received” and “Given Out” sides

FORM NO. 34								
GIVEN OUT								
QUANTITY RECEIVED	TO WHOM DELIVERED	QUANTITY DELIVERED TO SHOP	QUANTITY SHIPPED OUTSIDE FACTORY	BALANCE IN FINISHED STOCK	BALANCE IN SHOP	TOTAL BALANCE ON HAND	NET COST	INVENTORY VALUE

actly the same duty for Finished Stores that Form XXIII does for rough

FORM NO. 35									
GIVEN OUT					RETURNED				
QUANTITY DELIVERED	SIZE OR QUALITY DELIVERED	SHOP REQUISITION NO.	COST	BALANCE NEW STOCK ON HAND	DATE	BY WHOM RETURNED	CONDITION	VALUE	USED STOCK ON HAND

headings permit a complete inventory of new tools in use can be kept

FORM NO. 36								
GIVEN OUT								
COST	DATE	TO WHOM DELIVERED	QUANTITY DELIVERED	SIZE OR QUALITY DELIVERED	SHOP OR OFFICE RE-QUISITION NO.	TO BE USED FOR	COST	BALANCE ON HAND

eral and miscellaneous supplies—used as are the previous cards

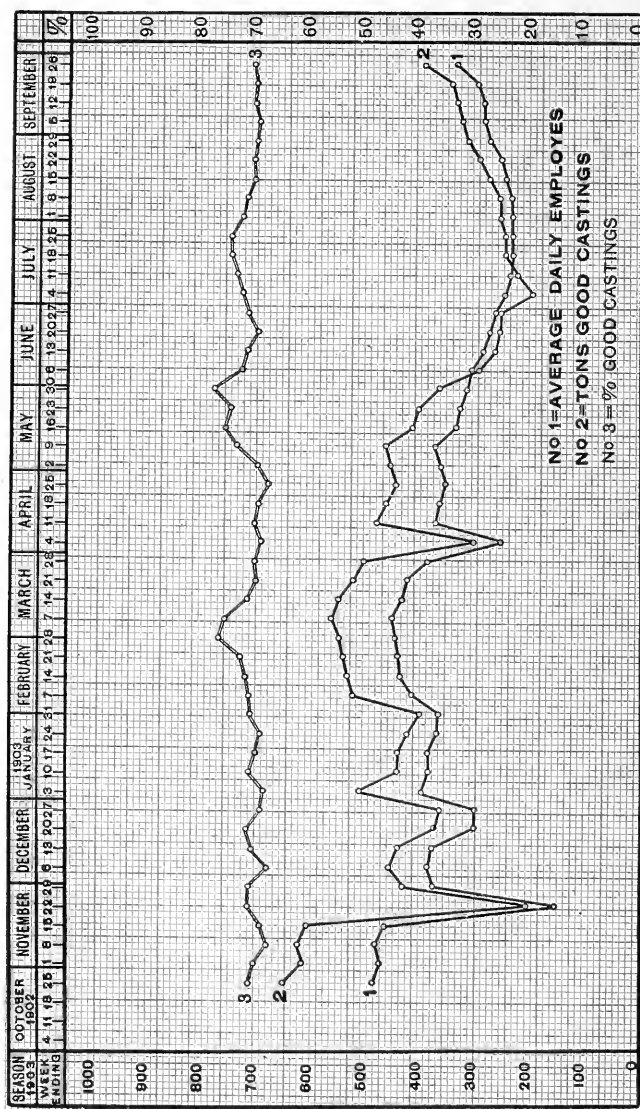


FIGURE XXVIII. Foundry weekly output and labor for season 1903

number and applicant's number as card Figure XVIII, and all correspondence resulting from this card should be filed in the same file so that at any time the complete history of any one man is kept together in one file of which either one of these cards is an index. I have seen many elaborate systems for covering these same features but after they were worked out in their detail I have found every bit of information that is required concerning labor in this respect is provided for on these two cards.

We now come to a form of report which should be filled out at some stated period, either weekly, monthly or at given pay periods, which shows the fluctuation in labor by departments and by classifications of each department in such a way as to correspond exactly with the distribution of labor expense on chart Figure IV, Chapter III, and with the prime organization chart, chart No. II, Chapter II. It is noticed that these departments are classified on the end under manufacturing and commercial expense, also under productive and nonproductive departments.

It will also be noticed that nonproductive and productive labor is divided up by classification of foremen, clerks, etc., and the number of each kind of this classification, together with the percentages of each kind in each department, is given. There is also a column, the one next to general information, in which the percentages of each department to all other departments is also given. This form thus provides an immediate survey at some stated period of any fluctuations, either by departments or by classification of different kinds of labor employed in any one department.

A comparison of this report is of vital importance

in connection with the variations in the amount of output, as with increase or decrease of output continuing for any period of time certain percentages of fluctuation in labor by departments and in labor of each department should take place, which will gradually be ascertained after a few weeks or months of careful watching. In other words, it forms an instrument for making up a schedule of labor required to produce some given output. I cannot impress too strongly upon the reader the value of this simple report in these respects.

I think it opportune to say here a few words in regard to the policy and attitude of any administration toward labor, and I say it from a very wide experience and study of the question. It should be borne in mind that labor as a whole does not work from choice but from necessity, and this effort is obtained only by employing incentives, and while the incentive of wage is the first desideratum, it does not by any means, as many suppose, cover the whole question. Absence of any other incentive than this simply makes it impossible to progress or modernize a business in any way. In addition we should bring to bear upon labor such incentives as will result in the use of their heads as well as their hands, by way of promotion, personal credit or financial reward.

Those men in a company who are in charge or have authority in any way, should have applied to them such incentives as to lead them to distinctly understand what their possible promotion may be and what personal credits will be allotted them for achievement of any kind. Other labor throughout a factory should have such incentives applied to it as will make them understand that sug-

Incentives  
to  
Labor

gestions for improvement in any way will be a subject of financial reward.

A workman may be dense and plebeian in his personal make-up. At the same time he may acquire an experience in certain operation or operations after months or years of service that will point out a new method of processing or even a design itself that will very materially result in a reduction of costs of production, and no incentive is so strong in any factory as the one which makes this man understand that if he can do this he will be suitably rewarded in hard cash.

Every man in every factory should be made to understand that provisions are arranged whereby his communication on any subject of this character will not first have to pass through his and several other foremen's hands with the probability of never reaching headquarters. He must be provided with means whereby his suggestion can reach the management direct and be made to understand that it will be given consideration by this management,—first, in the shape of an immediate acknowledgment, and second, in the shape of action, either for or against, by some committee that may be provided for such work. If any one doubts the efficacy of such an arrangement, let them try it for sixty days and they will marvel at the amount of brain power stored up in their business that they have never taken advantage of.

## CHAPTER X

### PERPETUAL INVENTORIES—THE MACHINERY FOR KEEPING THE RECORDS

Before going into the detail of methods which should be employed in a perpetual inventory, I want to make one thing clear—that there is in reality no such thing as a perpetual inventory—the name unfortunately is a misnomer. Continuous valuations could more properly be used as the term, as this is exactly what is obtained—continuous valuations which have to be recapped and summarized weekly, monthly or annually to obtain an inventory proper.

There is still another point that should be given due consideration in connection with laying out a system for this kind of work—the method to be employed for receiving goods. It is clearly within the province of a purchasing department to buy goods. It is also within its province to receive goods at the factory. But after delivery and receipt of goods are made, all receipts of whatsoever nature, except coal, machinery, patterns and similar articles, should be passed into the keeping of the Chief Stores Clerk.

All checking by the receiving clerk should be done independent entirely of invoices, as it is the only way to insure a proper checking. Checking from an invoice makes check marks too easy and counting too hard; in other words, goods are often checked without counting. As soon as goods are received by the storekeeper or stores clerk they should again be checked off by him on a memorandum of receipt, independent of the receiving



clerk. The storekeeper signs this and gives it to the receiving clerk, who will compare it with his own memorandum of receipt, which has been compared with the consignor's invoice in the main office. As soon as this is O. K.'d the stores clerk adds to his standard cards, covering items in stores, the items received in new goods and enters them upon his various ledgers. This practically inventories this class of assets to date.

The first tools necessary for a stock-keeping system are the cards described in Chapter VII, on which are classified all the fixed assets of a company, such as fixed tools, general equipment, and so on. On the back of these cards are arranged columns for placing valuations from year to year in accordance with the depreciation or earnings which have been charged to cost, as was explained in Chapter VIII. For instance, if a lathe has earned \$100 on a wage scale during the year, that much of it should be written off on the back of the card as a depreciation. This is in accordance with the general scheme carried out in Chapter VIII.

The next step is to provide cards for the use of the Chief Stores Clerk for keeping track of the stock or material that is in storage. Figures XX, XXI, XXII exhibit these in detail. On Figures XX and XXI are posted all receipts put in boxes, bins, racks, shelves, and so on. All goods given out are likewise posted on this card.

Figure XXI shows a more detailed card of this character, in which the "on hand" amounts are entered and balanced off in some specified time required. It will be noticed that this card shows the minimum and maximum amount of any item to be carried in stock, the date from whom goods are last received, and the dis-

tribution as they are given out. If the system is laid out in accordance with Chapter VIII on keeping costs, the charges for everything given out from stores will be covered by a charge account or shop order number.

Figure XXII is a ledger card to be filled out once a month—say on the first—and kept in the main office or purchasing department as the inventory record of stores on hand. Figures XX and XXI are very similar in use—either one can be used in the same way.

Figure XXIII is a rough stores ledger on which all goods of whatsoever nature of rough stores must be entered on the receiving side. Thus, if 1,000 castings are received on a certain date, they alone would be entered on that side of the page until they were balanced up on the “given out” side to the same quantity. In other words, the handling of stores by this method is exactly the same as a cash ledger—quantities given out must balance receipts in opposition. In filling out the “to whom delivered” column, it should be borne in mind that the “to whom” is a charge account, shop order number, or whatever will show the exact classification which the distribution of “given out” covers. Columns are provided on the right of this, as will be seen, to show balances and quantities in values at any time, so that the actual kind of items and stores themselves by this method never becomes necessary.

Figure XXIV is precisely the same form of ledger as Figure XXIII, but it is used for finished stores and merchandise—that is, for such merchandise as is bought but never processed—simply handled and resold again; or such parts as are made in the factory, as repair parts or carried in stock as finished parts in an assembling room; or, again, a completely finished prod-

uct. The study of these two ledgers will show that as fast as rough stores are made into finished stores they will check themselves up properly in the columns indicated.

The value of these ledgers in connection with the cards cannot be overestimated in both store and stock-room, as on them is done all the accounting of all the stores, not in dollars and cents, but in quantities and numbers. Besides furnishing an absolute key to the distribution of stores, where and to what charge accounts they are distributed, they also indicate instantly any discrepancy in the amount used compared with the amount received. The Chief Stores Clerk is held accountable for any discrepancies that may exist.

Figure XXV is a ledger for small hand tools. It will be noticed that on this ledger there are three headings—one for “receipt,” one for “given out,” one for “returned.” To illustrate this: The stores clerk may receive one hundred monkey wrenches; John Smith on a certain date has two monkey wrenches given to him; they are charged up to John Smith and John Smith must sign his name in the column “to whom delivered,” or some other form of receipt must be used. These two wrenches thus stand charged against John Smith until he brings them back for renewals or returns or for any other purpose.

Figure XXVI is a ledger for general supplies used in the factory, such as oil, sandpaper, emery, and all the miscellaneous supplies that compose the general supplies of any manufacturing establishment, and is used as regards receipts and disbursements of supplies in exactly the same way that the foregoing ledger forms are used. This same ledger can also be used in the commercial end of the office in connection with all office supplies.

## CHAPTER XI

### HOW THE EXECUTIVE MAY KEEP IN TOUCH WITH THE FACTORY

Time is too valuable to allow the executive heads of present-day business concerns to devote to study of long and complicated accounts. They must transact a large volume of business; they cannot afford to distract their attention to the detailed minutiae of reports.

Old methods of making statements have not been comprehensive enough. The executive officer of today must grasp the whole of a situation or condition with as little detail as possible. Not only questions concerning the moment must be considered, but similar prior conditions must also be taken into account at the same time, that comparisons of progress may be made.

In his work for the larger industrials, I believe the writer has been one of the first to develop a system of expressing business conditions in a concentrated and comparative form.

To overcome the above objections has been one of his chief aims in organizing and systematizing manufacturing and commercial affairs by arranging statements and reports of concerns in such a way as to give an instantaneous review of conditions, snap shots of industrial progress in which, however, every detail of importance is found and placed to its proper reckoning.

This is done by making up statements in the form of charts instead of balance sheets—a heretofore unknown system of dealing with the summaries of a busi-

ness, although such methods have been used in engineering work for many years.

The value of a statement of any kind, when isolated, is very small. It is only when compared with some other similar statement that its full value is found. If a manufacturer says that he employed a thousand men last month, the idea is given that he has a large factory and employs a large number of men. But when he says that he employed a thousand men last month, eight hundred men the month before, and but five hundred men a year ago last month, the value of the current statement is intensified by each comparison. This means that every statement is always covered by a time period, and that a corresponding time period of some other date is necessary to fully grasp the present condition.

It is because of this that the writer's system of chart making has been found so efficacious. There are no details of a business as a whole, by departments, or by conditions regarding goods made or handled, that cannot be covered by some form of chart. The limited space here, however, will permit of but three general illustrations.

The first of these is Figure XXVII, which is a comparative labor chart of the number of men employed in a factory for a period of three years. The curves in this chart are taken from an actual record ending September 30, 1903. The headings, however, are given for 1903, 1904 and 1905, showing weekly and monthly divisions, and the dates that these come on during these years; so that those who may desire to use a chart of this kind may copy the headings and apply them to their own particular needs.

It will be noticed in the lines for all three years

that from the 1st to the 15th of October the labor involves only from 200 to 300 men; whereas, the normal working force is from 700 to 800 men. This was a two weeks' inventory period, after which the number of employes rises very rapidly. By the 1st of November the normal number of men employed is very nearly reached.

In reading a chart of this kind, first ascertain the year and date; follow this line down to the intersecting point of the curve for the corresponding year. Then, from the dot, trace to the left, where the average number of men employed for any particular week will be found in the left-hand column.

For example: On January 3, 1903, 800 men were employed; while the week ending January 2, 1904, but 750 men were employed; and the week ending January 1, 1905, only 690 men were employed. This shows a falling off in two years for the same month and week of 110 men.

Even when one not familiar with chart making inspects a chart of this kind, he sees at a glance that there was a variation in labor for the three years in corresponding periods. He also sees at once that there was a big drop in labor during the week of April 11, 1903. These points would constitute his first two inquiries.

The drop of April 11th was caused by a strike which lasted for four weeks, during that year, but it was four weeks more before the number of men employed had resumed normal proportions—altogether, an eight weeks' interference in the business.

This one chart shows the whole history as to the number of men employed each week for a period of three years. In other words, at a single glance the comparative labor conditions of a factory are comprehended for

that length of time in divisions of one year as compared with another. This chart is distinctively **Comparative Labor Chart** what is termed by the writer a "time period chart." That is to say, it represents on each dot the number of men employed at that particular time in a way relative to the number of men employed before or after it.

This method of making a chart to cover labor can be applied to as many different divisions or labor, or hours worked, or payrolls, or comparative number of piece-workers and day workers, or comparative number of productive as against nonproductive men, as it may be desired to have comparisons. Moreover, this same method of charting is used for showing the number, amount, quantity or measure of goods manufactured or sold for each day of the week, or for each day, week or month of the year.

The next chart (XXVIII) is an extremely interesting one, as it shows a certain output as compared with a certain number of men employed. It **Output Compared With Labor** shows, first, the average daily number of employes for each week for a period of one year; second, the number of tons of castings that were made each week for the same length of time; third, the percentage of good castings that were obtained out of the total amount made for each week during that time. The double line of percentages should be read from the percentage column on the right-hand side, while the number of men employed and number of tons of castings made should be read from the black figures in the column on the left-hand side.

For example: In the week ending November 15th 610 tons of good castings were made, 470 men were employed and 69 per cent of the castings made were good.

Here is another instance, more marked than ever, of the value of comparisons. The chart presents the report in so simple a way that we are able to take in at a glance the entire year's business as regards labor, output and percentage of good results.

The first marked deviation we notice is in the week ending November 22d, which was Thanksgiving week, with three holidays, so the output was low. The next low drop was the week ending April 4th, which was caused by primary elections and corresponding reductions in forces.

But there is something here of vastly more importance than all this, for we see the highest economical rate at which the foundry was operated. The maximum capacity of this factory each week was 700 tons, and the nearer this capacity was reached the less the labor required a ton of output, as shown in the last two weeks of October and by the higher rise during the months of February and March; while on the 6th of June the cost for labor has been increased to one ton a man instead of 1.3 tons a man as in the week of March 7th. All through the summer run this higher cost of outfit was maintained, until in August and September. As the tonnage crept up a little, the cost for labor was lessened.

There never was a balance sheet or a numerical statement made that would show actual conditions of a year's business as plainly as does this chart without spending hours of time over it in order to get an intelligent understanding of comparative conditions and relations.

Figure XXIX is particularly applied to a commercial or mercantile business and covers a time period of one month by days. It contains a quadruple expression



of a single item—e. g., sales—and shows two different methods of charting; one, which the writer terms a “step chart,” and the other by curves as in Figures XXVII and XXVIII. It shows the sales each day, as compared with every other day, and then the cumulative sales from day to day for the entire month. That is to say, the sales of one day are added to those of the next, and so on for the entire month, ending in the total sales for the month. The total sales are represented by curve No. 3, or about \$14,000 for the month.

In this chart the cumulative black lines are read from the black figures in the left-hand column, while the amount of sales made for each individual day, as indicated by the double line, is read from the light-faced figures in the right-hand column.

To illustrate: On the 15th of the month, the sales were \$850, while on the 16th they were but \$430. The cumulative sales for the same days were, closing the night of 15th, \$6,950, and on the night of the 16th, \$7,380.

The total sales are again divided into credit sales, curve No. 1, and cash sales, curve No. 2, the sum of which makes total sales, curve No. 3.

This chart shows at once what amount of sales has been made during the month, what the relative amount of credit and cash sales was, and what the relative amount of sales on any individual day was as compared with any other day of the month. It should be noticed that on every Friday sales ran much higher than on other days. This was due in this instance to Friday bargain day and was controlled by special prices and strong advertising features.

Another sharp illustration of the value of a chart

of this kind is shown on the 25th day of the month. On this day sales fell off to \$225. Inquiry showed that this was a very stormy day, with a little better weather on the 26th and 27th, normal trade on the 29th, and the 30th again being inclement weather. This particular month is chosen as it illustrates excellent values in chart making. It will be noticed that there is no rise to the curves on Sundays; the line is dotted only, showing that no trade was obtained on those days and for this reason neither rises nor falls.

The charts illustrated here are some of the more simple forms devised by the writer so that those interested might readily understand the method of procedure used in making them. But charts are made to cover every expression of a business as regards costs, or production and sales, or to show every variation contained in a trial balance, or to cover statistical records for any number of years of which it may be desired to make an exhibit in chart form.

For railroad and insurance companies, banks, department stores and other business concerns, this method of presenting results to executives will be found so broad in its expression, so concise in pointing out conditions that need executive administration, and so time-saving and clear in its whole presentation as to almost retire the use of the old-fashioned balance sheet with its numerical compilations and lack of means of comparison.

## CHAPTER XII

### REDUCTION OF LABOR COSTS

The one great aim of manufacturers toward the reduction of the costs of production has been to convert labor employed by the day into piece-work labor. By so doing they invariably expect that they will not only fix their cost of production at some definite point, but will also greatly cheapen the cost of production as a whole.

Theoretically this argument is logical, but in actual practice I propose to show that without a proper means of checking exactly what work is done and the prices paid for it, a very large possible profit to a factory may be eaten up with no outward indication that such is the case.

The governing feature in a piece-work system is a good and proportionate reward to labor for increased effort on its part, and a corresponding penalty if this effort is not made in the shape of a proportionately small wage. We all know that the weakness of the piece-work system lies in the fact that invariably the time comes—no matter how the price rate may have been computed—when the wage earned is too high for the labor employed. At that point rate cutting inevitably begins.

This in itself introduces a third penalty—a penalty of an inverse nature that is somewhat disastrous, as it makes piece-work subject to two penalties—one for not doing well (in the small amount of wage earned), and one for doing too well (when too large a wage is

earned). Rate cutting in the latter case results in a whole or partial cessation of further speed effort on the part of the employe, and this in turn affects the equipment, speed and cost proportionately.

The broadest experiences have shown that the whole tendency in the cost of production for labor, whether by piece-work or day work, is downward as the years go by. There may be times of advance in piece-work prices, but they are short lived. The effort of every financial interest and of every engineering interest is centered on lessening costs, while the laborer himself, by virtue of his accumulation of experience in dealing with an operation or piece of work, increases his speed and contributes unconsciously to this same lessening of cost by increasing his output.

The laborer knows, however, that if he increases his output beyond a certain point the inevitable cut will come. As a result, a body of piece-workers in a factory often establish among themselves an understanding regarding the amount of output that they will produce at a given price. This understanding is so thoroughly established that in many cases it becomes an unwritten law.

In factories where speed bosses are employed, or where special tests for output have been devised, I have seen men purposely dull their drills and other cutting tools, so that by the most diligent work they could only show a production equal to some standard set among themselves, in order to avoid any checking on the part of those interested which would have a tendency toward a cut in piece rates. It was to overcome this waste that the writer conceived of the plan of measuring this waste through the channels which are illustrated on the accompanying charts.

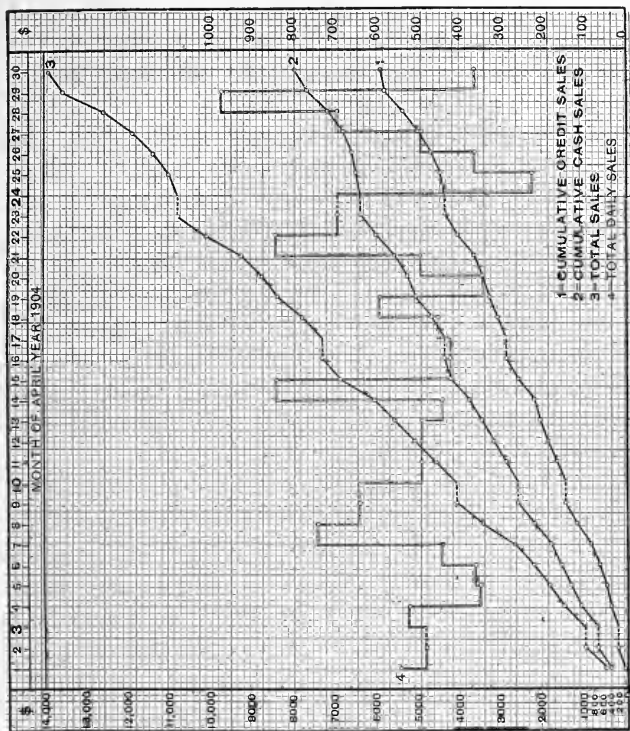


FIGURE XXIX. The Sales Chart

## ORGANIZING A FACTORY

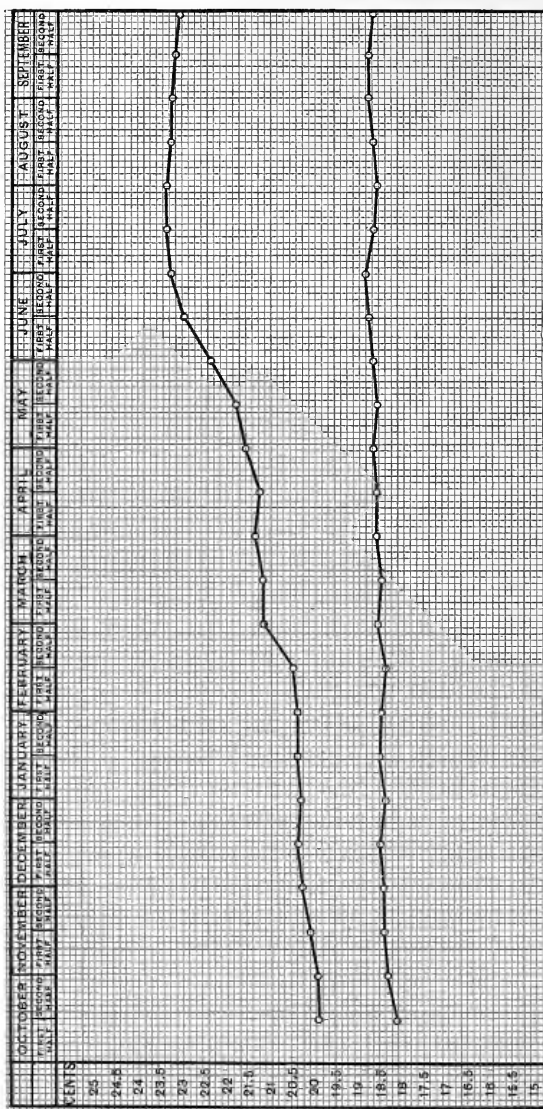


FIGURE XXX. The Average Hourly Wage record for an entire year. The upper line represents the hourly wages of piece-workers, the lower of day-workers. From June to October the piece-workers had either reached their maximum of speed or were deliberately restricting their output

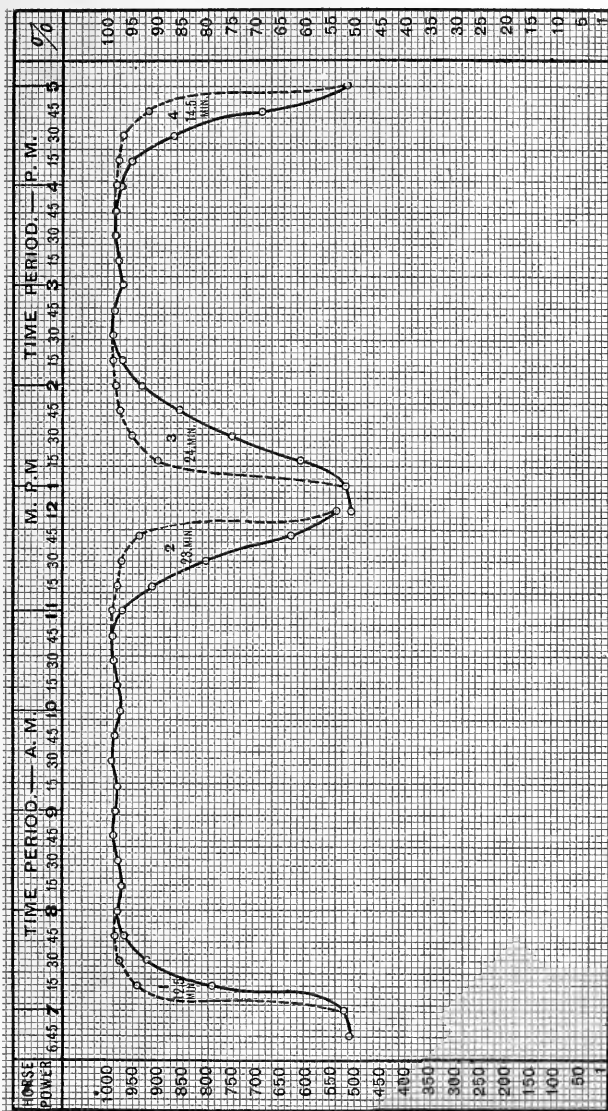


FIGURE XXXI. Shows the average daily indicated horsepower used in a factory. This sheet indicates the hours of maximum and minimum labor. The dotted line shows the saving effected by proper supervision of work, in this case amounting to \$89,610 a year

## Comparative Life of Various Units Used in Factories

STEAM EQUIPMENT			
2808 Hours for a Year			
<b>STEAM BOILERS</b>			
Tubular Construction	30 years	}	Salvage Old Iron
Water Tube Construction	40 years		
<b>STEAM ENGINES</b>			
High Speed Automatics	20 years	}	Salvage 5% to 10%
Medium Speed Automatics	30 years		
Coltize Type	40 years		
<b>STEAM PUMPS</b>			
125 to 150 R. P. M.	8 years	}	Salvage 5% to 10%
75 to 100 R. P. M.	15 years		
50 to 75 R. P. M.	20 years		
30 to 50 R. P. M.	25 years		
<b>STEAM PIPING</b>			
Ordinary Work	30 years	}	Junk
High Grade Work	40 years		
<b>PLUMBING</b>			
Ordinary Work	40 years	}	Junk
High Grade Work	50 years		
ELECTRIC EQUIPMENT			
Voltages up to 250			
<b>ELECTRICAL MACHINERY</b>			
Very High Speed	8 years	}	Salvage 15% to 20%
Medium Speed	15 years		
Very Slow Speed	20 and 25 years		
<b>ELECTRIC WIRING FOR POWER AND LIGHT</b>			
Ordinary Open Weather Proof	15 years	}	Salvage 20% to 25%
High Grade Insulation Concealed	23 years		
High Grade Insulation in Conduits	40 years		
<b>16 C. P. ELECTRIC LAMPS</b>			
110 to 125 Volts	600 hours	}	Salvage 2% to 4%
220 to 250 Volts	500 hours		
<b>STORAGE BATTERIES</b>			
Never Worked Above Normal	15 years	}	Salvage 2½% to 5%
Never Worked up to Normal	20 years		
Frequently Worked Above Normal	10 years		
GENERAL MACHINERY EQUIPMENT			
2000 Hours for a Year			
<b>LATHES, PLANES, DRILL PRESSES, ETC.</b>			
Very High Speed	10 years	}	Salvage 7½% to 10%
Medium Speed	15 years		
Very Slow Speed	20 years		
<b>AUTOMATICS AND TURRETS</b>			
High Speed	8 years	}	Salvage 7½% to 10%
Medium Speed	12 years		
Slow Speed	16 years		
<b>LINE AND COUNTER SHAFTING</b>			
High Speed	12 years	}	Salvage 20% to 25%
Medium Speed	18 years		
Slow Speed	24 years		
<b>BELTING</b>			
High Speed	12 years	}	Salvage Nothing
Medium Speed	15 years		
Slow Speed	26 years		
<b>BUILDINGS</b>			
Frame, Ordinary	50 years	}	Salvage 5% to 10%
Mill Construction	75 years		
Steel, Unknown, Left to	75 years		

Comparative Table showing life of various equipments



In the first place, a chart was made on which was shown the average wage paid an hour for both day work and piece-work for a time period covering an entire year. This chart is illustrated in Figure XXX. The upper line represents the hourly wages of the piece-workers, the lower line of the day workers. This chart has proved of inestimable value in keeping the record of either an advance in wages by day work or an advance in earnings by piece-work, for, as before said, the time invariably comes when piece-work has to be re-adjusted. In the instance illustrated the time was very near, as there had been a gradual increase throughout the year up to June, while from June until the end of September, the increase in piece-work had been practically nothing. These figures showed that either a maximum speed had been attained by the piece-workers, or that they had reached a point (which was the fact) where they dare not make higher speed for fear of being cut. The aim was to find out the exact facts in the case.

In the Figure XXXI, I make an exhibit regarding these facts. This is one of the most interesting charts that has ever been plotted in connection with a manufacturing business, and one that is capable of doing more to point out a possible reduction in costs, or rather increase in the value of labor, than any chart that I have ever made. It is entirely original with the writer in so far as its specific use in connection with labor is concerned, and has proven wonderfully effective in pointing out the exact conditions relative to the subject.

To indicate the steam engine of a factory for the purpose of finding out whether foremen were holding their men up to the work or not and obtaining efficient

**Learning the  
Efficiency  
of Labor**

service from them and the factory equipment, would at first sight seem to be a far-fetched proposition. But such is the method used in obtaining the facts as shown on Chart B.

On the left side of the chart it is seen that at 6:45 in the morning about 520 horsepower was being used. There is very little rise on this from that time until 7 o'clock. It is also seen that this same condition prevailed at 12:45 in the afternoon as at 6:45 in the morning. This shows that the friction load of the engine, or the load on the engine for transmission devices, such as belting, shafting and idle machines, amounted to a trifle over fifty per cent of the maximum power required when the plant was running with its full load factor.

Following from 7 o'clock up for the first fifteen minutes, it is noticed on the heavy line that but 800 horsepower was being used, and at 7:30 but 935 horsepower was being used, and that the maximum load, or 1,000 horsepower was not reached until 8 o'clock. At 11 o'clock it will be further noticed that the load has dropped about 20 horsepower, that at 11:15 it has dropped 80 horsepower, that at 11:30 it has dropped 200 horsepower, that at 11:45 it has dropped 355 horsepower, and that at noon it is back practically to friction load.

Starting again at 1 o'clock, it is noticed that the maximum load is not reached until 2:30, and that the load again commences to drop off at 4 o'clock and continues to do so down to 5 o'clock, very similar to what it did at 11 o'clock.

From this chart one fact is certain—the amount of power required is exactly in proportion to the machines in operation, and the machines in operation are exactly in proportion to the men at work. Consequently fluctu-

ations in power can indicate but one possible condition, i. e., that the men are not operating their machines at such times as the power is lower than normal.

Investigation into the causes pertaining to this particular instance showed in addition to the information gathered concerning the total amount of power required that the labor throughout the plant using this power was not being kept up to its work. In other words, it was a case of building glass offices for the foremen and letting the men idle a great deal of the time. For this chart is an absolute indication of such a condition.

If the machines were kept busy up to within five to ten minutes of noon the power could not fall off. If the men were at work promptly at 7 o'clock and at 1 o'clock the load factor could not be so slow in reaching a maximum. The whole evidence shows a great lack of discipline over the men throughout the factory, and a wanton waste of time on their part, resulting in an equal waste of time for the equipment employed.

In a factory that employs day work and piece-work labor, as in this instance, and in which the piece-work labor amounts to over fifty per cent of the total labor, the natural inquiry is, why, with so large a percentage of piece-workers, is the load so slow in reaching a maximum, and why does it fall off so early in both the forenoon and afternoon?

An analysis of Figure XXX, showing the average wage earned an hour, indicates that the piece-workers had reached the point in wages earned beyond which they dared not go for fear of being cut. Consequently the piece-workers were at the times indicated "soldiering" on their work. This in itself was incentive enough for the day workers to do likewise.

Enforcement of discipline in this particular instance and the keeping of the men up to their work, resulted in forcing the power demand out to the point shown by the dotted lines, which made an actual gain in time, each day, of 74 minutes. This time multiplied by 800, the number of men employed, equals 986 working hours, which, at an average rate of 20 cents an hour, is \$197.20 a day, or \$59,160 a year. These figures represent the actual cost to one company of a lack of a system for recording the work of employes.

But the results were more far-reaching than this. The discovery recorded on this chart not only increased the output capacity of the factory by about eleven per cent, but it resulted in an adjustment of piece-work rates which amounted to nearly a fifteen per cent cut in wage cost for piece-work—and still left the piece-workers earning as much as ever. But they had to work a full day.

The writer has found this means of investigation so far-reaching as a cost-reducing factor as to almost revolutionize the internal workings of a plant. But in no instance, in conducting these tests, has it ever been surmised in the factory, beyond the superintendent himself, exactly what was being done.

This method of making tests can be made in two ways: First, by indicating the steam engine which operates the factory; and, second, by using an electric motor placed upon a truck to make it portable, and running each individual department in the factory with this motor for a sufficient number of days or periods to find out the facts required. The writer has yet to see an instance in which the expense attached to such a test has not paid for itself a thousandfold.

The latter method, of taking one department at a time, is the most effective of the two, for the simple reason that it locates to a nicety which foreman and which class of workers are most responsible for the discrepancies found.

A still further value to the investigation is the fact that it showed the tremendous loss of power due to transmission and friction, amounting to 50 per cent of the maximum power required, or about 62 per cent of the average power required through the day. A re-designing of the entire power transmission system resulted in a saving of 50 per cent of this loss, or in dollars and cents a saving of \$4,050 a year, making a net saving due to the investigation as follows:

Time saved.....	\$59,160
Reduction in piece-work rates.....	26,400
Power saved.....	4,050
	<hr/>
Total.....	\$89,610

Yet there are manufacturers who do not believe in the application of modern ideas to their business.

## GLOSSARY.

### DEFINITIONS OF TERMS USED IN FACTORY COST ACCOUNTING

- ACCOUNTING:** *Commercial Cost*; accounting which concerns all expenses attached to the selling of goods. This is to the commercial side of the business what overhead, is to the manufacturing end. *Factory Cost*; all the accounting done in the factory to ascertain the cost on a product from raw material to shipment, inclusive, primarily divided into Labor, Material and General Overhead. *Mercantile*; accounting pertaining strictly to transactions in the purchase and sale of goods as merchandise.
- BETTERMENTS:** *Plant*; any extensions or additions to real Estate, Buildings, Equipment or Fittings; must not include any addition to Material, Supplies or Merchandise; is same as improvements.
- COST:** *Factory Burden*; the English term for General Overhead expense, and is identical with it. (See General Overhead, below.) *Factory*; a term used to designate all of the costs of making a product ready for sale. *Flat*; an American expression that signifies the exact labor and material cost on a product. *General Overhead*; all of the expense incurred in a factory, of any nature whatsoever, that is not direct labor and material expense. *General Expense*; the same as General Overhead.

**COST (CONTD.):** *Labor, Nonproductive;* all of the labor employed in a factory, whether clerical or otherwise, not directly engaged on a product made for sale.

*Labor, Productive;* all of the labor actually engaged in making a product for sale.

*L. & M.;* the cost of all actual labor and all material employed in producing an article for sale.

*Material;* expense of any material used for the making of an article.

(NOTE.—In making dies, jigs, special tools, etc., for the factory itself, it must always be borne in mind that the plant is buying its own product, and that labor, material and overhead expense should be attached to the regular product.)

*Office;* all of the executive, managerial and clerical expense and supplies attached to a factory as distinguished from work shop items.

*Overhead;* a term exactly the same in items as General Overhead, but applying to individual departments only.

*Plant;* expense attached to betterments and additions.

*Prime;* an English expression for labor and material cost.

*To Make and Sell;* all of the expense in every detail incurred in the manufacture and marketing of a product.

*Total;* the complete cost of any individual part, unit or any subdivision of a business it is desired to individualize into totals.

**EQUIPMENT:** Any form of apparatus or machinery necessary to manufacture or construct a product.

**EXTENSIONS & ADDITIONS:** As applied to a Factory, same as Improvements or Plant Betterments.

**FACTORY:** A manufacturing plant; the term covers all of the buildings in which any individual indus-

- FACTORY** trial operations are carried on, although the  
 (CONTD.): words "Mill," "Works" and "Shop" signify the same thing in some instances, such as Machine Shop, Tool Works, Rolling Mill, etc., but the word Factory and Factory Organization covers all of these.  
*Organization*; the arrangement and division of a factory business into departments and the methods employed for the systematizing of same, and for the collection and tabulation of costs.  
*Receipts*; all matter which is received in a plant in the shape of material and supplies. Has no relation to finances.
- FINISHED** *Parts*; parts that are finished to a point ready for sale or for assembling into complete units or repairs, same as Current Machine Parts.  
*Product*; complete units, as manufactured by any factory for sale.
- FLOORMEN:** Any and all men employed as Sweepers, Cleaners, Oilers, Scrubbers, Window Washers, and often includes Watchmen and Yardmen, and sometimes in small plants Truckers or Shop Carriers.
- FUEL:** *Manufacturing*; fuel which is used in a direct application to product made, as for Forging, Brazing, Smithwork, etc.  
*Power*; fuel used for the generation of steam only; divided into Light, Heat and Power.
- HAND** *Tools*; (See Tools.)
- IMPROVEMENTS:** Same as Betterments, being often confused with Repairs; begins at the exact point where Repairs leave off, for a repair is only a replacement, while an improvement is an extension.
- INTAKE:** Same as Factory Receipts.



**TABLES FOR USE IN CONNECTION WITH DEPRECIATIONS  
ANNUAL AMOUNTS TO BE EARNED**

AMTS	YEARS										YEARS									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
\$ 25.00	\$ 26.50	\$ 13.63	\$ 9.22	\$ 7.19	\$ 5.90	\$ 5.04	\$ 4.43	\$ 3.97	\$ 3.60	\$ 3.33	\$ 3.09	\$ 2.88	\$ 2.74	\$ 2.69	\$ 2.45	2.34	2.26	2.17	2.09	2.03
50.00	63.00	27.26	18.43	14.39	11.80	10.08	8.86	7.94	7.22	6.65	6.17	5.79	5.47	5.20	4.96	4.69	4.50	4.33	4.18	4.08
100.00	126.00	54.50	36.88	28.78	23.60	20.16	17.71	15.93	14.46	13.30	12.36	11.59	10.63	10.38	9.86	9.36	9.00	8.65	8.39	8.13
200.00	212.00	109.00	74.66	57.60	47.20	40.32	35.42	31.75	28.89	26.80	24.73	23.16	21.96	20.72	19.73	18.72	19.00	17.30	16.70	16.30
300.00	316.00	163.50	112.00	86.25	70.80	60.50	53.13	47.61	43.33	39.90	37.09	34.75	32.78	31.07	29.80	29.09	27.00	25.95	25.05	24.45
400.00	424.00	218.00	145.33	116.00	94.40	86.64	79.84	83.50	87.78	83.20	40.46	46.33	43.71	41.39	39.48	37.41	38.00	34.90	33.40	32.80
500.00	530.00	272.00	186.68	143.76	118.00	100.80	89.65	79.35	72.21	66.50	61.82	57.91	54.82	51.78	49.33	46.80	45.00	43.25	41.75	40.75
800.00	836.00	327.00	224.00	172.50	141.60	121.00	106.28	95.25	86.66	79.50	74.18	69.50	65.33	62.74	59.24	56.16	54.00	51.90	50.10	49.90
700.00	742.00	391.60	281.00	201.25	165.20	141.12	124.00	111.12	101.11	93.10	86.39	81.15	76.47	72.50	69.06	65.52	63.00	60.55	58.46	57.05
800.00	848.00	439.00	294.88	230.00	186.80	161.66	141.68	127.00	115.54	109.40	98.91	92.66	87.39	82.87	78.93	74.69	72.00	69.20	66.80	65.20
900.00	954.00	490.50	339.00	266.75	212.40	181.50	159.39	142.93	130.00	119.70	111.29	104.25	99.32	93.22	88.90	84.24	81.00	77.95	76.15	73.25
1000.00	1050.00	545.00	378.00	287.60	229.00	201.80	177.10	158.76	144.44	133.00	123.85	115.84	109.21	103.51	98.84	93.60	90.00	86.50	83.60	81.50
1100.00	1166.00	599.60	410.00	319.25	259.60	221.78	194.81	174.82	158.89	146.30	136.00	127.41	120.17	113.62	108.53	102.96	99.00	95.15	91.80	88.65
1200.00	1272.00	654.00	448.00	345.00	283.20	242.00	212.59	190.50	173.33	159.60	149.30	139.00	131.10	124.29	118.40	112.32	108.00	103.90	100.20	97.80
1300.00	1378.00	708.60	485.00	373.75	306.80	281.83	230.26	206.37	197.78	172.90	160.73	150.59	142.00	134.71	128.26	121.68	117.00	112.45	108.55	106.95
1400.00	1464.00	763.00	522.00	402.80	330.40	282.24	248.00	222.26	202.22	186.20	173.09	162.16	152.93	145.00	138.15	131.04	126.00	121.10	116.90	114.10
1500.00	1590.00	817.50	560.00	431.65	354.00	302.60	265.72	238.12	216.69	199.50	185.46	173.75	163.85	156.36	148.00	141.40	135.00	129.75	125.25	122.25

This chart shows the annual depreciation for a period of twenty years on machinery valued from \$25.00 to \$1500.00. Any value in excess to this may be found by adding the proper amounts.

To find the amount to be earned annually for any given cost for any number of years up to twenty, take the figure representing the known cost, in the left column, follow the line toward the right until it intersects the required number of years; the figure at that point shows the amount to be earned annually for that number of years, and includes all interest at 6 per cent.

AMTS	HOURLY WAGE FOR ANNUAL AMOUNTS STANDARD TIME 2000 HOURS PER YEAR																			
	YEARS																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
\$ 25.00	\$.0132	\$.0088	\$.0046	\$.0036	\$.00295	\$.0028	\$.00199	\$.0018	\$.0016	\$.0015	\$.0014	\$.0013	\$.0012	\$.0011	\$.0010	\$.0009	\$.0008	\$.0007	\$.0006	\$.0005
50.00	.0285	.0136	.0082	.0072	.0059	.005	.0044	.0039	.0038	.0035	.003	.0029	.0027	.0026	.00245	.0023	.00225	.00215	.002	.002
100.00	.053	.0272	.0184	.0143	.0118	.01	.0088	.0078	.0072	.0066	.0051	.0054	.0054	.0052	.0049	.0048	.0045	.0043	.0041	.004
200.00	.106	.0545	.0373	.0287	.0235	.0201	.0177	.0158	.0144	.0133	.0123	.0118	.0109	.0104	.0098	.0093	.0085	.0085	.0083	.008
300.00	.158	.0817	.056	.0431	.0354	.0302	.0265	.0236	.0216	.0199	.0165	.0173	.0163	.0155	.0147	.014	.0135	.0129	.0125	.012
400.00	.2012	.109	.0746	.0575	.0472	.0403	.0354	.0317	.0288	.0266	.0207	.0231	.0218	.0207	.0197	.0187	.018	.0173	.0167	.016
500.00	.265	.1362	.0933	.0718	.059	.0504	.0442	.0398	.0361	.0332	.0309	.0289	.0273	.0259	.0246	.0234	.0225	.0216	.0206	.02
600.00	.318	.168	.120	.0892	.0706	.0605	.0531	.0476	.0433	.0399	.037	.0348	.0327	.031	.0298	.028	.027	.0259	.025	.024
700.00	.371	.197	.1307	.1006	.0826	.0706	.062	.0565	.0505	.0466	.0431	.0405	.0382	.0362	.0345	.0327	.0316	.0302	.0292	.028
800.00	.424	.216	.1474	.115	.0944	.0808	.0708	.0635	.0577	.0532	.0494	.0463	.0437	.0414	.0392	.0374	.036	.0346	.0334	.032
900.00	.477	.2462	.168	.1293	.1062	.0907	.0798	.0714	.065	.0598	.0558	.0521	.0491	.0466	.0444	.0421	.0405	.0389	.0379	.036
1000.00	.53	.2785	.1865	.1437	.116	.1008	.0885	.0793	.0722	.0665	.0518	.0579	.0548	.0516	.0493	.0456	.0452	.0432	.0417	.04
1100.00	.583	.2997	.205	.1561	.1298	.1108	.0974	.0873	.0794	.0731	.068	.0637	.06	.0569	.0542	.0514	.0495	.0475	.0459	.044
1200.00	.638	.317	.224	.1726	.1415	.1210	.1062	.0952	.0868	.0798	.0741	.0695	.0655	.0621	.0592	.0561	.054	.0519	.0501	.048
1300.00	.693	.3542	.2425	.1868	.1534	.1309	.1151	.1031	.0938	.0864	.0803	.0751	.071	.0673	.0641	.0608	.0585	.0562	.0542	.052
1400.00	.742	.3815	.261	.2012	.1652	.1411	.1240	.1111	.1011	.0931	.0865	.0810	.0764	.0725	.069	.0655	.063	.0605	.0584	.057
1500.00	.795	.4087	.280	.2156	.177	.1513	.1326	.1190	.1083	.0992	.0927	.0868	.0818	.0777	.074	.0707	.0675	.0646	.0626	.061

This chart shows the hourly wage scale of machinery costing from \$25.00 to \$1500.00, for a period of twenty years. Each year is allowed 2,000 hours each, or about 166 hours a month, which is an average of 6.4 hours a day of 26 working days a month.

The figure at the intersecting point of the year and of the amount indicate the wage to be earned hourly to earn the sum given in that number of years, including all interests

- JOB**                    *Tickets*; those tickets used by the workmen for collecting the time or material, or both, of each individual worker, on any specified shop order.
- MACHINE:**            Usually, some product manufactured; should not be confused with Machine Tools, which are a part of Equipment.
- MAINTENANCE:**    The expense incidental to the keeping of a thing or condition up to a certain standard of usefulness.
- MATERIAL:**        Any substance or matter to be made up as a product either for sale or improvement; must not be confused with Supplies. (See Supplies.)
- MERCHANDISE:**    Those commodities which are neither material nor supplies, being composed of such articles as are bought by a factory to be sold again without having any labor added to them.
- NUMBER:**           *Belt*; a number usually applied only to Main Driving belt.  
*Blue Print*; the serial number of a blue print and having no relation to the drawing number.  
*Building*; a number used in the classification and identification of a number of buildings belonging to one plant.  
*Catalogue*; one of a series used to classify completed units or a number of parts of units as manufactured by a factory for sale.  
*Check*; the number on the face of the check used by workmen for identification.  
*Combination*; union of two or more numbers or a letter and number for the classification of parts.  
*Department*; one of a series of numbers used for the classification of the departmental divisions.  
*Die*; a number for the classification of all dies.  
*Drawing*; a number used for the classification

- NUMBER** of all drawings, and may either be in combination or single.  
**(CONTD.):** *Flask*; a number used for the classification of all flasks in a foundry.  
*Parts*; a number used for classification of the various parts required to make a complete unit.  
*Pattern*; a number used for the classification of all patterns.  
*Power Equipment*; a number used for the classification of all units whatsoever for the development, transmission and application of power required.  
*Purchasing*; a number used for the identification of all orders under this heading.  
*Record*; a number used both for identification and classification of all records.  
*Requisition*; a number used for the identification of all requirements under this heading.  
*Serial*; a number used for the recording of all units or parts of units that are sold.  
*Shafts*; a number used for the classification and location usually of main line shafts only.  
*Shipping*; a number used for the identification of all shipping orders.  
*Tickets*; a number used for the identification of all tickets required for the collection of costs.
- MILL:** (See Factory.)
- ORDER:** *Chief Engineer*; an order issued directly by the Chief Engineer to his subordinates.  
*Factory*; usually, a production order, but should be obsolete and production order used instead. (See Production Order.)  
*Foreman*; an order issuing from the Foreman to his subordinates.  
*Mechanical Engineer*; an order issuing from the Mechanical Engineer to his subordinates.  
*Mill*; (See Production Order.)  
*Production*; an order from the commercial

**ORDER (CONTD.):** end of a business to the manufacturing end, for the latter to produce or manufacture goods in accordance. Is by some carried directly into the factory as a Production Order, but by others is treated as a Sub-Production Order, owing to the fact that the Works Manager or Superintendent may merge two or more Production Orders together in issuing same to the factory, especially in parts required.

*Production, Shop;* (See Production Order.)

*Purchasing;* any order for the purchase of material, supplies or machinery.

*Sales;* any order received from those who purchase the product manufactured.

*Stock;* any order issued to a factory to make up a product that has not as yet been sold, in anticipation of some future market.

*Shop Transportation;* any order having to do with the transportation of material, parts or product made in a factory in itself.

*Shipping Directions;* an order directing the routing of a shipment by Express or Freight.

*Shipping;* direct instructions covering a specific amount of product to be shipped.

**OUTPUT:**

*Complete Product;* that which is a complete unit manufactured by any plant.

*Café;* all sales or receipts realized from the operation of café direct by the factory itself or by lease.

*Contract;* specific or special work taken in to be manufactured that is not a regular product.

*Merchandise;* the quantity of any goods or pieces bought and sold without having any material or labor added by the factory.

*Parts and Repairs;* any one or number of parts as manufactured by a plant for its completed units and sold exclusively by Parts and Repair Department.

*Plant Sales;* any portion of a plant or its equipment that may be sold.

- OUTPUT**            *Scrap*; all income realized from the sale of  
(CONTD.): scrap of any kind.
- PRODUCT:**        Anything that is manufactured for sale.
- PARTS:**            *Current Machine*; all parts in a factory which are completely finished as far as labor and material are concerned, as individual parts, whether in the Stock Room, Factory, Warehouse packages or otherwise, except such parts as are set aside into what is commonly termed as Parts Repair Department.  
*Repair*; all parts carried in stock for either local repairs in factory on the product manufactured, or for shipment to other points for the same purpose. Specifically, stock on hand belonging to the Parts Repair Department of the business.  
*Work in Progress*; those items which have ceased to be raw material by having had one or more operations performed upon them that has individualized them sufficiently to give them the dignity of a name, but are not as yet completed parts. These must not include castings bought outside, but if made by the factory itself, then they are a department product and become Work in Progress, as does any other item converted to some definite form by a factory from Gross or Prime Substances.
- POWER:**            Any apparatus used for the generation or application of power in a factory. The word "Transmission" to be included with Electrical Equipment.
- REPAIRS:**         *Plant*; all repairs incident to the up-keep or maintenance of a Plant. Must not be confounded with improvements.  
*Product*; any labor or material furnished to repair the product made. Belongs to Parts and Repair account.

- SALES:** *Café*; all income derived from operating a Café in connection with a plant.  
*Contract*; sales, as in certain lines of business, where contract is not only for product manufactured by contractor, but for product not made or controlled by him; as for instance, an engine builder may contract to furnish dynamos and boiler to go with his engine.  
*Merchandise*; all goods bought and sold without having either labor or material added to them, except for handling.  
*Outside Work*; sales made by special contract covered by some specific form of construction differing from regular product.  
*Parts and Repairs*; both labor and material for repair work.  
*Plant*; anything sold from real estate, building, fittings or equipment.
- SHOP:** (See Factory.)  
*Carrying*; any form of convenient product parts, material or supplies in a factory, whether by crane, truck, hand or barrow.
- SMALL TOOLS:** (See Tools.)
- STOCK:** *Raw Material*; any material as it is received prior to processing by the factory.  
*Parts and Repairs*; any completed parts that are carried directly in stock for the purpose of supplying repair parts.  
*Finished Product*; all product finished into complete units that is for sale.
- STORES:** *Assembly*; (1) in some instances the same as finished stores; (2) in other instances, such stores as are separated into an assembly room and classified as assembly parts.  
*Finished*; same as stock finished product, and includes stock parts and repairs.  
*Rough*; same as raw material; all that material which goes into a factory from which

- STORES** finished stores are produced prior to its having any work done on it. May include, however, highly finished items, such as wire, sheet metal, screws or any completed parts bought outside of the factory, to which no further labor and material is added; also, castings that have not as yet been processed in any way, if bought outside.  
*Semi-Finished*; those stores usually termed Work in Progress, in which rough material has become individualized, but is not yet a completed part or parts.  
*Stock*; (See Stock.)
- SUPPLIES:** Such items as are consumed in the plant itself, as Oil, Fuel, Waste, etc.; must not be confused with material.
- TOOLS:** *Hand*; all such tools as die and tap sets, files, hammers, wrenches, etc.  
*Machine*; all general equipment of the machine tools or machines used in a factory outside of the power equipment.  
*Small*; jigs, and dies, drills, reamers, arbors, cutters, and tools of like character.  
*Workingmen's*; all tools that are the individual property of the workingman.
- UP-KEEP:** Same as *Maintenance*; must not be confounded with Betterments, Improvements or Depreciation, as is often done. Comprehends strictly the necessary expense of keeping a thing in condition, operative and useful; broadly speaking, includes all repairs to buildings and equipment.
- WORKS:** (See Factory.)









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