

# FACTORY ORGANIZATION IN RELATION TO INDUSTRIAL EDUCATION

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## ORGANIZATION DEFINED

Organization consists of the laying out of the scope and limits of action of the various individuals and groups of individuals whose work is required for carrying on the objects of the establishment. It consists further of the uniting of these individuals and groups of individuals in such a manner as to cooperate harmoniously for the common good. In a good organization the laying out and uniting have been done in such a manner as to carry on the objects of the establishment along lines which secure greatest effectiveness and economy. Organization is distinct from system and management, although the term has been loosely used to indicate or include either or both by persons who have failed to make proper distinction. An industrial establishment may have excellent filing and accounting systems but no well-defined lines of organization. Again there may be clearly defined organization but very poor management.

## TYPES OF DEPARTMENTALIZATION AND CONTROL IN A NEW ORGANIZATION

Determine first the processes and classes of activity required of plant, equipment and human individuals. List these in detail. Then determine which of these prime elements are to stand alone and which are to be combined so as to make a well-arranged, well-built, smooth-running machine of the entire aggregation of individuals. Such determination requires a knowledge of the principles of control. Control may be based on the principle of military authority, as exemplified by the line officers, on specialization or on functionalization. Each of these principles will be dwelt on in further detail.

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*Numerical-Military Type.*—The numerical type of departmentalization and control, sometimes designated as the military type, divides the men into groups in such a manner that each group receives its orders and instructions of all kinds from one man only. This man in some shops is known as the gang leader. The gang leaders in turn get their orders and instructions of all kinds from the assistant foreman. The assistant foremen get their orders and instructions of all kinds from the foreman. If it is a railway shop the foremen get their orders of all kinds from the assistant master mechanic. The assistant master mechanics get their orders and instructions of all kinds from the master mechanic. The master mechanics get their orders and instructions of all kinds from the superintendent of motive power.

*Specialized Type.*—In this type all similar duties and trades are selected and performed by one man or group of men so far as processes and classes of activity permit. The departmental division then follows processes, trades and classes of labor and equipment. The principle of specialization, though of slow growth, has come into pretty general application even in conservative establishments. It is exemplified in the manufacturing side by such departments as lathe department, automatic screw machine department, milling machine department, etc., and in the commercial side by such departments as correspondence, sales, etc.

*Functionalized Type.*—This term is used to designate a type of control in which there is delegated to a staff officer or department absolute control over certain features, performances or functions common to all departments but distinct from specialized duties. To distinguish between specialization and functionalization we may define a specialist as an individual who is expert in a certain trade, handicraft or science which is an essential constituent of the particular industrial process of the given establishment. A functional staff officer or department, on the other hand, investigates a single phase or aspect common to all these handicrafts, trades or sciences.

Functional management is more than the assignment of one function to a specialist, which is the distinguishing feature of specialization. Functionalization determines what functions come into play in managing all departments and establishes a functional head for each of these functions, such functional head being supreme in that function in all departments. It is by means of the functional

departments and staff officers that the efficient modern organization best accomplishes the co-ordination which is so requisite after departmental specialization has been well instituted.

*Setting Forth Specific Duties.*—These must be clearly set forth not only for each group of individuals and various department heads and sub-department heads, but also for the general and managing heads, groups and committees. Departmental and individual duties must be clearly defined. Charts or diagrams should be prepared to show limits of authority and responsibility as well as inter-relation of various departments, officials and committees of the organization as a whole. Similar departmental charts and diagrams should be prepared for the various departments and sub-departments. These charts must be supplemented by explicit detailed instructions.

It must be distinctly specified as the first duty of each department head that he is to carry on continuously the particular departmental duties and relations. In these matters he must yield his personal ideas to the expressed will of the organization as a whole.

*Determining the Will of the Organization as a Whole.*—In planning a new organization and matters pertaining to such a change, the officers desiring to institute the change should call a meeting of the various existing officials and department heads and present the proposal to them. The proposal should be presented in written form, a copy being furnished to each man present. A time should be set when after due reflection the proposal or proposals can be thoroughly discussed. While it has been stated that it has not been customary in the past to ask the opinions or consent of the governed by those governing in organizations other than political, social or religious, it has been found that the application of democratic principles to industrial organizations has never proven a failure. Recognition of the rights of the employee usually results in a quickened sense of obligation to the proprietorship, on the part of the employee. These general meetings should be continued until the form of organization has been agreed on, and until it has also been agreed in what manner the various topics which may be brought up in the future may be advantageously handled by committees.

*Two-Fold Control.*—The first departure from the strictly numerical-military type of manufacturing organization was the substitution of a two-fold control for the old-time single control of business and technique by the master-craftsman. This two-fold control

segregated the commercial from the manufacturing interests. Inasmuch as it came to pass that the proprietorship was usually held by persons familiar with the commercial or mercantile side, this type of organization developed the principle of specialization in the commercial side earlier than in the manufacturing side.

*Development of the Principle of Specialization on the Commercial Side.*—As the commercial side of business developed, there came to be recognized a more or less clearly defined science in finance and in selling, so that a further development showed itself in what Mr. Charles B. Going has designated as the three-column type of organization. In this type we have the activities divided into three groups, financial, manufacturing, and selling, with military-numerical control in the manufacturing group.

*Further Sub-division of Control in the Commercial Division.*—The recognition of the principle of specialization gradually brought about further sub-division of control in the commercial division until we have, as a standard frequently found, an organization in which the activities are divided into finance, correspondence, advertising, selling, accounting, purchasing and manufacturing, the last-named group still maintaining the military-numerical type of control.

*Development of the Principle of Specialization on the Manufacturing Side.*—With the development of the manufacturing side, we begin to have not only increased departmentalization by handicrafts, trades and types of machinery, but we have as a rule the division of machine-shop work into three classes, namely, tooling, group-assembly and final assembly or erecting. Next comes the recognition of the advantage of distinct departments of engineering works including power, light and heat, design of product, tool designing, stores, orders, shipping, cost and other factory accounts. In this type of organization we still have military-numerical control of all these departments without the development of the principle of functionalization.

*Staff Principle Applied to Industry.*—To a certain extent industrial establishments more or less unconsciously adopted some of the principles of staff control as developed in the more modern military organizations. Under the old military system of line officers only, the head of the line officers in the manufacturing side was the shop superintendent, or in the railway shop, the superintendent of motive power. The other line officers under these, *e. g.*, the shop foremen,

assistant foremen and gang leaders, had to carry on many and diverse functions which the modern industrial organization turns over to the staff officials or functional heads. The duties of the line officials thus become more and more those of supervision and leadership.

*Type of Staff Organization to be Applied to Manufacturing Side of Industries.*—It would be very difficult to set down a standard type of staff organization to apply to all industrial establishments. Mr. Emerson divides staff control to cover four groups: 1, men; 2, materials; 3, equipment; 4, methods and conditions. Mr. Taylor divides shop control among four types of executive functional heads whom he designates as 1, "gang boss;" 2, "speed boss;" 3, "inspector," and 4, "repair boss." Possibly an alternate acceptable in many cases would be the following proposed by the writer: 1, records; 2, materials; 3, plant, equipment and processes; 4, men. I shall briefly outline how the work of some of these functional staff departments is to be carried out.

*Department of Records.*—This department, like all of the staff departments, is a department which has no direct disciplinary control over any of the various departments which keep records. It is primarily a research and advisory department the results of whose investigations and whose recommendations are brought up at such meetings of department heads and others as may have been predetermined. It is the duty of the record department to see that records kept by various departments are not merely kept and stored away, but that from each set of records is secured a method of most effective analysis so that the records of the past may be compared with records of the present and conclusions may be drawn as to future action. The individuals engaged in this department must be experts in theory of accounts, the science of statistics, the art of graphical presentation and cost accounting. The tendencies and facts indicated by an analysis of the records must be brought forcibly to the attention of all individuals whose actions based on experience and intuition differ from the action indicated by an analysis of figures, records and statistics.

*Department of Materials.*—This department is advisory as to the fitness of materials as indicated by the technology of the various materials employed, with constant attention to cost reduction as well as the bettering of product.

*Department of Plant, Equipment and Processes.*—This department will consider: 1, routing; 2, scheduling; 3, motion and time studies; 4, preparation of instruction sheets and cards; 5, standardization of equipment. In all of these matters the work of the staff department ends with the adoption of the method. The routine work is carried on by men adapted to carry out routine work successfully. For instance, many of the decisions of this staff department are applied to the routine work of the planning or production department, which is not a staff department.

*Routing.*—This involves a study of the processes and product and the preparation of process maps for the various classes of product and determination of most predominant paths, together with floor spaces, weights, bulks, etc., involved, and recommendations as to rearrangements of equipment, and departments and proposals as to building modifications and extensions. It consists further in the designation of which department, machine and class of individuals are to perform the operations indicated by the instructions and the recording of such assignments in such a way that the scheduling department can, in consultation with the department of records, prepare means for enabling the planning or production department to have positive definite information as to the work ahead for each individual, machine and department.

*Scheduling.*—This consists of the determination of the manner in which all orders which are to be worked on by the various departments of the establishment are to be listed so as to determine their sequence and the methods of preparing a definite program in order that the shop may be provided by the production department with a daily schedule covering the sequence of all work for the day.

*Motion and Time Studies.*—Motion study consists of the analysis of each process into its ultimate simplest steps, and the elimination of useless or improper motions. This process is prerequisite to and more difficult than time study, which consists in the timing with a stop watch all the elements indicated by the motion study. Motion study research can be applied to accounting, designing and drafting as well as to mechanical and trade processes.

*Preparing Instructions, Instruction Cards or Instruction Sheets.*—The results of the researches of the routing, motion studies and time studies are to be taken up with the most skilled men in each process, these being the men usually detailed as demonstrators while the

motion and time study observations are being made; then detailed instructions are to be prepared which are to be the standard practice and are not to be departed from. Proposals for different steps or methods from the standard are to be encouraged and duly rewarded if they result in improvements. The instruction sheets are to be furnished to the production or planning department by the staff department on plant, equipment and processes in just the same manner that the designing department furnishes the detailed shop working drawings for the designed product.

*Standardization of Equipment.*—This covers all items other than those involving motion and time studies, such as tools, appliances and fixtures, although the expert in tooling processes may wish to cooperate with the motion and time study man or men.

*Department of Men.*—This staff department will consider: 1, hygiene and efficiency; 2, psychology and efficiency; 3, industrial education and efficiency; 4, development of loyalty, through social and religious activities.

*Hygiene and Efficiency.*—This branch will take up such matters as adequate provisions for pure and abundant drinking water, proper sanitary and toilet arrangements, first aid to the injured, eye-strain due to poor light, poorly directed light, glare, lassitude due to impure air or too dry air, discomfort due to temperature being too hot or too cold, together with installation of proper remedies and maintenance of proper conditions.

*Psychology and Efficiency.*—Careful researches must be made as to the presence of avoidable fatigue due to such factors as monotony of occupation, long maintenance of a single position, constant repetition of certain movements, lack of conversation, studies of temperaments of eligible candidates for promotion so as to give due consideration to these characteristics of future gang leaders, assistant foremen, foremen and other officials, since irascibility, lack of sympathy on the one hand and lack of stamina and vigorous discipline on the other hand, may seriously interfere with the efficiency of a newly appointed line officer.

*Industrial Education.*—This department not only provides for training of apprentices, but must provide means for each individual, so far as possible, for attaining greater efficiency. There must be systematic selection of each individual for his work and his systematic training for further development must be carefully planned. Devel-

oping the individual will automatically provide for the development of leaders. This department will handle such matters as shop library and suggestion system.

*Development of Loyalty Through Social and Religious Activities.*—Systematic and continuous efforts must be made to make each individual's work inspiring and to get each man interested in his work. The system of promotion must be such as to afford numerous examples whereby ambition may be preserved. Lectures on the history, processes and appliances of the company's product are a factor in the development of loyalty. An active work in the interests of good fellowship and social democracy will tend toward fair play for all and the avoidance of sharp practices in the dealings of employees with each other.

*Carrying Into Effect the Above Principles.*—It may be urged by many that they are doing all of the things above indicated, only they are not calling them by any fancy names or appointing special officers to attend to them. My answer to such is that they are not controlling their industries systematically or scientifically. There may be few industries large enough to require fully manned departments for all of the activities indicated. No matter how small the industry is, however, it must be analyzed minutely and the above principles applied in its organization. A department need not consist of many men. It may consist of but one man or one man may conduct several departments, but his specific duties, routine and responsibilities must be accurately determined and carried out, otherwise the industry is being carried on in a slipshod, inefficient manner; in other words, it is unorganized.

#### EDUCATIONAL TRAINING FOR INDUSTRIAL LIFE

A study of the most effective modern industrial organizations reveals an increasing tendency toward the interweaving or interlocking of the two divisions formerly designated as commercial and technical, respectively. In the filling of certain offices and the manning of certain departments it is necessary to find individuals who have an advanced knowledge of both commercial and technical matters. Our educational systems have segregated commercial from mechanical training in the past so that it is rare that we find a man who has had school or academic training in both branches.



*Commercial Schools.*—These have been of four classes, namely: 1, private business colleges, training in arithmetic, penmanship, book-keeping and shorthand; 2, commercial high schools, in which the usual high school curriculum was maintained with the exception of the introduction of book-keeping, stenography, commercial geography and industrial history; 3, undergraduate college courses in commerce, including courses in accounting, economics, commercial and industrial history, finance and business law, and 4, graduate college courses.

*Technical Schools.*—These have been of five classes, namely: 1, trade schools giving courses in specific trades with but little general education outside the trades; 2, technical schools with little or no preparatory entrance requirements other than a minimum age limit and teaching some science, mathematics and language in addition to the trades or mechanic arts; 3, technical high schools in which the usual high school curriculum is maintained with the exception of the introduction of mechanical drawing, wood-work and metal work; 4, undergraduate courses in engineering, industrial chemistry or textiles in which are taught sciences, mathematics, a little English and sometimes a little foreign language, the remainder of the course being devoted to drafting, design and technology, and 5, graduate courses in engineering in which the curriculum is usually similar to the undergraduate courses excepting that it is devoted exclusively to technology.

*Industrial and Technical Branches in General Public Schools.*—Of late years many public schools, owing to popular demand, have introduced options in commercial, mechanical, agricultural and household arts subjects, beginning usually in the high schools and extending the work downward into the grades where instruction is frequently given in plastic, textile, book-making, graphic and mechanic arts.

*“Vocational” and “Continuation” Schools.*—The term “vocational” education has been used to designate the immediate bread-and-butter type of school. Massachusetts has by law defined the term to designate “any education the controlling purpose of which is to fit for profitable employment.” The same law defines “industrial education” as that form of vocational education which fits for the trades, crafts and manufacturing pursuits including the occupations of girls and women carried on in workshops. It further defines

“continuation” schools as schools for persons giving a part of their time to profitable employment and receiving, in a part-time school instruction complementary to the practical work carried on in such employment.

*Distinction Between Vocational and Manual Arts Work as Taught in Public Schools.*—The term “Manual Arts” has been used by some educators to distinguish between such manual instruction as they considered of a general cultural value irrespective of the future occupation of the individual and vocational instruction, preparing for profitable employment.

*Failure of All of the Above Conceptions to Coordinate Commercial, Economic and Technical Fields.*—In view of the development of the modern industrial organization it is apparent that as we pass along the scales of advanced responsibility in the various line and staff departments the individuals occupying the posts of advanced responsibility must have a knowledge of economics, logic, psychology and theory of accounts, whether their occupation is concerned more particularly with the commercial or with the technical side. Even workers in the ranks would think and act far more rationally in their schemes for self-betterment and collective bargaining if they had received some elementary instruction in principles of economics adapted to their capacity of understanding.

*Proposed Method to Coordinate These Fields in the Lower Schools.*—Instead of having distinct directors or assistant superintendents of state instruction in large cities in charge respectively of commercial education, manual training and vocational education, these various branches should in the matter of central control be under the headship of a single assistant superintendent. Although the Massachusetts law, above cited, limits the term “industrial education” in its scope so as to designate it as a sort of sub-division of vocational education which fits for trades, handicrafts and manufacturing, it is nevertheless true that the general acceptance of the term “industrial education” is more inclusive, and that such an assistant superintendent might be designated as in charge of industrial and commercial education. It would be the duty of such assistant superintendent to see that the instruction given coordinated commercial and technical branches and that all courses of instruction included such graded instruction in economics with later such selected portions of logic and psychology as would further a clear understanding of labor and industrial problems.

*Proposed Method of Coordination in Colleges and Universities.*— College courses in technology should be made to include consecutive work in such branches as industrial history, history of commerce, finance, transportation, principles of economics, theory of accounts, logic, psychology, business law and advanced industrial economics. These branches should not be taught before or after the student's work in technology but simultaneous with such work even if the course required a fifth year. I would designate such courses as courses in industrial engineering to distinguish them from the strictly technical courses. Men trained in such courses would be admirably prepared for the staff positions open in the modern industrial organization. I would not have these courses under the jurisdiction of departments or schools of finance or commerce, although some of the branches would be selected from branches taught by such departments. They should be under the direction of a department head who had received technical training and who had had the benefit of association with a modern industrial organization as well as some training in the broader economic and liberal studies proposed to be taught the students in his course. In my own experience as a consulting expert in installing factory systems I have had occasion to test college graduates from various institutions. I have put graduates from college courses in business administration side by side with graduates from courses in engineering. While the latter showed a remarkable lack of business principles, economics and accounting, yet even with this handicap they were better adapted to filling positions in such factory departments as planning, tracing, motion and time study and cost departments than graduates of business and commercial courses whose ignorance of engineering and manufacturing methods was a greater disadvantage to them than the engineering school student's lack of knowledge of business practice. Most of the engineering school graduates had spent one or more summers in shops and had imbibed what is known as the shop atmosphere, while the commercial school graduates seemed to think more of high finance and disliked the grease and dirt of the shops. A combination of the two types would have been most desirable and is really necessary with the modern industrial organization.