THE ELECTRICAL ENGINEER IN MANUFACTURING

by

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III. The Manufacturing Organization

Manufacturing is concerned with the conversion of raw materials into a usable form of product. An example is the conversion of raw rubber into a rubber wheel. Another is the conversion of various raw materials such as copper, silicon steel, oil, insulating materials, and steel into transformer products.

Almost always the purpose of a manufacturing enterprise is to make profit from its business to be able to sustain its operation. The manufacturing enterprise is organized to achieve this ultimate goal. In general, any manufacturing enterprise will be doing any or all of the following functions:

PRODUCTION — utilization of manpower, machines, materials and other resources to come up with the final product.

PRODUCTION PLANNING AND CONTROL — planning and controlling the use of manpower, machines, materials and other resources for the purpose of reducing the manufacturing cost.

QUALITY ASSURANCE — assuring the integrity of the product through effective control of materials, manufacturing processes and implementation of the design specifications.

MANUFACTURING ENGINEERING — improvement of productivity through better design of manufacturing processes, work stations, plant lay out, materials handling, etc.

PRODUCT DEVELOPMENT — modification of the designs of existing products with the end in view of reducing manufacturing cost without necessarily going down to a substandard level of quality/development of new proudcts to assist the existing products in carrying the heavy burden of fixed costs.

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PLANT ENGINEERING — seeing to it that all facilities are in good working condition when they are needed.

PURCHASING — procurement of materials and facilities at the best price.

HUMAN RESOURCE DEVELOPMENT — maintenance of the existing manpower and the recruitment of additional manpower when the need arises.

FINANCE — providing the necessary monetary resource in the most economical way.

ACCOUNTING — generation of cost data for the purpose of controlling cost and giving top management an idea of the status of the business.

BUSINESS DEVELOPMENT PLANNING — charting the destiny of the corporation or giving the manufacturing enterprise its corporate direction.

MARKETING — generation of sales revenue/maintenance of existing markets and development of new ones.

There is not a single organization that will aptly suit the needs of all kinds of manufacturing enterprise. Too many factors affect the design of the organization, such as the type of manufacturing processes used, the type of products, the people in the organization, the nature of the market, etc., but no matter what type of organization is used, whether it be the centralized, decentralized or matrix type, the aforementioned functions are always there.

The objective of this discussion is not to delve deep into organization design but rather to give the electrical engineer an idea of the kinds of opportunities that can be expected in a manufacturing organization and, thus, it is sufficient to be aware only of the various functions that have already been stated.

II. The Role of the Electrical Engineer in Manufacturing

The job opportunities for the electrical engineer in a manufacturing concern vary with the type of business the enterprise is in. Some businesses will definitely have more opportunities to offer than the others. If the business is, say, the manufacture of electrical equipment such as transformers, motors, or switchgear assemblies, the electrical engineer will probably fit in any functions except those that are traditionally handled by non-engineers such as accounting and finance. However, if the business is, say, petrochemicals or pharmaceuticals, the job opportunities may be drastically narrowed down to, say, plant engineering where he can do equipment maintenance, equipment replacement study, or design of instrumentation and control systems.

Since this discussion is addressed to the electrical engineer, we should be looking at the brighter side of the manufacturing field, that which poses enough challenge to the electrical engineer. It is opportune then to be discussing the role of the electrical engineer in the electrical manufacturing industry.

The electrical manufacturing industry is concerned with the conversion of raw materials into usable products such as transformers, electric motors, switchgear assemblies, circuit breakers, motor controllers, cables, etc. To be effective in any of the engineering functions that have been mentioned earlier, one has to be familiar with the materials that go into the product how the product is manufactured, and how the product is to be used. The very nature of the product and the requisites of the job put the electrical engineer in an advantageous position. A good electrical engineer would know the basic raw materials such as copper or aluminum, insulating materials, electrical steel, and even electrical accessories. He would also know where and how the particular product is applied. He would be as easy to train the manufacturing aspect as the engineers from other disciplines.

Normally, the newly-graduated electrical engineer would prefer a job with a direct application of his course. If such is the case, then he could probably assume a product development, a quality assurance, or a marketing function.

As a product development engineer, he will have any or all of the following specific functions:

(a) Analyzes product or equipment specifications and performance requirements to conceive practical designs which can be produced by existing manufacturing facilities or methods.

(b) Consults with customer representatives and personnel in research, production planning, product styling, and with other departments to resolve design problems.

(c) Provides technical information concerning construction and manufacturing techniques, material properties, quality control specifications for new designs or improvement of existing ones.

(d) Compiles and analyzes operational data and performs tests and research to establish the performance standard of the newly modified products or processes.

(e) Analyzes engineering proposals, process requirements, and related technical data pertaining to product design to determine the feasibility and practicability of acquiring or designing new plant equipment or modifying existing facilities from standpoint of costs, available space, time limitations,

company planning, availability of standard equipment, and other technical and economic factors affecting engineering decisions.

(f) Reviews over-all standardization of materials and parts.

This particular job will have any or all of the following specific requirements:

(a) Knowledge of the various principles involved in specific products or components of a product.

(b) Knowledge of the various techniques involved in product design, engineering materials, value analysis, manufacturing processes and relevant standards.

(c) Familiarity with material and product test procedures and manufacturing processes.

(d) Knowledge of the techniques of economic and technical evaluation for project feasibility studies.

(e) Knowledge of statistical analysis.

As a quality assurance engineer, he will assume the following specific functions:

(a) Develops and initiates methods and procedures for routine inspection, testing and evaluation of raw materials, in-process goods and finished products.

(b) Devices sampling procedures, designs forms for recording, evaluating and reporting quality and reliability data, and writes instructions on use of forms.

(c) Establishes program to evaluate precision and accuracy of production and processing equipment and testing, measurement, and analytical facilities.

(d) Handles technical service activities and prepares reports on cases.

(e) Devices and initiates non-routine methods such as functional or accelerated life tests and reliability tests on components.

The specific requirements of the job are as follows:

(a) Knowledge of the basic principles of the product and its design and application.

(b) Knowledge of statistical quality control procedures.

(c) Familiarity with engineering materials, manufacturing processes and relevant test and design standards.

As a sales engineer, he will assume any or all of the following specific functions:

(a) Develops the sales plan for the particular products that are handled.

(b) Generates sales by serving the customer in terms of application engineering preparing bid proposals, etc.

(c) Attends to customer complaints and sees to it that proper technical service is rendered to satisfy such complaints.

(d) Assists in product planning and value analysis of the product.

The specific requirements of the jobs are as follows:

(a) Knowledge of the product and its application.

(b) Basic knowledge of systems engineering.

(c) Familiarity with marketing techniques, e.g., forecasting, etc.

Other opportunities are also open to the electrical engineer. With some training in the basic manufacturing processes, plant lay-outing, work station design, and tool design, the electrical engineer can also handle with ease a manufacturing engineering task. Similarly, training in scheduling, production planning, and inventory control will qualify him for a production planning and control engineer's job. Also, adding to what he already knows some basic knowledge about equipment and facilities can enable him to handle a maintenance engineer's task. Familiarity with engineering materials can make him an effective purchasing engineer.

While the electrical engineer is inherently a technical man, he can be trained to do supervision works. Like any good manager, he can acquire skills in leadership, planning, control, and organization.

III. The Role of the School in Preparing the Electrical Engineer for a Manufacturing Job

Particularly in an electrical manufacturing enterprise, there is a lot that an electrical engineer can contribute provided he has the proper orientation. While the engineering schools offer improved curricula on the basic electrical engineering course, such are still wanting on subjects that suit the requirements of the manufacturing sector. As a matter of recommendation, the following subjects need be offered if they are not yet offered, or improved, if they are already being ocered:

SUBJECT	EMPHASIS
Electrical equipment	generating, transforming, protecting, and switching equipment and the latest development in such apparatus.
Transformer Engineering	transformer applications such as connections, grounding, etc. and problems, such as surges, exciting currents, cooling, etc.
Engineering materials	dielectrics, conductors, magnetic materials, hard metals; their properties and tests for properties
Electrical machine design	transformers and induction motors; design procedures and standards.
Switchgear and Control	control devices, circuit protective devices, and the assemblies that make use of them such as switchgears motor control centers and control switchboards.
Power Engineering	protective relaying, surge phenomena, substation design and maintenance, short circuit calculations, etc.
Statistical Quality Control	basic statistics and its application to quality control; regression analysis and curve fitting.
Manufacturing Processes	basic manufacturing processes and their application.

Many of the above-mentioned subjects are already being offered. However, the present level of standards of instruction needs to be elevated and present library facilities must be expanded to include useful references in the above-mentioned subjects which are not yet available. One way of elevating the level of standards of instruction is by letting those who have the experience in the field teach their experience or if this is not possible, by enhancing the development of instructors by sending them to related plant visits, technical conferences, or even formal training.

While the industry can train the electrical engineer for any position he may desire to assume, such training can be facilitated by a wholesome preparation in the engineering school.