THE ELECTRICAL ENGINEER AS DESIGN CONSULTANT

by

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The engineering profession is one of the most versatile and encompassing professions in our physical world. By definition it is the professional art of applying science to the optimum conversion of the resources of nature to benefit man. The words engine and ingenious are derived from the same latin root ingenerare, meaning "to create". The early English verb engine meant "to contrive".

Engineers have probably contributed more to the shaping of civilization than any other group of men. For in every society, the engineer's role is to develop from the knowledge of his day, technological applications which meet practical needs of our real world.

As such, the profession embraces a family of interrelated but highly specialized professions—chemical, civil, mechanical, industrial, mining, metalurgical, and electrical. With a few exceptions, these professions originated in and carry forward the interests and activities of ancient and long established practical arts.

Electrical and electronics engineering originally comprised electrical power, illumination, and the telephone and telegraph but has now expanded into other areas including radio communication, digital computation, automatic control of machines and system, navigational systems as for radar, sonar, loran and shoran equipment, laser measurements and the science of information as a basic understanding of the communication process. Frequently included in this field is the analysis of large interacting systems ranging from transportation to biological, ecological and economic systems. These are locally related to electrical engineering because the mathematical processes employed in the solution of interconnected electrical systems can be applied to other complex interrelated systems.

Along these areas of expertise there is one engineering profession which to a great extent attempts to integrate all these allied disciplines of engineering, that of professional engineering consultancy.

Consulting as it is often termed is a service. It provides a client or project owner the required technical advise, guidance, planning and design

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services, supervision of developments and in some cases, training. Its service to the construction industry is one of utmost importance. It becomes the vital link between an Architect's conceptualized model and an Owner's utilitarian objectives. Despite these however, consulting is still a relatively unknown and often misunderstood profession. To many people, Designers/ Consultants are merely creators of blueprints. Still, to many others, including some clients themselves, consultants are indistinguishable from the builders or contractor.

History

Professional consultancy as an independent service in the Philippines is a relatively young profession. Many years ago, design services were considered an integral part of a contractor's scope of services. This was however not as a matter of convention but rather out of a necessity. Independent consultancy services just not readily available or fully adequate to serve the growing needs of the construction industry.

This void has however presently been to some extent partly served. Local engineering consultancy capability during the last 10 years has evolved into a well organized, highly skilled profession. Multi-discipline engineering consulting companies as well as individual professional engineering practitioners have developed to fill this void.

On the business side of the profession, all these however have not gone without rewards. Our local construction industry alone during the last five years generated an average annual business of something between ₱300M to ₱400M in terms of professional engineering fees. This is equivalent to a construction business volume of roughly ₱20B which represents combined projects funded by the government and private sectors of the industry. At current proportions, there constitute approximately 65% from the government sector and the balance of 35% from the private sector. As compared with the last three years of the construction industry there has been a notable decline this year in the private construction projects. The slack has however been filled up by the government sector in terms of infrastructure projects and some government supported industries.

Major Fields

Basically there are six (6) major fields of consultancy services available for the electrical engineer. They are:

(i) Power Generation, transmission and distribution
(ii) Power utilization
(iii) Manufacturing
(iv) Telecommunications
(v) Electronics
(vi) Energy Management

All these areas except energy management are traditional fields for the practising electrical engineer. Energy management is a fairly recent specialization that has been a consequence of the energy crisis of the decade. The government thrust in the countrywide electrification program will continue to create opportunities in electric power generation transmission and distribution. A very recent ambitious program in the power field is the program to set up within a 10-year period mini-hydroelectric plants and wood-fired steam plants on a nationwide basis. The ultimate goal in the program is the reduced dependency on oil for power generation.

In the power utilization aspect, transportation could grow new opportunities. Already on study is a proposed electric tramcar service for Metro Manila.

In the field of telecommunications, equal degrees of opportunities are developing. Currently a nationwide integrated telecommunication system is under study. While it is true that a number of these engineering engagements would involve foreign expertise to some extent, a substantial portion of the engineer-effort would still rest on the local engineers.

Role

The role of the consulting engineer in projects generally fall under four (4) categories

1. Counselling or Advisory
2. Pre-investment Services
3. Design and Supervision Services
4. Specialized Design and Development Services.

As technical adviser, a consultant generally renders technical assistance to a client on a case to case basis usually requiring a specific engineering expertise. Retainer type of services normally fall under this category.

Project preparatory studies consisting of tentative planning and identifying financing requirements are normally rendered under this category 2. Feasibility studies also fall under this category.

Design and supervision services consist of full engineering services for planning, detailed engineering design preparation of construction drawings, equipment and material technical specifications and tender documents. Supervision services normally are rendered during construction and could either be full time supervision or occasional, depending on the owner needs.

Design such as a typical housing unit of a large subdivision which generally would be constructed repeatedly cover a type of service under specialized design.

It is essential that the role of the consulting engineer in project achievement be understood so that the owners can derive maximum benefit from such professional services.

There are a number of project achievement approaches available to the owners and to consulting engineers.

In their most elementary form they are:

1. Conventional
2. In-house
3. Project management
4. Turnkey

However, only the owner is inevitably the ultimate decision maker in determining how the achievement of his project will be made.

It is essential that the role of the consulting engineer in project achievement be understood so that the owners can derive maximum benefit from such professional services.

Substantial pre-investment analysis is usually required prior to owner decision to proceed with design and construction of a project. Such analysis should include definition of project objectives, establishment of need for the project, market studies, evaluation of economic and environmental impact of the project, preliminary cost estimates, consideration of project financing and project cash flow, study of operation and management of the project and determination of technical and economic feasibility.

Consulting engineers are available to assist owners in pre-investment analysis leading to owner decision on feasibility.

With whatever project involved, the design consultants objective should be to meet owner needs, consistent with public interest.

What is involved in the conventional form of project achievement? In this type, the consulting engineer is used to prepare plans and specifications for a project, to represent the owner's interests in taking bids or in negotiating and contractors to carry out the construction and to inspect and supervise construction of the project, acting as the owner's representative.

Within this form, the consultant is not only a designer but project manager as well.

One of the advantages of this form is that the design is completed before any construction contracts are awarded thereby eliminating the risk of unforseen problems during design development.

In the In-House Project method, the staff of the owner's organization handles everything including the design aspect. The role of the independent consulting engineer is limited to consultation or assistance on certain aspects of the projects of which the owner's staff do not have sufficient capability, experience or capacity.

In the third method (Project-Management), the owner involves himself in a single contract with a firm that will handle all phases of the project. This will involve only the professional services and will not include actual project construction.

The design consultant is attached to the firm that heads the project or part of the consortium which handles the project.

In the Turkey method, a single company goes into contract for the design and construction of a complete project ready for operation with some responsibility for subsequent efficient operation.

With this method, the consulting engineer acts as adviser to the owner helping him to meet his requirements and to protect the owner's interest.

The other role is as sub-contractor to the company involved with the design and project construction and also as an advisory body to the company.

With the above discussed methods, it is for the owner himself to decide which form will be advantageous for his project.

Design

The electrical engineering process is a system to a physical problem. It evolves from an interaction between the real world and the technical concepts.

The stages in a design process cover:

1. Identification of the design problem
2. Setting up of design criteria
3. Preparation of tentative scheme, budgetary costs and approval
4. Preparation of detailed engineering drawings
5. Preparation of construction specification, cost estimates and documents

To achieve the above process, the design consultant should avoid the following pitfalls to achieve best results.

1. Structural design logic

The structuring of design logic may represent the greatest potential for improving the effectiveness of the engineer. Structuring is achieved by imposing specific limits in the options which are available in the application of design logic to particular parts. In one way or another, structuring produces a standardization of design and, in turn makes it easier to correct design data processing instructions and operations.

Structuring may be simple or quite complex. It may apply to materials, processes, parts, products, or some combination of these. Structuring may restrict the specifications and sizes of materials which will be used for the project involved.

2. Rooting Out Poor Design Practices. An engineer's effectiveness in applying technical knowledge ultimately is determined by cost consideration. While the responsibility for some items of cost is shared, the burden of accountability for costs rests heavily on engineering.

One costly practice that has a way of creeping into design efforts is the tendency to over design. Specifications are sometimes padded to provide extra assurance that the plans and specifications for a project will fulfill their function. In such cases, additional operations, the use of special equipment or more costly processes or increased quality checking are usually required to achieve the specified dimensions and finishes. Cost can escalate further if methods planners and operators also decide to hedge a little to be sure that engineering expectations will be achieved.

Engineering effectiveness is also dissipated when any other function introduces unnecessary refinements and extra costs in its interpretation of engineering specifications.

3. Interfacing With Manufacturing (fostering better communications with manufacturing).

Engineering effectiveness depends to a great degree on the quality of the communications between engineers and their manufacturing counterparts. Such communications mostly concern the transfer of information about the design features of materials and equipment for the project.

Those involved should understand the function which engineering seeks to accommodate with the design and the alternative methods, costs, and schedule with which manufacturing can respond to.

Responsibilities

One activity common to all engineering work is problem solving. The problem may involve quantitative or qualitative factors; it may be physical or economic, it may require abstract mathematics or common sense. Of great importance is the process of creative synthesis or design, putting ideas together to create a new optimum solution of the problem. Since the engineer functions at the socio technological "interface" 'with science and technology on one side and individuals and communities on the other), he bears a unique responsibility to decide on priorities, establish performance criteria, select materials and processes, and specify evaluation procedures.

With this broad responsibility, the consulting engineer should have the necessary qualifications to do his job well. It is not only enough that he should have the necessary education but also the experience required.

Consulting engineers should not have any financial interest in construction or manufacturing or supply of materials and equipment for the project under consideration and thus would be free from any possible conflicts of interest arising therefrom.

Another area of responsibility covers the protection of the owner's financial interest. A client expects that his consultant, because of his training and experience, have the power to foretell building cost with substantial accuracy. It is a professional's contractual duty to attempt to design approximately with a maximum project budget set by the client. However, there are exceptions to this rule.

The consulting engineer should also be guided by an inflexible sense of fairness in his relationship with the contractor and with other professionals and must provide society in general with buildings which are safe and stable.

In the preparation of his plans and specifications and in the supervision of the job as well, if either professional has the requisite skill and does not use it, he is chargeable with negligence, and if he does not possess the requisite skill, he is liable because of the lack of it. However, these professionals are not held responsible for absolute accuracy in performing their professional duties, nor do they warrant the perfection of their plans and specifications.

Should he fail in any one of these areas, and injury to person or property results from such failure he may be liable under the law for any damages sustained.

Manpower

With our rapidly expanding technologies that are expected to drastically change systems, techniques and application, there is a need for more consulting engineers.

The manpower needs of the consulting profession are drawn from two sources: the industry for an experience and technological exposure and educational institutions for fresh ideas and the adventures.

However, due to financial renumerations, a relatively large number of our annual crop of engineering graduates gravitate towards other fields of the profession including the government, sales and education. Even our electrical engineers currently registered, not all are in the active pursuit of their profession. One of the factors could be attributed to low fees paid for yet an aspiring engineer.

The Future

With continuing new developments in the semiconductor field and with the computer industry having many opportunities for further expansion of use, with global communication by satellite now expanding, and with the power industry facing challenges raised by rapid growth in demand coupled with environmental encroachment, the electrical engineering field does not lack unsolved problems. In the future, it will continue developing solutions to its problems through applications of well-founded theories.