CONSULTING ENGINEERING PRACTICE IN THE ROC

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1. Development of the Consulting Engineering Practice in the ROC

Compared with most of the developed countries, the consulting engineering profession in the Republic of China is very young. In the past, when the Government of the ROC was on the mainland and during the early years after moving to Taiwan, practically all the public works were carried out directly by government agencies. Planning, design and construction supervision were either done in-house or given to foreign consulting companies. In the private sector, besides small scale industrial plants, developments were concentrated on low rise buildings, and the works were almost entirely handled by architects. With the rapid economic development, increase in population and demand for higher standards of living, the level of engineering services, in terms of technological requirements, efficient utilization of technical manpower and timely implementation, had to change rapidly. Due to the inherent nature of governmental agencies, which should be more at the level of policy decision and in a supervisory capacity for project implementations, the consulting engineering profession started to evolve in the ROC in the early Fifties. Development or growth of the consulting engineering profession in the ROC in the past thirty years can be divided into three stages:

(A) Infant Stage- During the early days of the Big Ten Construction Projects, in view of the higher technological development and demand for more sophisticated engineering services, the Government took the step of establishing specialized consulting engineering organizations under the category of "non-profit organizations". These organizations or companies are not governmental agencies but under the nominal supervision of the sponsoring ministries. The major shareholders of these companies are governmental departments and the directors are appointed by the government. They are different from normal state enterprises because these "companies" are exempted from paying profit tax. Three "companies" were established during this period of time. They are:

(1) China Technical Consultants, Inc. (CTCI)- CTCI was the first "non-profit" engineering organization established in October 1959 under the auspices of the Ministry of Economic Affairs, specializing in petrochemical and other chemical industries. It is an unique company since it offers both engineering design and construction. In 1979, the company was re-organized into a profit-taking firm - the CTCI Corporation, but CTCI, Inc. the non-profit foundation remains as a major shareholder.

(2) China Engineering Consultants, Inc. (CECI)- CECI was established in November 1969 under the auspices of the Ministry of Communications with specializations in transportation projects.

(3) Sinotech Engineering Consultants, Inc. (Sinotech)- Sinotech was organized in April 1970 under the auspices of the Ministry of Economic Affairs specializing in water resources and power developments.

(B) Adolescent Stage- This is the period of time when the Big Ten Construction Projects were implemented. The three state-sponsored consulting engineering organizations have made significant contributions to the country in terms of not only providing engineering services, but also in terms of raising engineering standards, training of engineering manpower and to a certain extent accomplishing technology transfer through cooperation with established consulting firms from the developed countries. During this period of time the economic development in Taiwan has progressed rapidly, the ROC was moving from an underdeveloped country towards a developing country. Besides government-sponsored projects and state-owned industries, the private sector played a major role in the nation's economic development which has made the ROC one of the four little giants in Asia. Because of the demand as well as advancement in technology in the engineering profession (including many people returning home after receiving advanced academic and practical training abroad), many independent consulting engineering firms started to emerge. In 1986, there are 225 firms registered with the Commercial Bureau of the Ministry of Economic Affairs as consulting engineering firms or technical consultants.

(C) Matured Stage- The development and growth of engineering services in the Seventies has brought the consulting engineering profession moving from the adolescent stage towards a third stage of development - a matured stage. During the later part of the second, the growing stage, and the very early part of the matured stage, the consulting engineering firms, both the State-sponsored and the private companies, were exporting their services to the neighbouring developing countries such as Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam. The three State-sponsored companies have grown to international size. In 1985, CTCI has more than 1,100 employees, CECI with 600 plus and Sinotech over 700. The scope of services of these companies has greatly expanded and overlapped with each other. In 1979, Sinotech formed two joint venture companies in Taipei with Bechtel Inc. and Gibbs and Hill, Inc. to provide specialized services in nuclear and conventional thermal power generations, respectively. In the following year, CTCI formed a joint venture with EBASCO, also providing engineering services for nuclear power generation.

The growth of the private independent consulting engineering firms was however impeded by the "protectionism" of the State-sponsored companies. Although there are more than 200 firms registered for business today, less than a handful of them has more than 20 engineers and can offer quality services. Because of the so-called "non-profit", in fact "non-tax paying" status of the State-sponsored companies, many public projects, particularly those of significantly large scale, were given authomatically to those companies, even at a higher fee scale. Only with few exceptional cases when the head of a governmental organization was brave enough to risk undue criticism, the private sector of

the profession was given a chance to demonstrate their ability and competence. In fact, this protectionism has impeded the growth of the competence of our engineering profession.

It is a well-known fact that, for any business or development, open competition and fair free market are key elements for success. Looking at the various industrial developments in the ROC, the most successful ones are those "unprotected" free enterprises such as computers, shoes, sporting goods and ready-to-wears. On the other hand, those industries being protected by the Government, such as automobile industry, still remain in a developing stage. A similar situation also exists in Singapore. The Government of Singapore, after experiencing a very bad economic ression last year, has announced that the government should not compete with the private sector in order to get a stable and growing economy. The engineering service industry is one of the important industries which a country can export. Only through fair competion and quality assurance can the industry grow. The consulting engineering profession will never really reach a matured and progressive stage if these two elements are not present.

To enable the consulting engineering profession to really enter into a matured state, the following steps become necessary:

(1) The consulting engineering profession must take up the responsibility of being professionals with national interest and public safety as their major concerns.

(2) The profession must be given the opportunity to grow and to develop without undue protectionism. It is the government's responsibility to encourage, not to prevent, the profession to improve, to develop, to take up professional responsibility and to play an active role in the national development.

(3) The government must take a lead in establishing proper professional fee structure so that the consulting engineers can afford to think, therefore to produce safe and economical designs.

2. Professional Engineers' Act

For quality engineering services, those people who carry out the planning, design and construction work must possess adequate academic training and appropriate practical experience. In all developed and in a large number of developing countries, the engineering profession in practice is carried out by Professional Engineers. A Professional Engineer, or P.Eng., is a person who possesses the necessary academic and practical qualifications and who has been granted the right to practice as an Engineer, similar to a lawyer, and medical doctor. The body, which is authorized by the government, to be responsible for awarding or approving P.Eng. is different in each country. For example, in the USA, each State has a Board of Professional Engineers appointed in accordance with the P.Eng. Act in that particular State. In the ROC, the Bureau of Industry of the Minstry of Economic Affairs issues the P.Eng. licence on the basis of certificate of qualifications issued by the Examination Yuan. In other words, in the ROC, the government authority who issues the licence for practice and supervises the Professional Engineers is different from the authority who determines the qualifications of a Professional Engineer. This is a unique situation

in the world. This "double headed carriage" system has caused serious problem in the smooth enactment of the P.Eng. Act.

The Professional Engineers Act of the ROC was first promulgated in 1947, and the most recent amendment was gazetted in December 1985. Although the P.Eng. Act has been in existence for more than 35 years and the MOEA claimed that the Act was in force, endorsement of design or manufacturing by licenced professional engineers has never been enforced. In the ROC, up to now, there is not a single design or manufactured product properly endorsed by a Professional Engineer despite many cries of poor quality or lack of control on many projects in recent years. According to the laws of the ROC, the enforcement or requirement for Professional Engineer's endorsement is the responsibility of different Ministries under the authorization of different Acts such as the Building Act (Ministry of Interior), Highway Act, Railway Act (Ministry of Communications), Powers Act, Industry Act (Ministry of Economic Affairs), etc. Unfortunately, there is a lack of coordination and unification among the various Ministries. Although a similar situation also exists in some other countries, but the Professional Engineers Act is respected by all concerned for the sole purpose of ensuring public safety. In the last few years, the professional engineers' associations in the ROC were working diligently with the MOEA in the hope that a proper system can be established in the country. This lack of attention or irrespect for the need for endorsement by professional engineers is probably also related to the protectionism of State-sponsored consulting engineering organizations.

According to the latest amendment of the P.Eng. Act gazetted in December 1985, a Professional Engineer can provide his/her service in one of the following three ways:

(a) Act as an independent P.Eng. or join with other P.Engineers.

(b) Be employed by a consulting engineering firm.

(c) Be employed by organizations which are required by law to have P.Engineers on the staff.

As of May 1986, besides the 225 firms registered as engineering or technical consultants, some of them in fact do not possess qualified P.Eng., there are 326 P.Engs. registered as independent engineers including 75 civil engineers, 86 structural engineers, 50 mechanical engineers and 115 electrical engineers.

Tables 1, 2 and 3 show the status of Professional Engineers Acts, organization responsible for granting Professional Engineership and qualification requirements for professional engineers in the ROC and a number of neighbouring countries.

3. Government Regulations on Consulting Engineers and Engineering Practice

Up to the present (June 1986), there is no regulation regarding the registration and supervision (or control) of consulting engineering practice besides the Professional Engineers Act which was unfortunately not really enforced in the ROC. Anyone can register a company as consulting engineers or engineering consultants or technical consultants

with the Commercial Bureau of the Ministry of Economic Affairs, and the company can conduct business by just obtaining a commercial company licence from the city authority. There is no professional qualification requirement and there is no control over the quality or professional responsibility besides those governing normal commercial activities. The large number of so-called consulting engineering firms registered for business operation, 225 in May 1986, can well illustrate this point. In view of this, proposals have been made to set up regulations to govern the establishment and operation of consulting engineering firms.

In some countries, like Malaysia, the Professional Engineers Act stipulates that no one else can be either shareholder or director of a consulting engineering firm besides those with professional engineer qualifications.

4. Technology Transfer

One of the major items of concern to many developing countries is technology transfer. This is a novelty term which has been used extensively by both governments which receive foreign assistance and foreign governments which provide the assistance. This has also been used by consulting engineering firms from developed countries as a promotional gimmick. Technology transfer has been the subject of discussion at many international conferences. It should be appreciated that technology transfer is a two-way communication. It takes the sincerity and willingness of the transferer to give the technology but it also requires the transferee to receive the new technology. To receive the new technology, the engineers at the receiving end must be properly trained, armed with the necessary basic knowledge and techniques. More importantly, the receiver must have the motivation and desire to learn.

In the ROC, technology transfer has been reasonably successful in some cases but has failed miserably in many other cases. In the past thirty years there were many joint venture efforts for carrying out planning and design of major projects in Taiwan. Several of those projects have been repeated either with extension or with new facilities at new sites. Unfortunately, many of these new projects still relied heavily on foreign consultants. There were several cases when engineers in some joint venture companies openly criticised the failure of technology transfer. In order to achieve the goal of technology transfer for elevating the engineering capability in the country and henceforth export technology and technical service, one must examine the following questions critically:

(1) Is the partner, who is supposed to play the transferring role, sincere and open-minded?

(2) Is the receiving side properly prepared to receive?

(3) Is there sufficient motivation for both the transferer and the transferee?

(4) Is the environment (including government policies and regulations) proper and encouraging?

5. Concluding Remarks

Compared with most developed countries, the consulting engineering profession in the ROC is relatively young. During the past 20 years, the profession has grown from the infant stage past the adolescent stage and is gradually moving into the matured stage. However, the profession needs the encouragement from the government for further development and improvement in quality. It is not that the profession does not possess the necessary quality and enthusiasm for upgrading and development, it is the practice of the government which has greatly impeded the growth.

This paper reviews the history of development of consulting engineering practice and problems of the engineering profession in the ROC and offers some suggestions for future improvement.

Table 1:

PROFESSIONAL ENGINEER'S ACT
IN SOUTHEAST ASIAN COUNTRIES

COUNTRY	PROFESSIONAL ENGINEERS ACT	
	Year of Promulgation	Year of Amendments
HONG KONG	1974	
MALAYSIA	1967	1972, 1973, 1974
SINGAPORE	1972	1977, 1980
ROC	1947	1954, 1972, 1977, 1985

TABLE 2

ORGANIZATIONS RESPONSIBLE FOR
GRANTING AND REGULATING PROFESSIONAL ENGINEERS

COUNTRY	ORGANIZATIONS GRANTING P. ENG	RESPONSIBLE FOR REGULATING P. ENG	APPEALING BODY	REQUIREMENT FOR SUBMITTING PLANS
Hong Kong	Board of AP	Board of AP	Board of AP	Yes
Malaysia	Board of Engineers Appointment by Minister of Works	Board of Engineers	Appeal Board (High Court Judge)	Yes
Singapore	Board of Engineers Appointment by Minister of National Development	Board of Engineers	High Court	Yes
Republic of China	Bureau of Industry MOEA (Qualification determined by Examination Yuan)	Bureau of Reconstruction of City or Province	Bureau of Industry, MOEA	Not enforced
United Kingdom	Institution of Engineers	Institution of Engineers	High Court	Yes
United States of America	State Board of Enginees	State Board of Engineers	Varies	Yes

Table 3:

QUALIFICATIONS OF PROFESSIONAL ENGINEERS

COUNTRY	MINIMUM REQUIREMENTS		
	Academic Qualifications	Engineering Institution Membership	Practical Experience
Hong Kong	1. Recognized degree	-	1. To be decided by the Board
Malaysia	1. Recognized degree		1. To be decided by the Board
		2. Member	2. (3 years)
Singapore	1. B.Eng. - NUS 2. Prof. Dipl. - S'pore Polytechnic 3. Other recognised degree 4. Recognized training plus exam.		1. Two years professional level experience plus exam. 2. 5 yrs exp. with 2 years prof. level in S'pore 3. Ten yrs proffesional level.
ROC	1. Recognized degree and pass higher exam 2. Recognized higher degree 3. Recognized Prof. Eng. qualifications		1. Two years
U.K. (ICE)	1. Recognized engineering degree 2. Not recog. degree By qualifying exam.	Same	1. Three yrs under training plus exam. 2. Four yrs plus exam.
USA	1. Recognized degree plus EIT		1. Four years (varies from state to state).