Continuing Professional Development for Practicing Engineers in Developing Economies

M. 'Tunde Oladiran

***Abstract*—This paper presents the results of an investigation to determine the level of continuing professional development (CPD) for engineers in developing countries. Questionnaires were administered randomly to engineers of different specialties. It was found that CPD for engineers in developing countries seems neglected. Experience and state of the art in the profession are, thus, not usually acquired in an organized fashion. Nevertheless, many of these engineers would support the introduction of continuing professional development at all levels of their careers.**

***Index Terms*—Continuing development, developing countries, engineers.**

I. INTRODUCTION

THE socio-technological success achieved during the Industrial Revolution era (1700–1950) was dependent on the importance ascribed to engineering practice. Early engineers passed the art and practices of the profession to younger ones through apprenticeship, continuous on the job instruction, and mentoring [1]. The industrial growth also led to rapid development of various engineering institutions and, hence, the introduction of formal engineering curricula. For example, the institutions of civil, mechanical, and electrical engineers were incorporated in 1771, 1847, and 1871, respectively. Both the professional and academic arms of engineering have been cooperating to ensure that engineers are trained to high standards so that the public and clients get the best value for services rendered.

Continuing professional development (CPD) is defined as learning for life or career-long learning, and can take place in normal classroom environment (i.e., teaching, research, discussions, and group work) or through distance learning using virtual classrooms, through satellites, telecast, video, etc. CPD can be an invaluable program in increasing both the confidence and productivity of engineers [2], [3]. Some investigations have been carried out on CPD programs in developing countries [4]–[6].

Many international engineering societies also organize CPD for their members. For example, the American Society of Mechanical Engineers (ASME) regularly organizes courses for professional development of engineers in local centers throughout the United States. In some of the American states, it is also becoming mandatory for engineers to acquire a certain minimum of credit units of continuing development to maintain registration [7], [8].

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II. THE NEED FOR CONTINUING TRAINING

In many developed nations, several successful practicing engineers sometimes discover that there were certain aspects of their profession that were not covered during their undergraduate studies. Some engineers are employed in organizations where they hardly use the bulk of the theoretical knowledge, such as, analysis of networks, signals, power systems, stresses, strains, and heat transfer acquired in college. For example, it has been found that as engineers progress to top management positions, they invariably require comprehensive training in nonengineering courses such as labor laws, redundancy, financial management, and leadership in large national or multinational organizations [9].

The principal forces of social and economic change are technology, tools, tasks, talent, and time. It is sometimes difficult for engineers who have been in practice for a long time to be current with modern developments in technology and available tools. Thus, they may become less competitive and unable to define tasks to increase quality and productivity. Cohen and Klensin [10] observed that engineers often suffer from midcareer crisis, such as fear of professional obsolescence. In such situations, the study found out that a system of development, information, and communication could be of great assistance in alleviating fears and increasing productivity.

Rochester [11] observed that the technical education of an engineer has a half-life of approximately five years only. Obsolescence then sets in, and such engineers cannot compete in the labor market. Although an engineer's work and progression are enhanced by his abilities, competence, and flare for development, Rochester suggested that it is the responsibility of professional societies to provide a diversified program of activities for engineers to update their technical skills through journal articles, conferences, books, and videotapes. The author concluded that professional activities can help engineers at all phases of their careers.

The European community [12] established a subcommittee that considered in detail shortages in skilled labor in Europe. Factors considered were the need for higher education, worldwide tighter labor markets, impact of advances in research, development, and modern technology. To combat the disturbing trends in Europe, the committee recommended that continuous training should be mounted for engineers and scientists. It was suggested that governments should also invest in the development of human resources, technology, and tools. No such comprehensive study is available for developing countries. However, it seems plausible to expect that the depressed situation will become more apparent in developing nations, especially in view of worldwide economic recession. Thus, continuing training of engineers should be viewed as a panacea for socio, economic, and technical problems.

In a similar work, D'Azevedo [13] studied educational networking among the European community. It was observed that networking of the educational and other training resources will be a valuable method of knowledge and technology transfer across the community. There are several economic blocks in various parts of the developing nations, e.g., SADC, ECOWAS, etc. Networking of CPD in these blocks will guarantee ease of movement, exchange of professionals and information, and sharing of diminishing resources among member states.

A. Policies for Technological Advancement

Governments in several developing countries have formulated policies designed to transform their societies. For example, Botswana, which has one of the highest rates of growth in the world, has invested substantially in industrialization, road networks, agriculture, communication, power utilities, agriculture, etc. These systems use most up to date technology, instruments, and control. The trend is expected to continue into the next century. However, such programs require research, development, and engineers who know the state of the art. The situation of scarce technical human resources in these countries can be improved by embarking on organized and well-planned continuing development for the available engineers. These will in turn encourage transfer of knowledge to other cadres of the profession.

III. Data Collection and Analysis

The focus of this study is the current state and future direction of lifelong or continuous learning of professional engineers in developing countries. Questionnaire surveys were employed for extensive sampling. About 150 questionnaires were administered to engineers of various specialties. However, only about 30% of the questionnaires were returned. The main sections of the returned questionnaires were completely and accurately filled. In a comparable study [8], 179 ASME members responded to the fax questionnaire that focused on the growing demand by American states demanding that practicing engineers should fulfill the minimum professional competency requirements.

The questionnaires in this investigation consisted of 14 items that covered various aspects, namely, limited demographic information, engineering discipline, continent of undergraduate training, amount of CPD received, willingness to participate in CPD, and CPD details.

IV. Results and Discussion

Although not many females are in the engineering profession, those who were surveyed did not make any returns. Gender may affect participation of engineers in CPD programs. For example, some females may not be able to attend frequent or long CPD courses. However, there are several other reasons (e.g., age, marital status, employment situation, nature of job, and location) which can determine interest in CPD, some of these are interactive, so that a multivariate statistical analysis would invariably be necessary to establish the reasons for participation or nonparticipation in CPD.

TABLE I
Variation in Years of Graduation of Engineers Sampled

Time of Graduation	Percent of Sample (%)
< 5 Years ago	18.5
6 - 10	3.7
11 - 15	22.2
16 - 20	14.8
21 - 24	14.8
25 & Over	25.9
	99.9

TABLE II
Distribution of Disciplines of Sample

Specialty of Sample	Percent of Sample (%)
Civil	30.8
Electrical & Electronics	23.1
Mechanical	30.8
Others	15.4

Fig. 1 depicts the breakdown by age of respondents to the survey. It can be observed that only about 15% of the sample were less than 30 years old, and the majority of those who responded were between the ages of 40 and 49 years. The continents of training of the respondents are 50, 25, 20, and 5% for Europe, Africa, Asia, and America, respectively. The academic curricula in some countries were studied, and it was discovered that the basic training of engineers in most developing countries seems comparable to that in similar institutions in the industrialized world.

Table I shows approximately how long since the respondents have graduated. Of the sample, 18.5% graduated less than five years ago. Thus, from Fig. 1 and Table I, it can be inferred that 3.5%, of the sample graduated when they were at least 25 years old. This may be due to the type of educational system in which some people went through vocational and technical training before embarking on engineering degree training. Table II presents the disciplines of the sample.

Sometimes, it seems that the knowledge gained in college or university is insufficient for the tasks that must be performed by fresh graduates. This is partly manifested by the large number of respondents who felt that the undergraduate studies did not prepare them well enough for the first professional job. Thus, employers and older engineers must provide necessary assistance to the crop of fresh professionals.

In many countries, especially the developed ones, graduate engineers have to successfully complete an internship before they can either be registered by professional societies or practice as engineers. Certainly, this is the case in the United Kingdom and United States. During internship, it is the pride and privilege of older engineers (who act as mentors) to disseminate knowledge and build up the professional ethics of the younger ones. For some graduate engineers, the "trainee period" is the first exposure to the real world of engineering

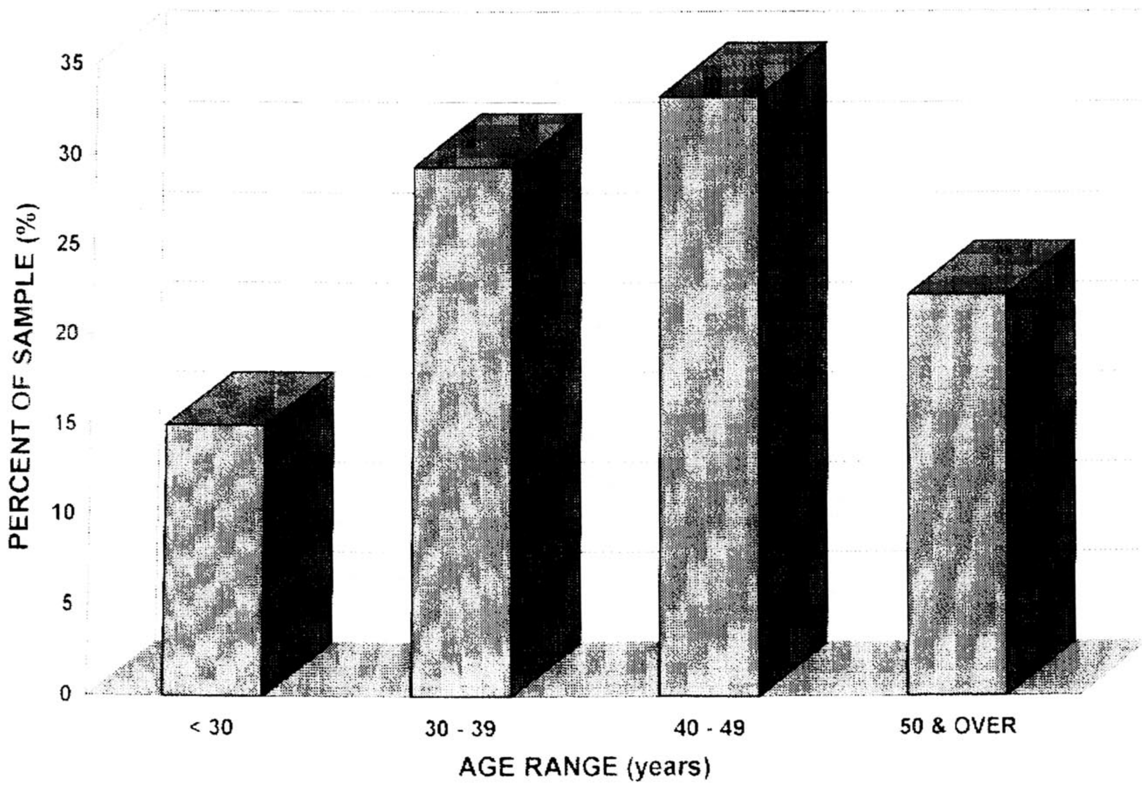

Fig. 1. Composition of sample by age.

TABLE III
VARIATION OF QUALITY OF ENGINEER TRAINEE PROGRAM

Quality of Engineer Trainee Program		Percent of Sample (%)
Not Available	N/A.	11.1
Poor	< 40	7.4
Average	40 - 54	14.8
Good	55 - 69	37
Very Good	70 & Over	29.6
		99.9

practice. The duration is not usually time dependent, but it can last for up to between 12 months, and two years depending on the attitude of candidates to work. The respondents in this study were requested to assess their "engineer trainee" period, and the results are presented in Table III. It can be seen that 11.1% did not have any trainee program. In such situations, it seems that these engineers were given professional responsibility immediately after graduation. A further 22.2% rated their internship as poor or average. Consequently, experience and the art of the profession were acquired usually by trial and error, or in a disorganized fashion. For these categories of professionals, CPD would be invaluable in developing their performance.

About 33% of engineers surveyed have never attended any CPD, such as short courses, seminar, higher education, and in-house courses. The major reasons why they have not been involved in CPD are, nonavailability of courses (67%), cost (22%), and employers not willing to release the engineers (11%). It is pertinent to mention that some of these engineers also never had any form of "engineer trainee" programs.

For working engineers, it is often difficult to find a convenient time to attend CPD. The respondents were asked to suggest the time when CPD should be organized in their localities. The results were 41.8, 33.3, and 25% for weekends, any time, and evenings, respectively. It is interesting to note that 66.8% recommend that CPD should be organized during weekends and evenings so that there is no time loss to the employers. Fig. 2 depicts the number of CPD hours per year recommended by the sample for every engineer. About 30% favor between 20–39 h. The willingness of engineers in this study to support CPD is manifested by the fact that 16.7, 12.5, and 4.2% suggest CPD of 60–79 h, 80–99 h, and over 100 h, respectively. Thus, individual engineers should always be sufficiently self-motivated to participate in CPD. In the United States, 15 h of CPD is mandatory for license renewal for engineers in some states [7].

The respondents were asked to indicate those who should sponsor CPD courses. The results are shown in Fig. 3. As expected, the majority feel that the employer should pay the cost of development of engineers. This should not be difficult for large corporate organizations and governments. However,

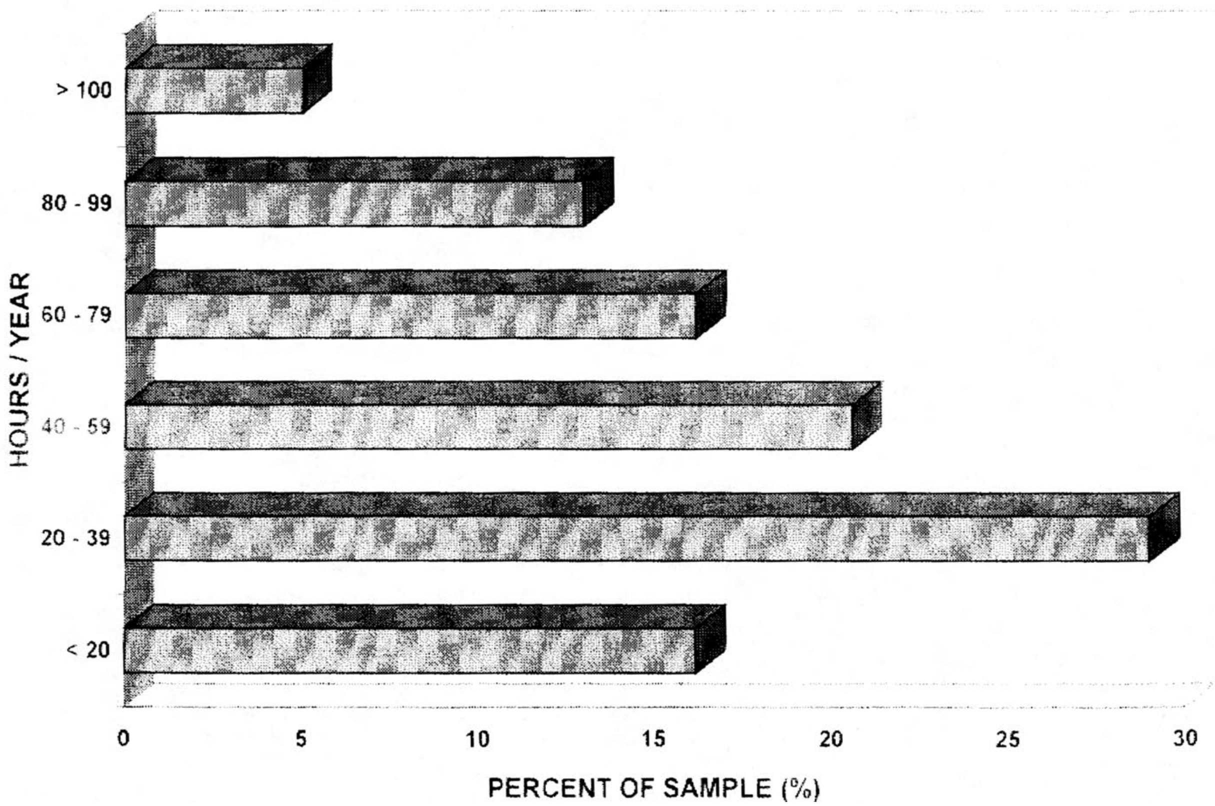

Fig. 2. Minimum hours for CPE programs.

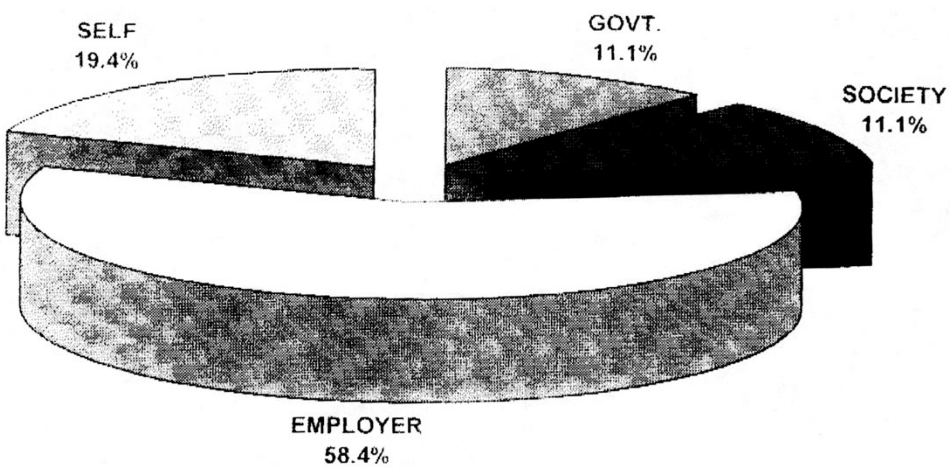

Fig. 3. Sponsors of CPE programs.

19.4% suggested that engineers should be completely or partially responsible for their own continuing development.

There are usually several areas that can be covered in CPD. Fig. 4 depicts nine major topics that would be subscribed to by engineers. Other minor topics include instrumentation and control, microprocessors, safety engineering, accounting for engineers, environmental protection, energy management, and expert systems, including artificial intelligence for diagnosis and fault detection. The success of any CPD depends on the program meeting the aspirations of engineers. Consequently, those professionals involved in mounting CPD should assess needs and problems before using strategies for program development and implementation [14]. Follow-up should also be seen as an integral part of successful CPD curricula.

Finally, 35% of the respondents did not belong to any professional society. Consequently, engineering professional

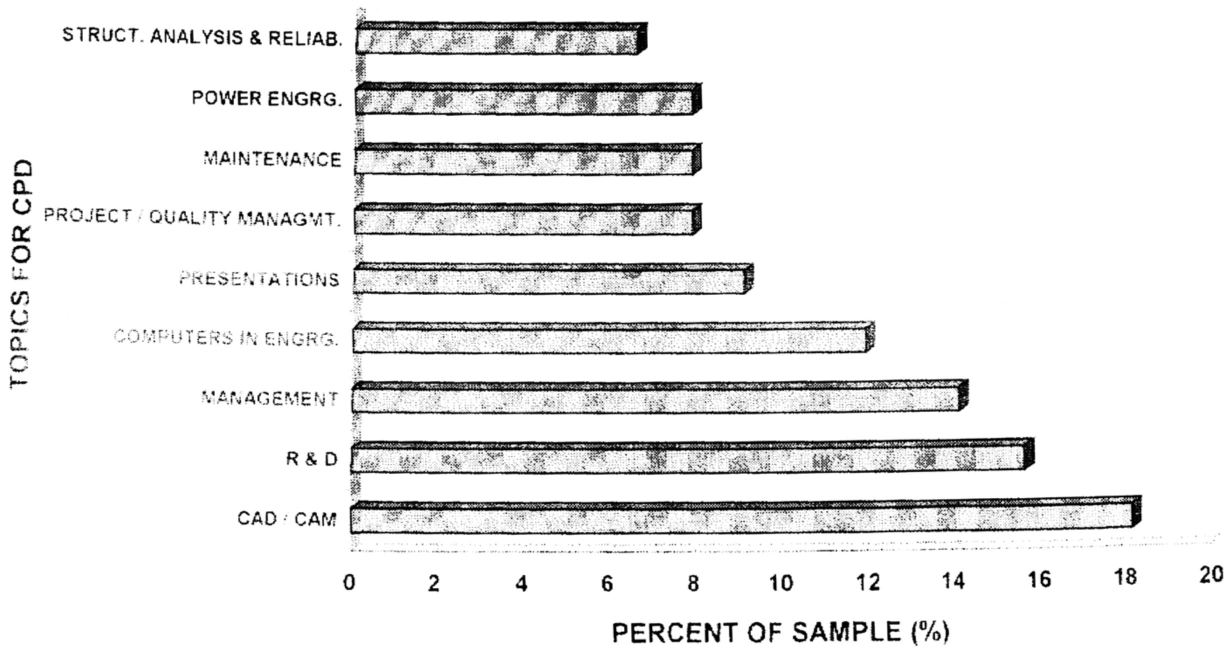

Fig. 4. Variation of topics for CPE.

societies must embark on membership drives and provide programs and activities to sustain the membership that will eventually benefit and contribute to CPD.

V. Conclusion

It can be concluded that policies to advance technological development that were articulated by governments in several less industrialized countries require the availability of engineers who are current and able to apply the arts of their profession skillfully. Consequently, CPD for engineers should be organized by professional societies in cooperation with institutions of higher learning and industry. Large corporate companies and governments should provide the cost of such programs.

VI. Recommendations

Each engineer must make concrete efforts to benefit from some CPD annually. This may be in the form of short courses, seminars, conferences, research and development, active participation in professional societies, and in-house instructions.

Institutions of higher learning should include CPD in their normal academic activities alongside undergraduate and postgraduate curricula. Such programs would also generate some revenue for these institutions.

Developers of CPD programs should use the pool of experienced professionals in private practice. CPD stands to benefit tremendously from closer and more effective working partnership with industry both in the development and delivery of programs.

The Engineers Registration Act existing in many developing countries should be revised to include compulsory CPD for engineers.

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