# †EFFECTIVENESS OF SIWES WITH RESPECT TO CHEMICAL ENGINEERING

By

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## PREAMBLE:

The Student Industrial Work-Experience Scheme (SIWES) is a planned and supervised training intervention based on stated and specific learning and career objectives, and geared towards developing the occupational competencies of the participants. It is a programme required to be undertaken by all students of tertiary institutions in Nigeria pursuing courses in "specialized engineering, technical, business, applied sciences and applied arts" (ITF, 2004a).

Therefore, SIWES is generic, cutting across over 60 programmes in the universities, over 40 programmes in the polytechnics and about 10 programmes in the colleges of education. Thus, SIWES is not specific to any one course of study or discipline.

Consequently, the effectiveness of SIWES cannot be looked at in isolation with respect to a single discipline; it is better explored in a holistic manner since many of the attributes, positive outcomes and challenges associated with SIWES are common to all disciplines participating in the scheme.

Hence, the approach of this paper is to look at SIWES as a general study programme cutting across several disciplines. Nevertheless, the paper also pays attention to the peculiarities and problems associated with effective implementation of SIWES for Chemical Engineering and its effectiveness in contributing to the professional development of the Chemical Engineering student.

## INTRODUCTION:

It is pertinent, at the onset, to clarify some related terms with respect to their usage within he context of the topic of this paper and the overall theme of the workshop.

### Standard vs. Quality:

These two closely related terms, **standard** and **quality**, are defined using the quality management framework (Mafe, 2005a)

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**Quality Management** involves the setting up of standards for a process, function, operation, production or service etc. and monitoring performance or outcomes to see if the set standards are met or not. **Standards** are benchmarks, specifications or targets that are set in order to meet the expectations of stakeholders. The extent to which set standards are attained in any activity relects the quality of the process, function, operation, product, service etc. for which the standards were set. **Quality**, therefore, is a measure or an indication of the extent of attainment of set standards applicable to a particular situation.

**STANDARD DURATION FOR A SEMESTER**

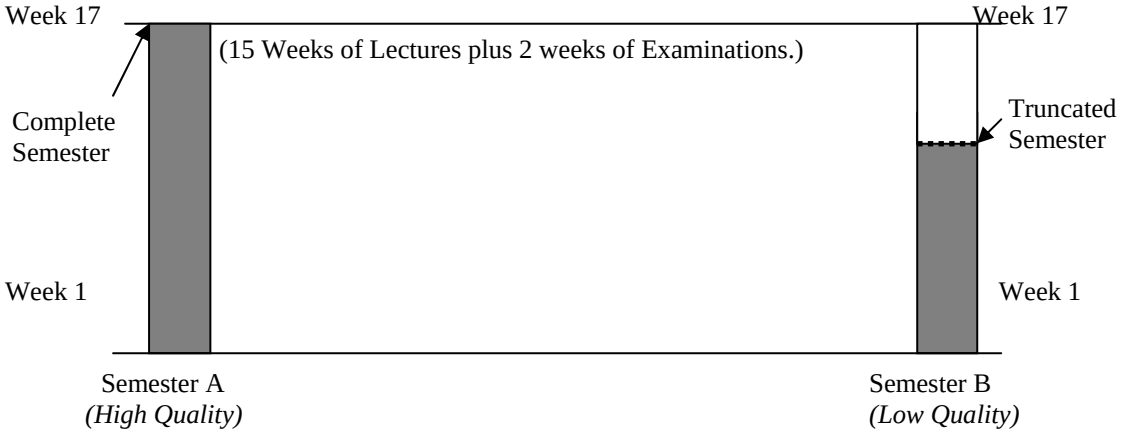



**FIGURE 1: The Quality Management Concept Applied to Duration of Semesters**

When set standards are substantially attained, the activity, process, function, product, service etc. is said to be of **high quality**. But when set standards are substantially unmet, the activity, process, function, product, service etc. is said to be of **low quality**. For example, the standard set by the National Universities Commission (NUC) for one semester is 15 weeks of lectures and two weeks of examinations – a total of 17 weeks. When a semester runs smoothly for 17 weeks, the **standard set for a semester** would have been substantially attained and the **quality of learning by students and quality of imparting of knowledge by lecturers** during the period would be considered **high**, in terms of standard duration of a semester. When a semester is truncated or shortened, for example to 10 weeks, due to strikes by staff or unrest on the part of students, the **standard set for a semester** would not have been attained and the **quality of learning by students and quality of imparting of knowledge by lecturers** during the period would be considered **low**, in terms of standard duration of a semester. These concepts are illustrated in Figure 1. However, it should be noted that the duration of a semester alone would not be enough to determine the quality of learning or knowledge imparted; other standards (Minimum Academic Standards) set for other facets of the educational process by the NUC would necessarily interact with duration of a semester in determining the **overall** quality of learning or knowledge imparted during any semester.

**Efficiency vs Effectiveness:**

In engineering, **efficiency** is defined as the ratio of input to output for example, the efficiency of a machine is the difference between the amount of energy that is put into it in the form of fuel, effort etc. and the amount of work done that comes out in the form of movement etc.

However, the concepts of **productivity** and value added are adopted in this paper in order to bring greater clarity to the term **effectiveness**.

**Productivity** is the comparison of output of goods or services to the input of resources needed to produce or deliver them (The Institute for Corporate Competitiveness). Thus, productivity can be expressed as: Productivity = Output/Input.
Consequently, productivity declines when output declines and input is constant or output is constant and input increases. Productivity improves when output is constant but input decreases or output increases and input is constant.

The concept of **value added** enhances understanding of productivity, since converting raw materials into finished or useable products adds value to the initial raw materials. Hence, value added is the difference between what it costs to produce a product and what it sells for in the marketplace. This difference represents the value that has been added to the product by the production process. The value added concept is illustrated in Figure 2.

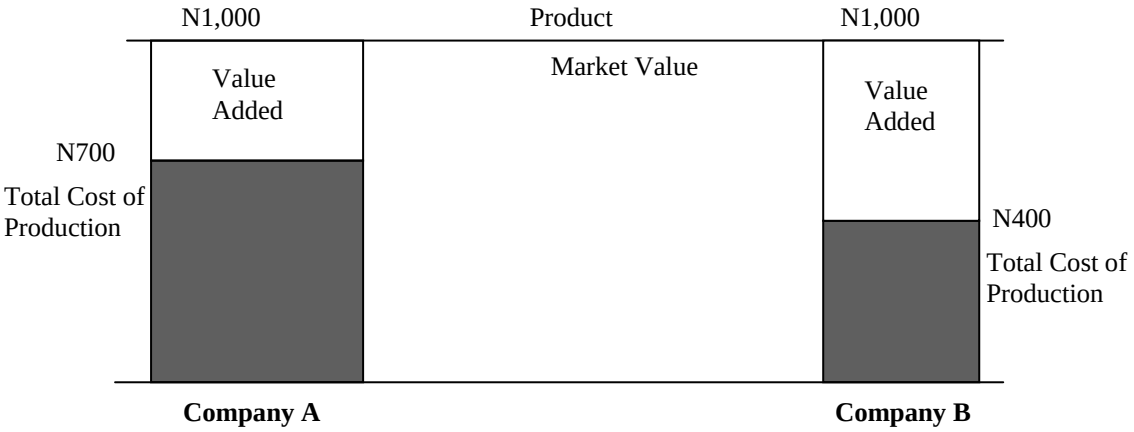



**FIGURE 2: Value Added Concept**

Clearly, from Figure 2, the productivity difference (value added) shows that company B is more **efficient** in producing the same product than company A. Thus, **efficiency** is inherently a term that expresses the cost-benefit ratio of a process. However, both company A and company B were able to produce the required product for the market irrespective of the cost of production to each company. In this sense, both companies A and B can be said to be **effective** in being able to produce the product for the market. Hence, effectiveness is a measure of the ability of a process to attain a desirable outcome or target, irrespective of the cost of doing so. It measures the ability to produce intended or expected results.

**Education vs. Training (Development)**

**Education** involves giving systematic instruction to students in a formal setting such as schools, colleges or universities. Education is the process of learning or the process of acquiring knowledge and information. It facilitates understanding of information by the recipient.

The recipient of education acquires knowledge and capabilities in a specific area of human endeavor or civilization. The process of education invariably requires that the recipient be literate while at the end of the programme he/she may remain largely unskilled in the particular subject area since skill comes with practice and experience.

The knowledge and capabilities acquired through education are usually not focused or targeted at enabling the recipient to do or carry out a specific job after completion of his studies. Education equips the recipient only with the **potential to do all, several or some jobs** in the subject area.

**Training** aims at giving the recipient the competencies required to do a job or carry out a function in the present. It is the process of transferring knowledge, skills, abilities and attitudes (KSAAs) required to do a specific job or carry out a specific function from one person to another or to a group of persons.

Although literacy can be advantage, it is not essential to training; hence the process of training can be encapsulated in the four steps of "**show, tell, do and check"** (Allen in Craig, 1987).

The KSAAs acquired through training are focused at enabling the recipient or trainee to do or carry out a specific job or function after the completion of the training programme. Training equips the recipient with the capability to do or carry out a specific task, job or function.

The distinctions between Science, Engineering and Technology (SET) Education on the one hand, and Science, Engineering and Technology (SET) Training, on the other hand, are summarized in Table 1 (Mafe, 2004a)

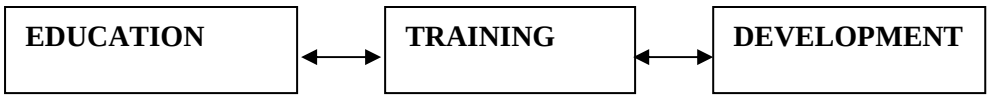
**TABLE 1: Distinctions between SET Education and SET Training**

| **Science/Engineering/Technology Education** | **Science/Engineering/Technology Training** |
|---|---|
| *Conceptual: learning of ideas and information | *Practical: hands-on application of information |
| *Generic: acquisition of base knowledge and information in the subject area | *Specific: application of knowledge and information (show, tell, do and check) to a defined job. |
| *Long-range and strategic | *Short-range and tactical |
| *Career-focused | *Job- or Task-focused |
| *Equips recipients with knowledge, capabilities and potentials to do all, several or some jobs in subject area | *Recipients acquire knowledge, skills, abilities and attitudes (KSAAs) to carry out specific tasks, jobs or functions |
| *Know-How (Understanding) | *Do-How (Competencies |
| *Formal Setting | *Largely Informal Setting |
| *Literacy Essential | *Literacy not essential but advantageous |
| *Limited Opportunities for Practice | *Enhanced Opportunities for Practice |
| *Limited Acquisition of Experience | *Enhanced Acquisition of Experience |

***Source: Mafe (2004a), The Role of Training in the Formation of Competent and Productive Technical Manpower.***

The concept of **development,** refers to training which is geared towards preparing an individual or a group of individuals for future jobs or to assume higher responsibilities based on identified potentials or capabilities. It is simply a future – oriented kind of training which is not focused on bringing the competencies of individuals up to the desired standards for the performance of current or present jobs but for future responsibilities.

In spite of the distinctions among the three terms, they are closely intertwined and often used interchangeably. There is the general acceptance of the notion that there are *bona fide* links between education and training on the one hand, and training and development on the other, with training straddling the other two.




## THE NEED FOR INDUSTRIAL TRAINING

Theoretical knowledge alone would not usually prepare an educated person for the world of work. The worker or productive individual must not only be knowledgeable but must also be versatile in the application of skills to perform defined jobs or work.

The reality of the foregoing fact can be illustrated by using a simple analogy. While it is possible for someone to learn and imbibe all the available information on driving a car in the classroom, it is unlikely that the individual would, based on this knowledge alone, be able to drive a car at the first opportunity. On the other hand, someone else without the theoretical information on how to drive a car, on being told and shown what to do, followed by hands-on practice and supervision by an instructor, would at the end of the day be able to drive a car successfully. Of course, someone who has been exposed to both the theoretical underpinnings of driving a car and the hands-on experience of doing so would and should be a better driver! (Mafe, 2009).

Consequently, there are two basic forms of learning - education and training – both of which are indispensable to the productive world of work and the functioning of society today. In the illustration given above, the first individual had abundant education on how to drive a car; the second individual had received adequate training on how to drive a car; the third individual had the advantage of being able to combine theoretical knowledge with practical skills to become a better driver.

This need to combine theoretical knowledge with practical skills in order to produce results in the form of goods and services or to be productive is the essence and rationale for industrial training.

Both education and training are important: there cannot be effective education without some training input and there cannot be effective training without some educational input. The productive individual, particularly in this millennium, must be able to combine and utilise the outcomes from the two forms of learning (Know-How Ability and Do-How Capability) for the production of goods and services. This requirement is particularly crucial for individuals pursuing careers in science, engineering and technology (SET) disciplines.

## THE PLACE OF TRAINING IN THE EMERGENCE OF ENGINEERING

Training, being the process of teaching and giving practice to a person in order to bring his behavior and performance of a task, job or function to a desirable standard, has **historically** played an **immeasurable** role in the march of civilization. Sustained advances in civilization over the millennia would not have been possible without the **central and unique role of training** as a vehicle for passing on knowledge and skills from one generation to another, particularly in the formation of technical manpower.

It is generally thought that human bengs began amassing knowledge at the beginning of the stone age. As they invented tools, weapons, clothing, shelter and language, the need for training became an essential ingredient in the march of civilization (O'Sullivan in Craig, 1987). Whether our ancestors stumbled upon or invented these facets of civilization is of very little significance. What is more important is that human beings had the ability to pass on to others the knowledge and skills gained in mastering these circumstances. This was done not by written words or through literacy but by deliberate example, by practice, by signs and by spoken words (**show, tell, do and check**"). Through these devices, the developmental process called training was administered; and when the message was received by another successfully, we say that learning took place and knowledge or skill was transferred.

**Training through communication**, exemplified by early cave wall drawings, which served as documentary records of the time, propelled the march of civilization. It is conceivable that the etchings and paintings were also effective instructions, orienting primeval youngsters to such **skills** as fishing, hunting, and how to protect themselves from danger (Miller, 1987). As archaeological excavations continue to unearth clay or brick tablets on which is inscribed information about the lives of people living 6,000 or more years ago, the place of training in the rapid development of knowledge and information has become dramatically more evident.

### Craftsmanship Training

The Sumerian Palace of Kish in Mesopotamia, built in 3500 B.C. is an example of the ancient use of brick. The Bible tells us that the Tower of Babel was also built of brick. The astounding architectural and masonry accomplishments of the craftspeople of old, embodied in the pyramids and ancient temples, such as Solomon's First Temple, are memorials to the stonemasons, the brick masons, the carpenters, the artists, architects and scientists of ancient times.

But let us keep in mind that thousands of people worked on most of these projects and that the work could not have been accomplished without training; **without the transfer of knowledge and skills** from one person to another, or from one person to many people. More importantly, it must be remembered that in these early civilizations, **literacy reached neither the craftspeople nor the peasantry**. The skills and knowledge of the crafts could only have been transmitted or transferred by direct instruction, example and practice (**"show, tell, do and check")** i.e. training from the skilled craftspeople to the unskilled or the not-so-skilled.

### Apprenticeship

Contemporary training formats have their roots in the apprenticeship system of old whereby an experienced person passed along knowledge and skills to the novice, who after a period of apprenticeship became a yeoman, or journeyman. Provisions governing apprenticeship were

instituted as early as 1800BC when such rules were included in the Code of Hammurabi, who placed a code of his laws in the temple of Shamash (God of Justice) in Babylon.

The apprenticeship system, although predominant in technical trades, was not restricted to artisans. The ancient temples taught religion and, frequently, art through apprenticeship. The armies took responsibiiities for training soldiers through apprenticeship. In all walks of life, knowledge was passed from one person to another – **mainly via training and not education.** Apprenticeship was the vehicle of instruction in medicine, law and many other professions where education now predominates and is in the domain of colleges and universities. As recently as the 1920s, it was possible in the United States of America for a person to "read law in the office of an attorney" (Eurich, 1985). Following a period of study, the apprentice lawyer took a government-sponsored examination, with a passing grade qualifying the apprentice to practice law. Similarly, one can qualify as an accountant, even today, in many parts of the world through a system of apprenticeship know as articleship. Further, in Nigeria qualifications to practise many traditional professions and trades (e.g. traditional medicine) are still obtained through the system of apprenticeship.

**Formation of Guilds**

The formation of guilds in the middle ages contributed to the evolution of modern-day training formats. Guilds were associations of people whose interests and pursuits were the same or similar.

The first guilds were established in England, before the Norman Conquest in 1066. By the end of the 12$^{th}$ Century, guilds were spread throughout the cities of Europe. The basic purposes of guilds were mutual protection, assistance and advantage. In essence, guilds created private franchise, and at the same time established standards for the quality of products and standards of workmanship.

Guilds contributed to the evolution of modern training through the standards of workmanship, as exemplified by the structure of their membership. There were three classes of membership in the guilds: the master workers, who owned the raw materials and tools and directed the work; the apprentices, who usually lived with the master and who received practically no pay, except sustenance and training; and lastly, the journeymen, who had passed through apprenticeship but were yet to qualify as masters and who worked under masters and received fixed wages for their labours.

The guilds are similar in many ways to the various technical trade associations (e.g. associations of mechanics, vulcanizers etc) prevalent in present-day Nigeria, particularly with respect to training function which they perform. Also, in some senses, particularly with respect to training and professional competence, the present-day professional bodies (e.g. Nigerian Society of Chemical Engineers) and regulatory agencies (e.g. Council for the Regulation of Engineering in Nigeria, COREN) are similar in structure and operation to the guilds. In fact, it may not be far-fetched to suggest that the professional bodies and regulatory agencies world-wide are mutants of the guilds, which over many mutations have come to assume their present forms.

**Vocational Training and Factory Schools**

The industrial revolution which began in England about 1750, and spread first to France and Belgium, then to Germany and the United States, ushered in an era of social legislation, and with it sizeable changes in the concept of work and work organization. Through all these changes, however, one constantly developing **emphasis was upon quality training of workers**,

Industrialization brought two changes in work preparation and execution. **Specific training was now required before specific tasks could be performed.** The other change required a different orientation on the part of workers: work activity was now focused away from the individual, family or small group and toward a large impersonal organization, existing within an even larger, impersonal urban community. **The industrial revolution required** training of workers for specific tasks, and the reorientation of workers to function within the emerging corporate organization (Eurich, 1985), i.e. the possession of relevant KSAAs by workers.

The industrial revolution which thrived on power-driven machinery, steam engines and a factory system that put useful knowledge and new technology to work needed a new class of workers. The new "working class" wanted the opportunities that industry offered as much as industry wanted workers with a certain level of intelligence, skill and resourcefulness. The new system of manufacturing meant that the machines were skilled, not necessarily the operators of the machines. Craftsmanship belonged to the past, and industrial training to the future.

However, since there was no public system of education or training to provide useful knowledge for potential young workers in these early days of the industrial era, training had to take place within a company or trade group out of necessity. But the companies did turn to the education system for help and this culminated in the establishment of institutions for the training of persons preparing themselves for jobs in industry, which came to be known as "**vocational training".** These types of institutions exist till today in many parts of the world including Nigeria where they are called Trade Centres or Technical Colleges.

In order to meet the demand of industry for workers with the requisite knowledge and skills, some companies established their own **"factory schools"**. One of the first factory schools was established in 1872 by Hoe and Company, New York. Similar factory schools were established by Westinghouse in 1888, by General Electric Company in 1901 and by International Harvester Company in 1907.

In Nigeria, some companies have also found it necessary to establish their own factory schools, as exemplified by Unilever Nigeria Plc which established its Engineering Craft Apprenticeship School in 1983. Other companies having factory schools include Nigerian Breweries Plc., Nigerite Plc, Bagco Plc., Flour Mills of Nigeria Plc. Government establishments are not left out: Nigeria Railways and Nigerian Ports Authority have Apprenticeship Training Schools. The Industrial Training Fund, although not a company, also has Apprenticeship Training Schools where people preparing themselves for employment in industry can acquire requisite KSAAs.

## THE ADVENT OF INDUSTRIAL TRAINING

The power-driven machines, steam engines and the new system of manufacturing associated with the industrial revolution demanded a cadre of workers who were freed from the limitations of their immediate craft capabilities and possessed knowledge of the new technologies prevalent then in the workplace. This demand led to the concept of "**the application of higher learning to practical and technical affairs"** (Eurich, 1985)**.**

The concept flourished with the establishment of technical and engineering courses first at the Rensselaer Polytechnic Institute, United States in 1824 and followed by Columbia University in 1830, which introduced a new scientific curriculum that required neither Latin nor Greek. By the close of the 19th Century, science, engineering and technical education had been firmly established in several universities and other institutions of higher learning in both the United States and Europe.

The graduates of these institutions were equipped, through systematic instruction (i.e. education), with a body of knowledge in science and engineering which was conceptual and generic. They possessed general ideas or notions underlying the workings of various engineering systems but lacked a thorough grounding in the application of knowledge to the execution of specific jobs.

It became clear that engineering students needed to supplement their education with practical experience and training in industry for them to be effective and productive workers in the execution of specific jobs after graduation.

An innovation in engineering education which took place during the first decade of the 20th Century addressed the need of engineering students for job-related practical hands-on experience when Herman Schneider, Dean of the College of Engineering, University of Cincinnati introduced Cooperative Education (Eurich, 1985). The engineering student would go to school for a time, followed by working in a factory or industry for an equal period of time. Then the student would repeat the process: going to school for additional education and going back to the factory or industry for additional training and practical experience.

Although variations of cooperative education exist today, the innovation of Schneider in 1906 constitutes the foundation and the bedrock of all forms of industrial training of Science, Engineering and Technology (SET) students throughout the world. The Centennary or 100 years of this innovation was celebrated in 2006 through a World Conference on Cooperative Education at the University of Cincinnati, U. S. A.

In Nigeria industrial training also began with the dependence of industry on technical competencies for the operation and maintenance of its resources. Industrial training or work-experience had its origins in the practice at the first Nigerian Polytechnic, the Yaba Technical Institute (now Yaba College of Technology) which was founded in 1948. Students were sponsored by government establishments or private firms at the time. They returned to work with their employers during the long vacations. In this way, the students had some form of industrial training or work-experience integrated with their learning at the polytechnic (Uvah, 2004).

Subsequent expansion in higher education in Nigeria and discontinuation of the system of automatic sponsorship by employers, as a result of the increase in the number of institutions and enrolments, led to the demise of this format for industrial training.

## EXTANT NEED FOR INDUSTRIAL TRAINING

The need for industrial training of Science, Engineering and Technology (SET) students as identified by Schneider exists till today.

Advanced countries, with over 100 years of sustained industrial development and requisite technical and human infrastructure, have been able to adequately implement industrial training for their SET students. Developing countries, which are really just starting their industrial development and having a weak or non-existent technical infrastructure, face problems in adequately implementing industrial training for SET students.

The situation is exacerbated in African countries by the inappropriate and inadequate technical manpower training structures that are prevalent in these countries. This is exemplified in the comments of Professor Kwake, former Vice-Chancellor of the University of Science and Technology, Kumasi, Ghana (Kwake in Mordell and Coales, 1983): "It is true that most universities in Africa were initially inspired by, and developed as carbon copies of universities in Europe; course contents, standards, methods of assessment and other aspects of the educational programme were copied from the model and any departures from the European practice were looked upon as anathema both inside and outside the African country. In the science and technology disciplines and especially in engineering, the result has been devastating. The products have been academically equal to the best in the world but they have not brought any significant progress in endogenous technology ….. Let us face it, the main criticism that has been persistently leveled against technology-based professions is that their products are too theoretical, and in some cases, too specialized".
These observations are supported by the findings of the study jointly conducted, by the World Bank and the Nigerian Institute for Social and Economic Research (World Bank and NISER, 2000), on the one hand, and the National Needs Assessment Surveys conducted by the National Universities Commission (NUC, 2004), on the other. Both reports highlight the criticisms of Nigerian SET graduates by employers, particularly with respect to their performance on the job. **The main criticism is that employers believe that SET graduates bring sufficient theoretical knowledge to the job but that they generally lack hands-on or practical skills that would make them productive.**

This situation has led to some employers establishing special training schools where fresh SET graduates acquire the requisite KSAAs before they can be employed. An example of this approach to bridging the gaps in the knowledge and skills repertoire of fresh SET graduates is the Special Intensive Training Programme (SITP) of the Shell Petroleum Develoment Company of Nigeria Limited (Kragha, 2004), which was established in 1998. Participants in the programme undergo a one-year intensive technical skills acquisition through hands-on experience.

Although the SPDC's approach is commendable since it contributes to the enhancement of availability of technical skills for the economy (particularly for the oil and gas sector), not all employers can adopt this model because of cost implications and likely erosion of their profits. Secondly, only a small number of SET graduates can benefit from such programmes since available places are limited.

Consequently, there is a need to put in place modalities that would ensure that fresh SET graduates are equipped with the requisite KSAAs that would enable them to be productive on the job following graduation. The Students' Industrial Work Experience Scheme (SIWES), properly implemented through the joint efforts of all stakeholders, offers an avenue for achieving this objective.

## BENEFITS OF INDUSTRIAL TRAINING

The major benefits accruing to students who participate conscientiously in industrial training are the skills and competencies they acquire. These relevant production skills (RPSs) remain a part of the recipients of industrial training as life-long assets which cannot be taken away from them. This is because the knowledge and skills acquired through training are internalised and become relevant when required to perform jobs or functions (Mafe, 2009).

Several other benefits can accrue to students who participate in industrial training. These include the following:

- Opportunity for students to blend theoretical knowledge acquired in the classroom with practical hands-on application of knowledge required to perform work in industry.
- Exposure of students to the environment in which they will eventually work, thereby enabling them to see how their future professions are organised in practice.
- Minimization of the bewildement experienced by students, particularly those from a non-technological background, pursuing courses in science, engineering and technology with regard to different equipment, processes, tools etc. available in industry.
- Enabling SET students appreciate work methods and gain experience in handling equipment and machinery which may not be available in their institutions.
- Preparing students to contribute to the productivity of their employers and national development immediately after graduation.
- Provision of an enabling environment where students can develop and enhance personal attributes such as critical thinking, creativity, initiative, resourcefulness, leadership, time management, presentation skills and interpersonal skills, amongst others.
- Preparing students for employment and making the transition from school to the world of work easier after graduation.
- Enhancing students' contacts with potential employers while on training.
- Enabling students bridge the gap between the knowledge acquired in institutions and the relevant production skills (RPSs) required in work organisations.
- Making SET students appreciate the role of their professions as the creators of change and wealth and indispensable contributors to growing the economy and national development.
- Enabling students appreciate the connection between their courses of study and other related disciplines in the production of goods and services.

## THE STUDENTS' INDUSTRIAL WORK-EXPERIENCE SCHEME

As earlier stated, there are different forms of Cooperative Education around the world, all emanating from the innovation of Herman Schneider in 1906.

In Nigeria, the current form of Cooperative Education is known as the Students' Industrial Work-Experience Scheme (SIWES).

Often, students mistakenly and commonly refer to "SIWES" as "I.T"; whereas industrial training is generic while SIWES is a specific form of Cooperative Education or industrial training operated in Nigeria.

### Antecedents of SIWES

Following the discontinuation of the system of sponsorship of students by employers at the Yaba Technical Institute and the emergence of other higher institutions offering science, engineering and technology programmes, there was no organised industrial training in Nigeria. Only those students who engaged in holiday jobs in areas relevant to their courses of study could be said to have had some form of work-experience or industrial training while others did not.

The situation led to a spate of criticisms of SET graduates from Nigerian institutions as lacking practical skills in general and, in particular, the relevant production skills needed by industry. Consequently, some higher institutions introduced the Student Work-Experience Programme (SWEP) to enrich the curricula of engineering courses (Uvah, 2004). SWEP was designed to enable students understand the practical applications of the basic principles underlying the traditional engineering programmes (Civil, Electrical and Mechanical Engineering).

SWEP was conducted during the long vacation in the institutional workshops under simulated industrial conditions for 200 Level students of universities who have just been introduced to engineering and technology courses. Students were allowed to use machines and tools available in the workshops in the production of simple jobs and were introduced to some basic practices which they were likely to encounter during industrial training.

However, SWEP was not a substitute for real industrial training.

### Advent of SIWES

In recognition of the shortcomings and weaknesses in the formation of SET graduates, particularly with respect to acquisition of relevant production skills (RPSs), the Industrial Training Fund established the Students' Industrial Work-Experience Scheme (SIWES) in 1973. The scheme was designed to expose students to the industrial environment and enable them develop occupational competencies so that they can readily contribute their quota to national economic and technological development after graduation.

Consequently, SIWES is **a planned and structured programme based on stated and specific career objectives** which are geared toward developing the occupational competencies of participants.

**Objectives of SIWES**

The Industrial Training Fund's Policy Document No. 1 of 1973 (ITF, 1973) which established SIWES outlined the objectives of the scheme. The objectives are to:

- Provide an avenue for students in institutions of higher learning to acquire industrial skills and experience during their courses of study;
- Prepare students for industrial work situations that they are likely to meet after graduation;
- Expose students to work methods and techniques in handling equipment and machinery that may not be available in their institutions;
- Make the transition from school to the world of work easier and enhance students' contacts for later job placements;
- Provide students with the opportunities to apply their educational knowledge in real work situations, thereby bridging the gap between theory and practice;
- Enlist and strengthen employers' involvement in the entire educational process through SIWES.

**Historical Perspectives on SIWES**

The Students' Industrial Work-Experience Scheme (SIWES) started in 1974 with 748 students from 11 institutions of higher learning participating. By 1978, the scope of participation in the scheme had increased to about 5,000 students from 32 institutions. The Industrial Training Fund, however, withdrew from the management of the scheme in 1979 owing to problems of organisational logistics and the increased financial burden associated with the rapid expansion of SIWES (ITF, 2003). Consequently, the Federal Government funded the scheme through the National Universities Commission (NUC) and the National Board for Technical Education (NBTE) who managed SIWES for five years (1979 – 1984). The supervising agencies (NUC and NBTE) operated the scheme in conjunction with their respective institutions during this period.

**TABLE 2: Growth of Students Population and Institutions, 1974 – 1978**

| YEAR | NUMBER OF INSTITUTIONS | NUMBER OF STUDENTS |
|---|---|---|
| 1974 | 11 | 784 |
| 1975 | 14 | 1,866 |
| 1976 | 18 | 3,030 |
| 1977 | 26 | 3,088 |
| 1978 | 32 | 4,713 |
| **Total** | **32** | **13,481** |

***Source: ITF (2003). Students Industrial Work-Experience Scheme in Human Resource Development in Nigeria.***

The scheme was subsequently reviewed by the Federal Government resulting in Decree No 16 of August, 1985 which required that **"all students enrolled in specialised engineering, technical, business, applied sciences and applied arts should have supervised industrial attachment as part of their studies"**. In the same vein, the ITF was directed by the Federal

Government to take charge and resume responsibility for the management of SIWES in collaboration with the supervising agencies, i.e. National Universities Commission (NUC), the National Board for Technical Education (NBTE) and the National Commission for Colleges of Education (NCCE).

**TABLE 3:Growth of Students Population and Institutions, 1985- 1995**

| YEAR | NUMBER OF INSTITUTIONS | NUMBER OF STUDENTS |
|---|---|---|
| 1985 | 58 | 16,912 |
| 1986 | 72 | 18,467 |
| 1987 | 79 | 20,488 |
| 1988 | 87 | 22,879 |
| 1989 | 94 | 26,565 |
| 1990 | 101 | 32,426 |
| 1991 | 104 | 29,410 |
| 1992 | 121 | 23,500 |
| 1993 | 134 | 50,280 |
| 1994 | 137 | 49,718 |
| 1995 | 141 | 57,433 |
| **Total** | **141** | **348,278** |

***Source: ITF (2003). Students Industrial Work-Experience Scheme in Human Resource Development in Nigeria.***

Following the resumption of management of SIWES by the ITF in 1984, the scheme has witnessed rapid expansion. Between 1985 and 1995, the numbers of institutions and students participating in SIWES rose to 141 and 57,433 respectively. Between 1995 and 2003, a total of 176 institutions and 535,210 students participated in the scheme. In 2008 alone, the number of institutions which participated in SIWES rose to 204 while the number of students from these institutions who participated in the scheme was 210,390.

**TABLE 4: Growth of Students Population and Institutions 1996 – 2001**

| YEAR | NUMBER OF INSTITUTIONS | NUMBER OF STUDENTS |
|---|---|---|
| 1996 | 138 | 40,178 |
| 1997 | 141 | 46,108 |
| 1998 | 144 | 42,011 |
| 1999 | 154 | 56,973 |
| 2000 | 154 | 60,241 |
| 2001 | 169 | 63,742 |
| **Total** | **169** | **309,253** |

***Source: ITF (2003). Students Industrial Work-Experience Scheme in Human Resource Development in Nigeria.***

**TABLE 5: Students and Supervisory Allowances from 1974 – 1978**

| YEAR | NUMBER OF INSTITUTIONS | NUMBER OF STUDENTS | AMOUNT EXPENDED ₦ |
|---|---|---|---|
| 1974 | 11 | 784 | 211,680.00 |
| 1975 | 14 | 1,866 | 503,550.00 |
| 1976 | 18 | 3,030 | 818,100.00 |
| 1977 | 26 | 3,088 | 833,760.00 |
| 1978 | 32 | 4,713 | 1,272,510.00 |
| **Total** | **32** | **13,481** | **3,639,600.00** |

***Source: ITF (2003). Students Industrial Work-Experience Scheme in Human Resource Development in Nigeria.***

**TABLE 6: Disbursement of Supervisory and Students Allowances from 1985 - 2002**

| YEAR | NUMBER OF INSTITUTIONS | NUMBER OF STUDENTS | AMOUNT EXPENDED ₦ |
|---|---|---|---|
| 1985 | 58 | 16,912 | 7,606,259.00 |
| 1986 | 72 | 18,467 | 7,611,871.00 |
| 1987 | 79 | 20,488 | 10,051,823.00 |
| 1988 | 87 | 22,879 | 11,918,000.00 |
| 1989 | 94 | 26,565 | 10,783,586.00 |
| 1990 | 101 | 32,426 | 11,005,080.00 |
| 1991 | 104 | 29,410 | 9,277,432.00 |
| 1992 | 121 | 23,500 | 10,662,784.00 |
| 1993 | 134 | 50,280 | 11,356,573.00 |
| 1994 | 137 | 49,718 | 18,356,767.00 |
| 1995 | 141 | 57,433 | 23,867,097.00 |
| 1996 | 162 | 58,313 | 36,740,592.50 |
| 1997 | 160 | 78,807 | 41,932,089.00 |
| 1998 | 162 | 78,263 | 44,611,367.00 |
| 1999 | 155 | 56,743 | 37,603,360.00 |
| 2000 | 159 | 148,100 | 228,089,164.00 |
| 2001 | 160 | 69,207 | 481,391,562.50 |
| 2002 | 167 | 137,451 | 337,147,733.00 |
| **Total** | **1,266** | **975,162** | **1,339,313,650.00** |

***Source: ITF (2003). Students Industrial Work-Experience Scheme in Human Resource Development in Nigeria.***

Presently, participation in the scheme is limited to science, engineering and technology programmes in Universities and Polytechnics while in the Colleges of Education NCE programmes in Technical Education, Agriculture, Business, Creative Arts & Design, Computer Studies and Home Economics are eligible.

## ORGANISATION AND OPERATION OF SIWES

The organisation of the Students' Industrial Work-Experience Scheme (SIWES) involves many stakeholders as follows:

- Federal Government (Federal Ministry of Commerce & Industry)
- Industrial Training Fund (SIWES Division)
- Supervising/Regulatory Agencies (NUC, NBTE, NCCE)
- Industry/Employers (NECA, NACCIMA, MAN, Government Establishments)
- Tertiary Institutions (Universities, Polytechnics, Colleges of Education) and
- Student Trainees (Engineering, Science, Technology, NCE Technical)

SIWES is operated as a joint venture through the contributory activities of the stakeholders identified above and as shown in Figure 3 below: (Mafe, 2009).

The roles of the various stakeholders are:

- The Federal Government (F.G) funds the scheme through the Federal Ministry of Commerce & Industry (FMC&I). It also laids down broad policies and guidelines that govern the scheme.
- The Industrial Training Fund (ITF), a parastatal of the Federal Ministry of Commerce & Industry, is responsible for the overall management of the scheme in collaboration with other stakeholders. The pivotal role of the ITF in ensuring smooth implementation of the scheme is very clear as shown in Figure 1. ITF collaborates with all other stakeholders directly or indirectly.

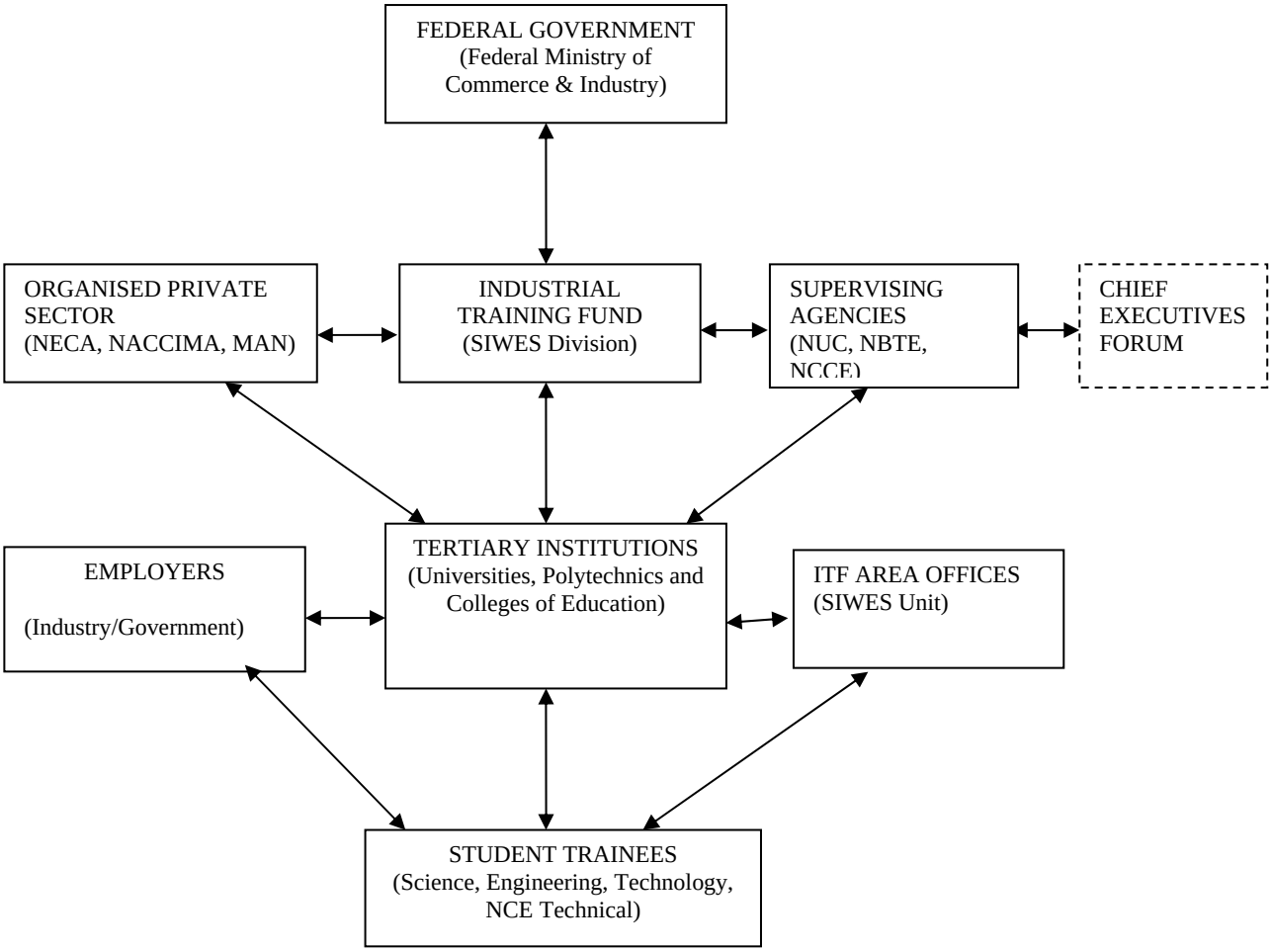


**FIGURE 3: Relationships Amongst SIWES Stakeholders**

- The Regulatory/Supervising Agencies (NUC, NBTE, NCCE) who regulate the tertiary institutions on behalf of the Federal Government ensure that the guidelines for the operation of SIWES are followed by the institutions.

- Employers, members of the Organised Private Sector (OPS) and Government Establishments, are the ultimate beneficiaries of SIWES since they depend on the national pool of technical skills for the operation and maintenance of their resources. They are required to provide places of industrial attachment for SIWES participants.

- Tertiary Institutions are the primary beneficiaries of SIWES since the scheme contributes to enhancing the quality of their products. They carry out the implementation of SIWES. As shown in Figure 3, the central role of the tertiary institutions in ensuring the successful implementation of SIWES is apparent. The institutions relate directly with all other stakeholders except the Federal Government.

- The students are the direct beneficiaries of SIWES since they are the recipients of the training provided through the scheme. In fact, the activities of all other stakeholders with respect to SIWES are geared towards ensuring that eligible students have the opportunity to acquire relevant production skills (RPSs) before graduation. Consequently, eligible students are required to participate in SIWES.

- In addition, an organ known as the Chief Executives Forum and comprising the Chief Executives of ITF, NUC, NBTE, NCCE and the OPS, is responsible for formulation of policies for the effective management and implementation of SIWES at the national level.

While all stakeholders are involved in the operation of the scheme, the key actors or major players directly involved in the implementation of the scheme are **the students, the employers and the institutions** as shown in Figures 4a and 4b. Other stakeholders have largely a lesser role or involvement with the actual training process (Mafe, 2009).

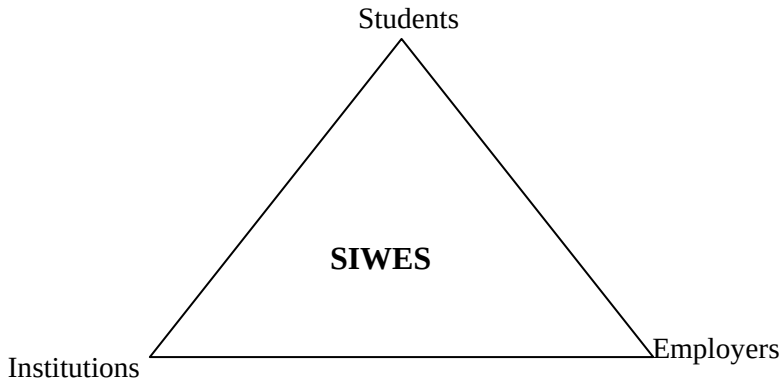
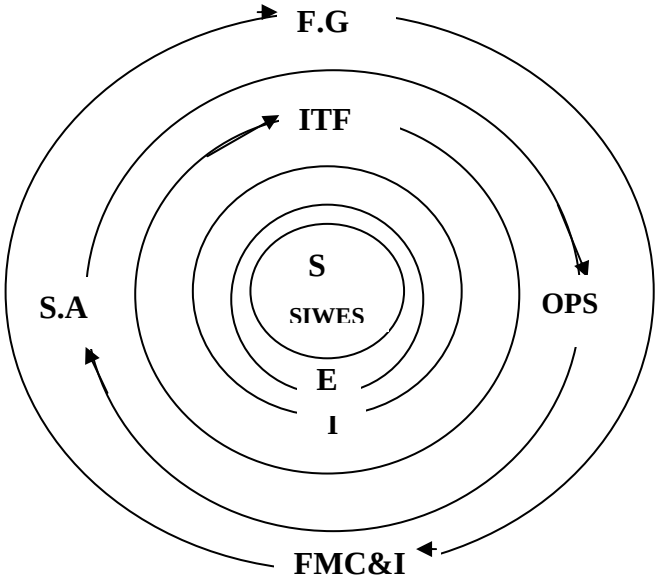



**FIGURE 4A: The SIWES Tripod - The Three Actors in SIWES Implementation**




**Key to Figure 4b**

| | |
|---|---|
| F.G: | Federal Government |
| FMC&I: | Federal Ministry of Commerce & Industry |
| ITF: | Industrial Training Fund |
| SA: | Supervising Agency |
| OPS: | Organised Private Sector |
| E: | Employers |
| I: | Institutions |
| S: | Student Trainees |

**FIGURE 4B: Relative Distance of Stakeholders from SIWES Implementation/Skills Acquisition by Students**

The relative involvement of each stakeholder in the actual implementation of SIWES is depicted by the distance of the stakeholder from the centre of the circle in Figure 4b.

**SIWES Guidelines**

For a scheme as large as SIWES (in terms of students' population, number of participating institutions, number of employers, number of stakeholders and the level of funding) guidelines must be put in place to ensure smooth implementation of the scheme.

The Guidelines for the Operation of SIWES stipulate the expected roles of each stakeholder and it is the adherence to these guidelines by every stakeholder that can ensure the successful implementation of the scheme and the attainment of its objectives and goals (ITF, 2004).

The expected roles of each stakeholder are as follow:

***Federal Government***

- Provide adequate funds to the ITF, through the Federal Ministry of Commerce & Industry, for implementation of the scheme.
- Make it mandatory for all Government Ministries, Parastatals, Private Companies and Commercial Ventures to offer places of attachment to students.
- Make policies to guide and regulate the scheme at the national level.

***Industrial Training Fund***

- Provide logistics and materials needed to administer the scheme.
- Compile lists of Employers with available training places for industrial attachment and circulate the lists to participating institutions.
- Supervise students on SIWES through its Area Offices

- Vet and process students' log books and ITF Form 8 returns
- Pay students' allowances and supervisory allowances due to institutions
- Organise Biennial conferences, seminars and Chief Executive Fora on SIWES.
- Arrange Group Insurance Scheme for students on SIWES
- Review and conduct research into the operations of SIWES.

***Supervising Agencies (NUC, NBTE, NCCE)***

- Ensure that functional SIWES Coordinating Units are established in participating institutions.
- Encourage the appointment of full-time Industrial Coordinators to operate the scheme in the institutions
- Evolve minimum national guidelines in respect of supervised training activities for programmes approved for SIWES.
- Vet and approve Master and Placement Lists and forward them to ITF.
- Ensure that institutions abide by the SIWES operational guidelines
- Ensure adequate funding of SIWES Coordinating Units in institutions
- Develop, monitor and review job specifications to guide the training of students on SIWES in collaboration with institutions
- Monitor and review courses eligible for SIWES

***Employers/Industry***

- Accept students and assign them to relevant on-the-job training
- Appoint industry-based supervisors for students on SIWES
- Control and discipline student attachees in like manner as permanent staff
- Pay students' allowances when received from the ITF
- Provide medical care for students within the limits of the employers' conditions of service during the duration of the attachment
- Follow tailor-made training programmes agreed to with institutions for the training of student attachees
- Permit representatives of ITF and institution-based supervisors to visit the students on attachment
- Grade students as provided for in the Assessment Form (ITF Form 8) at the end of the programme and submit same to institutions.

***Tertiary Institutions***

- Establish fully-staffed SIWES Coordinating Units in the institutions
- Appoint full-time SIWES Coordinators to operate the scheme at the institutional level
- Prepare and submit Master and Placement Lists to the ITF through the respective Supervising Agency (NUC, NBTE, NCCE)
- Place students on attachment with Employers in industry
- Organise Orientation Programmes for students to prepare them for industrial training
- Work out tailor-made training programmes with the industry-based supervisor to be followed by the students while on training
- Supervise students on SIWES at least on 3 occasions and sign their log books
- Assess students' performance at the end of training and award grades accordingly

- Allocate credit loads to SIWES as recommended by the Supervising Agencies
- Submit ITF Form-8 in respect of each student to the ITF at the end-of-training
- Maintain separate bank account for SIWES funding
- Submit comprehensive reports on the scheme to the ITF after each SIWES Cycle.

***Student Trainees***

- Participate in the SIWES Orientation Programme before proceeding on industrial training.
- Be regular and punctual at respective places of industrial attachment
- Avoid unilateral change of place of attachment except in special circumstances and only with the permission/approval of the institution's SIWES Coordinator and the Employer.
- Comply with the Employers' rules and regulations
- Keep proper records of training activities and other assignments in the log books
- Arrange own living accommodation during the period of attachment
- Submit to the ITF, through the institution, the Evaluation Form (ITF Form 8) duly completed by the student, the Employer and the Institution.
- Submit Log Books, Reports and other SIWES Documents required by the respective institutions at the end of the training programme.
- Be diligent, honest and conscientious in all activities
- Protect and safeguard employers' property throughout the period of training.

## APPRAISAL OF THE EFFECTIVENESS OF SIWES

The effectiveness of SIWES is appraised in relation to its organization and operation, guidelines and the roles of stakeholders, funding, operational standards and modalities, and the objectives of the scheme. There are key facets and aspects of the SIWES that determine the effectiveness of the scheme (Mafe, 1991 and 1997)

### Organisation and Operation of SIWES

The organizational structure (Figure 3) put in place for SIWES is apparently wieldly and cumbersome, involving many stakeholders who are not directly part of the SIWES Tripod. These stakeholders are the Federal Government, the Federal Ministry of Industry, the Industrial Training Fund, the Supervisory Agencies (NUC, NBTE and NCCE), the organized Private Sector (NECA, NACCIMA and MAN) as well as the organ known as the Chief Executives Forum charged with laying down policies for the scheme. These bodies are far-removed from the locus of training under SIWES which involves the tripartite cooperation of students, institutions and employers.

In spite of the guidelines on SIWES, stipulating the roles and responsibilities of the various stakeholders under the scheme, the organizational structure has continued to feature operational dysfunctions, avoidable administrative delays and bottlenecks and unnecessary overheads in the implementation of SIWES. Examples of the negative impact of the organizational structure on the implementation of SIWES are numerous but it suffices to highlight the process of payment of student allowances which has a backlog of about five years. A more effective organization for the implementation of SIWES that focuses on the primary objective of the scheme – acquisition of RPSs by students – is, therefore, called for.

It is proposed that a National Commission for Student Industrial Training or National Board for Cooperative Education be created to oversee the implementation of SIWES in the country. The establishment of a body dedicated solely to the effective implementation of SIWES would underscore the vital potential of the scheme in the formation of competent and productive technical manpower for the nation.

While giving kudos to the Industrial Training Fund for facilitating the establishment of the scheme in 1973 and its management of SIWES up to 1979 and subsequently, from 1985 to date, it is a fact that SIWES is not the primarily mandate of the ITF, which is "promoting and encouraging the acquisition of skills in industry and commerce " (Decree 47, 1971). It is clear that SIWES is only a secondary or subsidiary mandate of the ITF since the scheme, even though of great importance to technological development of the nation, is domiciled in a Division headed by a Deputy Director at the ITF Headquarters, Jos. It is the opinion in some quarters that saddling the ITF with the management of SIWES nationwide distracts the Fund from focusing fully on its primary mandate and, at the same time, from paying full attention to SIWES.

Based on the fact that SIWES is a training intervention for students of tertiary institutions, it might be considered appropriate to locate the management of the scheme in the respective supervising agencies (i.e. NUC, NBTC and NCCE). However, similar problems observed in relation to SIWES being managed by the ITF as a secondary or subsidiary mandate are likely to surface. In fact, it is because of such problems, arising from the fact that SIWES is not the primary mandate of the supervising agencies, that its management was reverted to ITF in 1984 by the Federal Government.

The establishment of the proposed national commission or national board for SIWES would bring focus to the need for the effective and proper implementation of the scheme. The commission or board would operate as a one-stop shop for all matters concerning SIWES in the country. It would have a mandate similar to that of the supervising agencies (NUC, NBTE and NCCE) and be charged with establishing standards for the operation of SIWES and monitoring the quality of implementation of the scheme in all tertiary institutions.

It is recommended that the commission or board be composed of representatives of bodies having relevance to the successful and effective implementation of SIWES. Thus, the ITF which is the initiator of SIWES and also a foremost training institution would be represented on the commission or board. The supervising agencies (NUC, NBTE and NCCE) would have representations on the commission since SIWES is targeted at students in tertiary institutions. The organized private sector should be represented on the commission or board by a representative each from NACCIMA, NECA and MAN. The Federal Ministries of Educton and Finance should also be represented on the commission or board. More importantly, there should representation from the institutions (one each from the universities, potytechnics and colleges of education) on rotational basis and reflecting the six geographical zones and proprietorship of institutions (i.e. Federal, State or Private).

The commission or board would serve as the governing and policy-making body for SIWES and would not be involved in the day-to-day management, operation and implementation of SIWES. The present staff of the SIWES Division of the ITF and the SIWES units of NUC, NBTE and NCCE could be redeployed to constitute the core staff of the proposed commission or board.

**Guidelines and Roles of Stakeholders**

As stated earlier, for a scheme as large as SIWES to be effective, all stakeholders must play and execute their roles diligently. Generally speaking, SIWES stakeholders, in one way or another, have not performed their roles up to the expressed or stated standards. For the purpose of this discourse, it suffices to highlight the shortcomings in the roles of stakeholders which impact the effectiveness of SIWES with a view to bringing about appropriate and necessary improvements.

***Federal Government:*** It is clear from Table 7 & 8 below that the Federal Government has not funded SIWES adequately, particularly in recent years.

**TABLE 7: Recent Trend in the Growth of SIWES, 1995 – 2008**

| Year | No of Institutions | No of Students |
|---|---|---|
| 1995 | 141 | 57,433 |
| 2001 | - | 63,732 |
| 2003 | 176 | - |
| 2008 | 204 | 210,390 |

***Source: Compiled from published ITF Documents.***

**TABLE 8: Recent Trend in Funding of SIWES, 2006– 2008**

| Year | Amount Required (₦) | Amount Appropriated (₦) | Amount Released (₦) |
|---|---|---|---|
| 2006 | 2,608,193,500.00 | - | 725,471,907.81 |
| 2007 | - | 765,000,000.00 | 693,471,907.63 |
| 2008 | 2,896,547,000.00 | 777,000,000.00 | 421,955,738.80* |

*Amount released as at August, 2008.

***Source: Welcome Address, Director-General, ITF; 11th Biennal SIWES National Conference, Jos, October, 2008.***

The underfunding of SIWES has led to a backlog in the payment of student allowances, extending as far back as 2004/2005 in some cases. This has resulted in lukewarm attitude on the part of students towards participation in SIWES; agitation, sometimes violent, by students for payment of their allowances; credibility problems and bad image being created for the scheme, amongst other undesirable impacts (Mafe, 2006).

The problems probably emanate from the process of providing funds for the scheme, whereby the National Assembly appropriates the funds for SIWES as part of the budget of the Federal Ministry of Industry, which in turn releases the monies for operation of the scheme to the ITF on piece-meal basis and which, in turn, then makes the funds available to the beneficiaries.

A national commission or board dedicated to the operation and implementation of SIWES in likely to bring focus to the importance of SIWES and its potentials in

contributing to the enhancement of the pool of technical skills for national industrial and technological development. It should be possible for the National Assembly to appropriate funds **directly** to the commission or board as is the case for the National Youth Service Corps (NYSC) Scheme.

On the other hand, if the Federal Government is unable to fund the scheme appropriately, it should consider not paying students' allowances for participation in SIWES but only making funds available for proper administration of the scheme and associated overheads. Afterall, students participating in pre-graduation or pre-qualification work-experience such as Teaching Practice are not paid allowances. Furthermore, SIWES is a course of study required for graduation in a similar way as the Final Year Project which does not attract allowances but is fully funded by the student or his/her sponsors.

Additionally, there is a need for the Federal Government to strengthen its stipulation that all employers must accept students for SIWES; and also review its policies that guide and regulate SIWES at the national level with a view to making the scheme conform with the international standards for Cooperative Education.

***Industrial Training Fund:*** The ITF should be commended for managing and running SIWES nationally in the face of dwindling resources (funding, materials and logistics) and in spite of SIWES being a secondary mandate of the Fund.

However, some roles of the Fund under the SIWES Guidelines have not been effectively performed. Firstly, there is no comprehensive and detailed list of employers who accept students for SIWES. The directory published by the ITF (ITF, 2004b) and made available to institutions contains only names of employers without their **physical addresses, telephone numbers, e-mail addresses, websites and contact persons**. The current directory, which needs to be updated regularly, is hardly useful for the purpose of seeking places of industrial attachment for participants in SIWES.

Probably owing to the large numbers of students participating n SIWES, the ITF has ceased supervising students participating in the scheme *in situ* in industry. What obtains now is that students are required to take their log books to the nearest ITF Area Office for endorsement by the schedule SIWES officer. This impacts on the quality assurance of he scheme and leaves room for truancy on the part of SIWES participants.

The ITF has responsibility for reviewing and conducting research into the operations of SIWES. The interim report of the research into SIWES operation conducted by the Fund following the 2006 SIWES Biennal Conference was presented during the 2008 edition of the forum. The interim report as well as the final report are yet to be circulated to SIWES stakeholders.

Although the Fund is not responsible for funding SIWES, it ought to do more to get the Federal Government to provide adequate funds for implementing the scheme in the face of the backlog in the payment of allowances to students and preventing the undesirable consequences of non-payment of the allowances.

***Supervising Agencies***: The Supervising Agencies (NUC, NBTE and NCCE) have generally lived up to expectations in directing institutions which they regulate to establish SIWES Coordinating Units, appoint full-time SIWES Coordinators, fund SIWES Coordinating Units adequately and abide by the SIWES Guidelines in operating the scheme. However, many institutions, particularly the newer ones, have not fully complied with these directives from the supervising/regulatory agencies. Therefore, there is a need for better and closer monitoring of the SIWES function and activities by the NUC, NBTE and NCCE in order to ensure that the scheme is properly implemented in the institutions. More attention needs to be paid to SIWES during the accreditation of SIWES-approved programmes in institutions to enable the scheme attain its potential in enhancing the pool of technical skills available to the economy.

Although the supervising agencies have made attempts to evolve minimum standards in respect of SIWES and to develop, monitor and review job specifications to guide the training of students on SIWES, not all SIWES-approved programmes are covered by these efforts. There is, therefore, a need by the supervising agents to collaborate more with the institutions in evolving minimum standards and job specifications for all SIWES-approved programmes.

***Employers/Industry***: Most employers accept students for SIWES and assign them to relevant on-the-job training. On the other hand, many employers, particularly medium-sized foreign companies operating in Nigeria, do not wholeheartedly accept students for SIWES. This attitude contributes to the scarcity of relevant places of attachment for students participating in SIWES. There is a need for the ITF to invoke the penalties entrenched in the Industrial Training Fund (Amendment) Decree, 1990 (F. G. 1990) in order to get the cooperation of employers in the training of students. It should be mentioned, however, that the penalties stipulated in the decree are not biting enough and there is an imperative to make them more stringent.

Some of the employers, who accept students for SIWES, are unwilling to allow students to handle equipment and machinery in the fear that students might damage them. It should be made clear to employers that they are the ultimate beneficiaries of the pool of technical skills that are available in the economy since they require relevant production skills for the operation of their non-human resources.

Those employers who readily accept students for SIWES and expose them to relevant on-the-job training deserve commendation. Some pay additional stipends, usually above the national minimum wage, to SIWES participants while others provide meals, transportation accommodation and medical care to students undergoing SIWES with them.

***Tertiary Institutions***: While many Institutions have complied with several aspects (establishment of fully-staffed SIWES Coordinating Units, appointment of full-time SIWES Coordinators, assessment of students' performance at the end of training, allocation of credit loads to SIWES, and operation of separate SIWES Bank Accounts), several others are not complying or are yet to comply with the standards set under the SIWES Guidelines. Such institutions need to put their acts in order to enable their students benefit maximally from participation in SIWES.

Generally speaking, placement of students in industry has been a major problem militating against effective implementation of SIWES for some time across all participating institutions. This is attributable to the increase in the large numbers of participating students and

institutions, scarcity of relevant places of attachment due to the state of the economy and refusal on the part of some employers to take on students for training. It is, therefore, important to state that without places of industrial attachment, students cannot take part in SIWES. Consequently, efforts need to be doubled by institutions to ensure that students are adequately placed for SIWES.

While all institutions organize some form of SIWES Orientation Programme for students going on SIWES, the programmes have not been completely effective. The shortcomings are traceable to factors including: the large number of issues and aspects of SIWES that should be thoroughly covered, the large numbers of participating students and the limited time available for the orientation programme. For students to fully benefit from SIWES they need adequate information on the scheme and the expectations of other stakeholders. A possible solution is to organize the orientation programme for batches of students and to make available a book on SIWES, such as the one written by the present author ((Mafe, 2009), for participants in SIWES.

Supervision of students ***in situ*** in industry is a key aspect of the quality assurance of SIWES. Whereas, students are required to be supervised three times while on SIWES, very few institutions are able to supervise their students even once over the stipulated durations of SIWES. This situation is attributable to the lack of funding and necessary logistics to carry out the supervision exercise.

Again, only very few institutions endeavor to work out tailor-made training programmes with industry to guide the students' learning and acquisition of skills while in industry. This situation is also attributable primarily to lack of logistics and funding.

***Student Trainees***: Many of the roles expected of students are embodied in the Code of Conduct for SIWES participants which is made available in the Log Book. While most students endeavor to keep to the tenets of the code of conduct; some students ignore aspects of the injunctions.

In addition, some students fail to take part in the SIWES Orientation Programme and, subsequently, run into problems while on training or after the training intervention.

Also, some students do not turn up in good time for posting to industry while other engage in unilateral change of place of attachment without the approval of the institutions' SIWES Coordinating Units. Such behavior is usually attributable to the students' quest for additional stipends from employers to whom they are to be attached.

Students, therefore, need to realize that they are the direct beneficiaries of SIWES and that the learning and skills they acquire while on SIWES remain life-long assets which cannot be taken away from them after the training intervention.

**Operational Standards and Modalities**

Some operational modalities which affect the attainment of set of standards, influence the quality of SIWES and impact the effectiveness of the scheme need to be further highlighted and emphasized.

***Durations and Periods of Training*:** There had been a multiplicity of standards for periods and durations of training prescribed for participation in SIWES for different programmes as illustrated by a few examples depicted in Table 9 below:

**Table 9: Durations and Periods of Training for Selected SIWES-Approved Programmes.**

| S/N. | Programme | No. of Periods | Durations of SIWES |
|---|---|---|---|
| 1. | Chemical Engineering | 2 | (a) 8 Weeks after 300 Level;<br>(b) 24 Weeks (2nd Semester of 400 level plus (Long vacation) |
| 2. | Petroleum Engineering | 3 | (a) 8 Weeks after 200 levels;<br>(b) 8 Weeks after 300 level;<br>(c) 24 Weeks (2nd Semester of 400 level plus Long vocation) |
| 3. | Building Technology | 4 | (a) 8 weeks after 200 Level;<br>(b) 8 weeks after 300 Level;<br>(c) 12 weeks (2nd Semester of 400 level)<br>(d) 8 weeks (long vacation after 400 level) |
| 4. | Urban & Regional Planning | 1 | (a) 15 weeks (2nd Semester of 400 level plus long vocation ) |
| 5. | Microbiology | 2 | (a) 12 weeks after 200 level<br>(b) 12 weeks after 300 level |

***Source: NUC, Students' Industrial Work-Experience Scheme, SIWES Job-Specifications.***

The dysfunctional situation brought about by the multiplicity of periods and durations of SIWES has now been streamlined through an innovation prescribing a 6-month single-stretch attachment mode for SIWES (Mafe, 2005a).

However, the importance of adequate duration of training in ensuring the effectiveness of SIWES must be stressed because the Training Phase actually consists of three sub-phases (Mafe, 2005a) as shown in Figure 5 below:

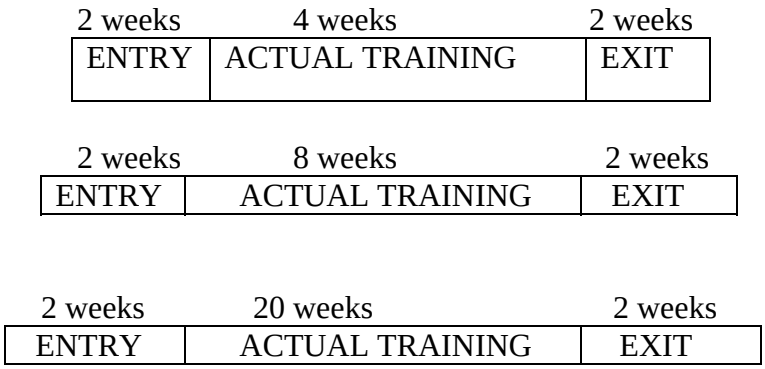



**FIGURE 5: Durations of Actual Training for 8-week, 12-week and 24-week SIWES**

It is clear from the foregoing that for any meaningful acquisition of skills and learning by SIWES participants, the duration of the training intervention must be adequate.

***Deadline for Posting and change of Placement:*** Deadline for posting is the latest time for students to report in industry in order to complete the required duration of SIWES before returning back to their institutions. In effect, any student reporting in industry long after the deadline would not be able to meet the required duration, thereby leading to a reduction in the extent of training that would otherwise have been received by the student.

Similarly, change of placement after the commencement of SIWES tends to shorten the duration that would otherwise have been available for meaningful training at either the initial or the new place of attachment.

Consequently, it is imperative to encourage students to seek relevant and acceptable places of attachment early and to discourage them from trying to change their initial places of attachment after the commencement of SIWES in order to make the training intervention effective and beneficial to the student.

***Placement of Students in Industry*:** As stated earlier, students cannot undergo SIWES without places of industrial attachment where they can acquire the desired competencies and RPSs.

Ideally, places of industrial attachment should be obtained and offered to students by the Coordinating Unit. However, the large numbers of students participating in SIWES, the decline in industrial capacity utilization, and inadequate staffing and logistics conspire to limit the ability of coordinating units to obtain and offer places of attachment to all eligible students.

Further, the requirement that students should arrange for their accommodation during SIWES dictates that they should be allowed and encouraged to seek places of industrial attachment which are convenient for them. However, such places must be subject to the approval of the coordinating unit in order to ensure their relevance to the disciplines of the students.

This inadequacies in he placement of students in industry militate against the effectiveness of SIWES. Because of the scarcity of quality places of attachment, students should be encouraged to undergo SIWES in small-and medium-scale industries with facilities that would enable them acquire RPSs relevant to their disciplines. In-fact, working in such organizations can point them towards and enhance their abilities to become entrepreneurs in the future (Mafe, 2003 and 2005b).

***SIWES Orientation:*** SIWES is a course of study which is not formally taught in a classroom setting but in the workplace where the desired learning and acquisition of skills occur. Hence, there is a need to prepare students to transit from the classroom to the industrial work environment and, also, to meet the expectations of the other SIWES stakeholders. The SIWES Orientation programme is designed to achieve these goals.

However, as mentioned earlier, the orientation programme has not been completely effective in empowering students to fully benefit from SIWES due to factors traceable to the large numbers of issues and aspects of the scheme that should be thoroughly covered, the large numbers of participating students and the limited time normally available for the programme. These factors militate against thorough comprehension and understanding of the issues and aspects of SIWES that should be expoused during the orientation programme.

Since adequate information is vital in enabling students to derive the maximum benefits from participation in the scheme, it is agreed by stakeholders that a text on SIWES such as "**Successful Participation in SIWES**" (Mafe, 2009), should be an indispensable companion of every serious participant in SIWES in the same way as the Log Book is essential to participation in the scheme; and that the book should be used before, during and after embarking on SIWES.

***Quality Assurance and Supervision*:** For a scheme as large as SIWES with the locus of training being outside the institution, it is imperative that the involvement of participants in training activities be monitored ***in situ*** in industry. This is necessary in order to guarantee the quality of the training intervention and also confer quality assurance on the effectiveness of the scheme.

As mentioned earlier, only very few institutions are able to supervise students on SIWES **even once** due to lack of logistics, particularly mobility, and adequate funding even though the standard set for supervision prescribes three rounds of visits to each student in industry. ITF which is expected to visit the students in industry on at least one occasion now vets and endorses the students' log books at its various area offices.

The situation does not urgur well for quality assurance of the scheme; students undergoing SIWES in industry should not be abandoned by their institutions, moreso that participation in the scheme attracts credit loads that are supposed to be incorporated into calculating cumulative grade points averages (CGPAs) of students. Consequently, the present situation needs urgent amelioration through provision of the wherewithals necessary for effective supervision of students on SIWES.

***SIWES as a Course of Study***: There is hardly any other course which attracts as high as six and four credit units in universities and polytechnics/colleges of education respectively, in the same way as SIWES. In fact, prior to the scores or performance of students being incorporated into the CGPAs, SIWES attracted as high as 12 or 16 credit units. However,

some institutions are yet to begin incorporating the scores in SIWES, which translates into one credit unit per month of training, into the calculation of CGPAs.

The allocation of credit units to SIWES and its incorporation into CGPAs underscore the importance of the scheme in the formation of competent and productive technical manpower. It is designed to make students take the training intervention seriously. Hence, there is a need to ensure that students actually earn the credits units allocated to SIWES through effective execution of all operational aspects of the scheme.

***Assessment of SIWES*:** SIWES being a course of study with assigned credit units must be assessed to determine the performance of students in the scheme. Students are required to obtain a pass grade and failure to do so may lead to the student repeating his/her participation in the scheme.

However, there are no uniform standards or criteria set for the assessment of students in SIWES across all institutions. Initially at the University of Lagos, the criteria adopted were Log Book (30 marks), End -of-Training Report (20 marks), Oral Presentation (30 marks), ITF Form 8 (10 marks) and Interim Report of Supervisors (10 marks), making a total of 100 marks. The last two criteria (ITF Form 8 and Interim Report) were supposed to capture the student's involvement in training while in industry; but these criteria are now presumed to be captured by the comments of the industry-based supervisor in the log book. Hence, the new criteria for assessment are:

| | |
|---|---|
| Log Book | 30 marks |
| Training Report | 30 marks |
| Oral Presentation | 40 marks |
| | **100 marks** |

Additionally, the University of Lagos has put in place sub-criteria for each of the three main criteria (Log Book, Training Report and Oral Presentation).

The need for a systematic assessment scheme for SIWES cannot be over-emphasized. Otherwise, the scores earned by students may end up being arbitrary since conditions under which they undergo training vary from one industry to another.

***Payment of Allowances*:** Two modes of payment of student allowances had been adopted in the past. These were payment through the employer while the student is in industry and payment through the institution after the end of SIWES. Both modalities had thrown up many problems which are capable of diminishing the significance of SIWES (Mafe, 2006). Some of these problems include:

- Delays in payment and, sometimes, non-payment of the student beneficiaries
- Inaccurate claims for re-imbursement by some employers.
- Diversion of student allowances to other uses by some employers
- Students already paid by employers claiming allowances though institutions
- Delays in payment of students by institutions
- Attempts by some institutions to inflate the number of students eligible for payment
- Diversion of student allowances for other purposes by some institutions.

Consequently, during the 10th Biennal SIWES Conference it was proposed that student allowances be paid on-line through the banks (Mafe, 2006). This proposal was accepted at the 11th Biennal SIWES Conference in 2008 and modalities were subsequently put in place to implement the proposal as from 2009. However, the website designed for this purpose (SIWESdata.org) has inherent problems which make the uploading of students' data cumbersome and complicated. As a result the online payment of the allowances into individual student bank account is yet to be put into operation.

It is imperative for the Industrial Training Fund to remove all bottlenecks associated with the website (i.e. SIWESdata.org) to facilitate **effective payment of student allowances whereby all eligible students are promptly paid in accordance with their performance while on training.** This would ensure completeness, promptness and equity in payment of student allowances.

**SIWES Objectives:**

An examination of the extent of attainment of the objectives of SIWES is germane and pertinent in appraising the effectiveness of the scheme.

Generally-speaking, there is consensus amongst stakeholders that SIWES has broadly met its objectives. The interim report of the research conducted by the ITF into SIWES and presented during the 11th Biennal SIWES Conference indicates that the scheme has contributed over the years in enhancing the quality of technical skills that are available in the economy.

However, not all participants in SIWES have the same opportunity with respect to quality placement nor derive the same benefits from participation in the scheme. It is necessary, therefore, to reposition SIWES to fully subscribe to and to implement the internationally accepted tenets of cooperative Education which promotes work-integrated learning. For example, the objective of SIWES to enlist and strengthen employers' involvement in the entire educational process can be enhanced through incorporating feedbacks from employers on the technical skills that are required by industry in the design of SET curricula in tertiary institutions. SIWES could also benefit from the placement processes used cooperative Education..

For SIWES to meet the international standards for work-integrated learning there is a need to review and fine tune its objectives in accordance with the principles of cooperative Education. (ITF, 2005). The participation of Nigerian students in trans-national exchange programme for industrial experience might enhance the attainment of these goals (Mafe, 2004b)

Importantly, there is need for a clear understanding and appreciation of the distinction between "work-experience" and "work-integrated learning" or "cooperative education. Primarily, work-experience is observational and exploratory whereby students are exposed to the production process with limited monitoring of the students' performance and assessment of the performance after completion of the programme. On the other hand, the focus of work-integrated learning is the development of the occupational competency of the student with the main purpose being learning. Already, SIWES has many aspects of cooperative education incorporated into its structure and operation (e.g. planning, placement, supervision

and assessment) but is deficient in implementation. It is, therefore, important that concerted efforts be adopted by all SIWES stakeholders to ensure that SIWES meets its objectives.

## SIWES IN CHEMICAL ENGINEERING

As earlier stated, SIWES is a generic programme with its impact and effectiveness cutting across all SIWES-approved disciplines including Chemical Engineering. However, two points need to be made with respect to SIWES in Chemical Engineering.

Firstly, Chemical Engineering has the peculiar problem of scarcity of quality places of industrial attachment. Although nearly all materials in modern civilization passes through one form of chemical processing or the other and, therefore, placement should normally not be a problem for chemical engineering students, the reality is that finding quality places of attachment for this category of students is becoming very daunting. This is, to a large extent, attributable to the decline in industrial activity in the economy and the large numbers of chemical engineering students in tertiary institutions competing for the limited available places. The situation is even worse for Petroleum and Gas Engineering students where the actors in the sector are finite and the onset of the crisis in the Niger Delta region coupled with the state of the refineries have conspired to reduce production activities, leading to scarcity of places of industrial attachment.

With improvements in the level of industrial activity in the economy and increased capacity utilization in the oil and gas sector, the problems of finding quality places of attachment for students of chemical engineering and/or petroleum and gas engineering might dissipate. The enactment of the Oil Industry Act with is provisions for local content and participation by Nigerian entrepreneurs might ameliorate the present scarcity of quality places for this category of students.

However, the departments of chemical engineering can contribute to finding quality places of attachment for their students by taking advantage of a functional network of chemical engineering Alumni.

The second point that needs to made is that SIWES is not and cannot be a substitute for structured professional training in Chemical Engineering as well as in other engineering fields. At best, SIWES is a pre-qualification introduction into the chemical engineering profession that enables the student to appreciate how the profession is practiced in real life.

Apart from passing appropriate examinations in the principles that under chemical engineering, the professional chemical engineer must also have received practical training in the skills and duties of an engineer and must also have obtained sufficient experience in carrying out the duties of a professional post (The Institution of Chemical Engineers, 1974). For the professional development of chemical engineering graduates from Nigerian tertiary institutions, a system of practical training and garnering of experience similar to that outlined by the Institution of Chemical Engineers, United Kingdom needs to be adopted. Such training and experience should cover Process Plant Fabrication and Materials of Construction, Process and Plant Development, Process and Plant Design, Process Plant Operation, Quality Assessment of Process Materials, and General Company/Management Training. The trainee Chemical Engineer would follow a route, lasting a minimum of about two years, in industry while the entire experience should be documented in log books and reports.

A commendable approach or system of professional training of engineers in Nigeria is the compulsory Supervised Industrial Training Scheme in Engineering (SITSIE) established by the erstwhile Council of Registered Engineers in Nigeria for fresh or young graduates (COREN, 1991). However, SITSIE experiences similar problems of inadequate human and technical infrastructure, scarcity of quality placement opportunities, logistics and financial limitations, amongst others in a similar way as SIWES. If properly implemented, SITSIE should be able to ensure appropriate training of graduate engineers before they attain the professional status. However, the operation and implementation of SITSIE need to be strengthened to achieve this purpose.

In a similar vein, there is a need for further development of the professional engineer after attaining professional status in view of the continuing advancements in science and engineering and the rapid rate of introduction of new technologies. The establishment of an Engineering Staff College of Nigeria (ESCON) is therefore highly recommended to cater for the continuing development of the professional engineer (Mafe, 2002). This should be structured formally as is the case in India rather than the diffused system of continuing education and training in engineering prevalent in Britain. While there are formal institutions for continuing education and training (ASCON, CMD etc) for management and for the military (Staff College, Jaji and War College, Abuja), there is none specifically for engineering, the creators of wealth and innovations.

**SUMMARY OF RECOMMENDATIONS**:

The recommendations arising from the foregoing appraisal of the effectiveness of SIWES in the formation of competent and productive technical manpower for the economy are summarized as follow.

1. The establishment of a National Commission for Student Industrial Training or a National Board for Cooperative Education was proposed to oversee the implementation of SIWES at the national level.

2. Funds earmarked for SIWES should be appropriated directly by the National Assembly in the same way as for the National Youth Service Corps scheme in order to remove the bottlenecks associated with release of funds for the operation of the scheme.

3. The Federal Government should make adequate provisions in the annual budget for proper funding of SIWES in view of the potentials of the scheme to contribute to enhancing the quality of the pool of technical skills available to the economy.

4. If the Federal Government is unable or unwilling to fund SIWES properly, it can consider cancelling the payment of allowances to participants in the scheme.

5. The stipulation that employers should accept students for SIWES should be strengthened with stiffer penalties put in place for defaulters.

6. A review of the policies that guide and regulate SIWES is necessary to ensure that the scheme complies fully with the tenents of cooperative education or work-integrated learning.

7. A comprehensive and detailed directory of employers who accept students for SIWES is urgently required to facilitate placement of students in industry.

8. In order to guarantee quality assurance of the scheme, there is a need for thorough supervision of SIWES participants by institutions and the ITF.

9. The ITF should make the final report on the research conducted into SIWES available to all SIWES stakeholders.

10. The ITF should ensure that the backlog in payment of student allowances is cleared urgently to remove the negative image being created for SIWES.

11. There is a need for closer monitoring of the SIWES function and activities in tertiary institutions by the Supervising agencies (NUC, NBTE and NCCE) to ensure that the scheme is properly implemented.

12. The supervising agencies in collaboration with institution, should evolve minimum standards in respect of SIWES and develop, monitor and review job specifications to guide the training of students for all SIWES-approved programmes.

13. The cooperation of employers in providing places for industrial attachment of students can be enhanced by more stringent penalties for defaulters.

14. Some employers need to be encouraged to provide meaningful training for students by allowing them to handle equipment and machinery while on SIWES

15. Tertiary institutions need to comply with the standards set for proper implementation of SIWES to enable students derive the greatest benefits from participation in the scheme.

16. Tertiary institutions need to provide adequate logistics (mobility, internet services etc.) and adequate funding to make their SIWES units functional.

17. Tertiary institutions need to double efforts in securing quality places of industrial attachment for students participants in SIWES.

18. Students should be well-prepared through meaningful orientation programmes by institutions before embarking on SIWES. A book, such as the "Guide to Successful Participation in SIWES" would be useful in achieving the purpose if read before, during and after SIWES by participants.

19. Tertiary institutions must diligently supervise students on SIWES in order to meet the standards for the scheme and those of cooperative education or work-integrated learning.

20. Tertiary institution need to work out tailor-made training programmes to guide students while on SIWES.

21. Students should be made to realize that SIWES is not holiday job but a course of study designed to enhance their relevant production skills and employability after graduation.

22. The Code of Conduct should be strictly adhered to by students participating in SIWES.

23. Students should adhere to the deadlines for posting of participants in SIWES to industry in order to have adequate time for acquisition of skills and experience.

24 Due to the scarcity of places of industrial attachment, students should be encouraged to undergo SIWES in small- and medium-scale industries where they can contribute to improving the production processes and also gain an insight into entrepreneurship.

25. The book, "Guide to Successful Participation in SIWES", recommended by all SIWES stakeholders, should be obtained along with the log book by students to enable them derive the greatest benefits from participation in the scheme.

26. Quality assurance of SIWES, through adequate supervision of participants by the relevant stakeholders (institutions, employers and ITF) would ensure that the scheme meets its objectives vis-à-vis the principles of cooperative education or work-integrated learning.

27. Institutions and students should appreciate the fact that SIWES is a course of study with credit loads allocated to it and which is incorporated into the calculation of CGPAs.

28. There is a need for uniform assessment of the performance of students in SIWES with the same criteria being applied by all tertiary institutions.

29. The ITF should revisit, redesign and fine-tune the website (SIWES data.org) created to facilitate online payment of student allowances in order to remove the bottlenecks associated with its usage.

30. Although many facets and aspects of SIWES conform with the principles of cooperative education or work-integrated learning, there is a need to ensure that the implementation of the scheme meets its stated objectives. Trans-national exchange of students for industrial experience could enhance he attainment of these goals.

31. There is a need for all stakeholders to appreciate the distinctions between "work-experience" and "work-integrated learning" and to endeavor to make SIWES conform with the principles and tenets of cooperative education.

32. The problems of scarcity of quality places of attachment for Chemical Engineering and Petroleum Gas Engineering can be partly surmounted through the establishment of virile and functional networks of alumni of various Chemical Engineering departments in the country.

33. SIWES is not a substitute or replacement for structured and proper professional training in Chemical Engineering; at best it is an introduction to the training required to become a professional chemical engineer.

34. The revamping and strengthening of the Supervised Industrial Training Scheme in Engineering (SITSIE) can enhance the professional training of young engineers

35. The establishment of the Engineering Staff College of Nigeria (ESCON) should provide opportunities for continuing education and training of engineers, thereby enhancing their professional development.

**CONCLUSION:**

The scientific, engineering and technological community constitutes one of the most precious resources and assets of any nation. They are the creators of change and innovation which drive the world today. Consequently, a developing nation like Nigeria needs to pay attention to the processes (**education and training)** involved in the formation of science, engineering and technology (SET) graduates for the economy.

However, SET graduates from Nigerian Universities are often criticized by employers for lacking practical orientations, skills and competencies even though they are considered to be academically equal to their counterparts in other parts of the world with respect to theoretical grounding in the particular subject area.

The lack of possession of relevant production skills (RPSs) by SET graduates is a manifestation of the over-emphasis placed on the educational component (**theory**) to the detriment of the training component (**hands-on experience**) in the formation of SET graduates

This paper, therefore, focused on the importance and complementary role of training in the formation of competent and productive technical manpower for the economy and national development. Specifically, the paper appraised the effectiveness of the Students Industrial Work-Experience Scheme (SIWES) in the formation of technical manpower in general and in the professional development of chemical engineers.

While it is agreed by all SIWES stakeholders that the scheme has contributed a great deal in improving the quality of technical skills available to the economy, the appraisal of the effectiveness of SIWES indicates that there are many areas and aspect of the scheme which need revamping in order to fully harness its potentials for enhancing rapid technological and economic development.

Therefore, several suggestions and recommendations have been proposed in the paper which are aimed at improving the implementation of SIWES in line with the tenets and principles of cooperative education or work-integrated learning.

With respect to Chemical Engineering, the paper posits that SIWES cannot be a replacement or substitute for a well-structured professional training. Consequently, the supervised Industrial Training Scheme in Engineering (SITSIE) put in place by COREN could be adopted as a format for professional training of chemical engineers.

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