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## **BRIDGING THE GAP BETWEEN THE ACADEMIA AND THE INDUSTRY: A PATHWAY TO QUALITY ASSURANCE IN CHEMICAL ENGINEERING TRAINING AND PRACTICE**

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### **ABSTRACT**

It has been seen that there exist a huge gap between the academia and the industry and this has in no small way affected the quality of graduates from the university, the quality, type and ease of research and the level of development in our technology most especially the Chemical Engineering profession. This research x-rayed the history of Chemical Engineering, the probable cause and cost of the gap, the way forward in addressing the problem, benefits to be derived and even a case study of industry-University linkage in India and how this have affected technological strides, employability of graduates and the profession in general. Lastly, practical suggestions were made. It is the belief of the writer that if these suggestions are followed, with the necessary seriousness, the gap will be bridged well on time and the benefits will be reaped before the system becomes too bad to repair.

Keywords: Academia, industry, gap and bridge.

### **INTRODUCTION**

Over the last decades, the falling barriers to international trade and investment has led to a more integrated and interdependent framework of international business. Employers today, as a result, operate in an environment that demands new and constantly developing skills to retain global competitiveness <sup>[1]</sup>. This has given rise to the high advancement in Engineering and Technology most especially of interest is the great strides of the Chemical Engineering profession. There is no doubt that Chemical Engineering is moving at a very fast pace beyond what any could have envisaged back in the 19<sup>th</sup> or 20<sup>th</sup> centuries. The pace is alarming that the need for any in or intending to join the Chemical engineering profession must work hard amidst all necessary provisions and odds to meet up with its stride. Thus it is necessary for both the academia and the industries to wake up to the challenges these posses. One way is for them to bridge the gap that exists between them because of the fundamental relationship between them.

It is of great importance to note that while the industries seem to be the custodian and end users of modern and recent technologies the academia is be the major inventor of them. Our tertiary institutions are where knowledge - driven fundamental science and engineering principles are taught. But these principles are best applied practically in the industries that are concerned with application driven research and development. While academic research develops methods of investigation and concepts remote from practical problems and at a level of understanding which cannot simply be extrapolated to practical application, industrial R&D, on the other hand operates on a more empirical basis and does not have the focus or the resources to build a comprehensive theoretical framework. Consequently, the need for closer tie between these two sectors is more than important.

The Chemical Engineering profession is certainly changing. Thus, If the education of Chemical engineers is viewed as the process itself, then engineering educators could be viewed as process engineer, responsible for designing the process and improving efficiency while keeping an eye on the supply chain both pre- and post – process including inventory levels, stock and the marketplace.

It therefore means that these process engineers and their counterparts in the industries have the responsibility to design a process that will ensure good interaction with a view to ensure quality assurance in the profession. If this interaction is strong enough, it will create a platform where students can learn from both the theoretical and practical perspectives of Chemical engineering and it will help students know; why, how and when these principles are applied and the industries can exploit the academia as research and development centres in addressing company specific – technological needs. But sad to say, this is not totally the case. The link between the schools and industries is either not active or totally non existence. Though, the industrial training scheme ,sabbatical leave is design to bridge this gap, in most cases, they have failed to meet the essence of their establishment because, most students do not get the opportunity to be attached to companies they will really want to or where they can tap the necessary skill they desire.

Consequently, the need to bridge this unwholesome gap between the academia and the industries by way of purposeful interaction cannot be over stretched. Thus, there is a serious need for the industries and academia to parley in other to allow good flow of information and ideas in terms of needs, new inventions, processes, expectations etc. It is the aim of the writer to bring to the fore the relevance and urgency of this parley and the possible gains that will eventually be reaped.

## **BRIEF HISTORY OF CHEMICAL ENGINEERING**

Chemical Engineering as the name implies deals with the task of finding more efficient and economical techniques to make the total cost of production of end product financially viable. Its origin can be attributed to the need for making various intermediate processes in the mechanical Engineering sector cost – effective. In the early years of its inception, Chemical engineering had little or minor part to play in the production processes. During this time, it was mainly concerned with the inspection of the product by putting it through different operations of the procedure and observing the quality of the end – product attained. In other words, the Chemical Engineers of those times were not any different from Chemists. Their involvement was less because the volume of production was less due to low demand.

The termed Chemical Engineering gained real significance during the time of industrial revolution, when the need for people who not only were aware of the Chemical processes but also the factors needed to enhance the efficiency of the process was highlighted. Hence, the modern Chemical Engineer is mainly concerned with the application of various scientific principles to the design and maintenance of different Chemical processes for large scale manufacturing procedures<sup>2</sup>.

Thus, it is evident from the brief historical account that the Chemical Engineer plays a strong role in innovation, optimization and stabilization of every production process. And since as mention above the theoretical framework is often the responsibility of the academia while the application of the frame work developed by the academia is effected in the industries, there is more than obvious reasons for these two to work together with a view to perfecting Chemical Engineering technology

### WHY THE GAP

There are various reasons for the unwholesome gap between these two sectors as highlighted below.

### THE STATE OF OUR UNIVERSITIES

Over the years, the University have had to grapple with a lot problems that become endemic and thus affect its stability and glory. In those early days, Universities were classed as ivory towers (do not know if they still are) and these have also affected the Chemical Engineering programme.

One of the problems is the gross inadequacy of infrastructure<sup>[3]</sup>. Physical facilities like classrooms, workshops and laboratories where either dilapidated or inadequate. The accreditation carried out in the years shown below reveals the magnitude of the problems in the Chemical Engineering programme like other Engineering programmes. Below is a table capturing the detail results for the Chemical Engineering programme from December 2009 to July 2005.

**Table 1: Accreditation status of Chemical Engineering programme<sup>[4]</sup>**

| Programme                    | Year          | No. of institutions | Full | Interim | Denied | Pre-accreditation |
|------------------------------|---------------|---------------------|------|---------|--------|-------------------|
| Chemical Engineering (B.ENG) | December 2009 | 19                  | 10   | 7       | 1      | 1                 |
| Chemical Engineering (B.ENG) | October, 2008 | 16                  | 10   | 6       | -      | -                 |
| Chemical Engineering (B.ENG) | April 2007    | 16                  | 8    | 8       | -      | -                 |
| Chemical Engineering (B.ENG) | July 2005     | 13                  | 8    | 5       | -      | -                 |
| Chemical Engineering (B.ENG) | 1999/2000     | 12                  | 3    | 7       | 2      | -                 |
| Chemical Engineering         | December 2009 | 6                   | 3    | 3       | -      | -                 |

|                             |              |   |   |   |   |   |
|-----------------------------|--------------|---|---|---|---|---|
| (PG.D)                      |              |   |   |   |   |   |
| Chemical Engineering (PG.D) | October 2008 | 5 | 2 | 3 | - | - |
| Chemical Engineering (PG.D) | July 2005    | 4 | - | 3 | 1 | - |

The accreditation also reveals the magnitude of the deficiency of teaching and research equipment in most schools. Apart from the inadequacy of these facilities, most of them are even obsolete, absence of current Chemical Engineering books and journals, lack of modern Chemical Engineering software for process simulation. Matters became worse with the Federal Government's attitude to funding of tertiary education with increasing emphasis on autonomy and the user pays principle. With this alone, there is serious need for the University to forge for partnership if it will continue to maintain its glory and prestige it used to command and keep its place as a major driver of national and technological growth<sup>[2]</sup>.

Another problem that bedevilled the University was poor economic conditions of staff from top to the bottom which resulted in lecturers leaving the shores of the country to Overseas for better offers and where their services can be appreciated. This most time referred to as brain –drain. Therefore, the few ones left behind in the University were without any financial motivation, over worked with heavy teaching and administrative responsibilities considering the phenomenal growth in University student population. Up to the just now, University staff salaries are still a far cry from what their counterparts in other countries within West Africa not to mention developed countries like those of the Western nations. This is a demoralising factor which constitutes a clog in the wheels of national, academic and technological progress.

Also, a Federal Government's policy banned Engineering academia from engaging in private practice while engaged in lecturing. But like the Lawyers and medical doctors they are allowed to engage in private practice while still in the teaching profession. This obviously helps any professional to get to meet more and recent challenges and approach of doing things. It sharpens a professional's professional expertise and creates a forum for professional interaction.

The University suffers from lack of incentives to keep good materials developed by the school after their graduation and to attract experience industry personnel as visiting or even industrial professors for those qualified as such. Thus, there continue to be depletion of good hands that can make positive impact on the system as the old experienced ones age and fade away. Also, the University still faces the issue of poor funding for staff development for the purpose of creating strong hands to ensure sustainability and growth.

## **THE MINDSET THAT PERMEATES THE TWO SECTORS**

The source and cause of the University – Industry gap lies on both ends. It is a product of the mindset that permeates these two sectors and this has contributed in no small measure to the ever widening gap. We shall x-ray this mindset from the two ends<sup>[10]</sup>. From the University's viewpoint, the views are:

That academic institutions are non-profit institutions, thus their prime objective and responsibility is to teach and educate students and undertake pure and fundamental research<sup>[8]</sup>. That academic research is an open activity where staff is valued only by publication record; their research is motivated by promotion and tenure and hence requires maximum publicity. The motto for survival is publish or perish.

Research is mainly to look for and extend new knowledge in absolute way. Acquisition of knowledge itself is valuable.

For faculty staff, research is a part-time activity. It be a relaxed activity and also scholarly. The objective of the University education is to develop students self confidence, mental capabilities and latent abilities, to promote creative individuals capable of independent thinking and mature judgement. It is not the function of the University to give professional training. Therefore, there is no big deal in liaising with the industry as such<sup>[3]</sup>. While from the industry's point of view, The almost sole objective of the industry is to make profit by producing a marketable product or rendering a useful service. To safeguard investment, research is a closed door activity and new developments require protection, namely through patents. Thus, communication and publication are restricted. Industries publish only when competitors learn only little from the discoveries as against the view of the academia. Knowledge is valuable only if it can be exploited in products. Likewise research is pointless unless investment in it can be justified by turning discoveries into products. Research and development (R&D) is a form of industrial investment leading to wealth creation. In an industrial research laboratory, research is full time activity. Industries goal are usually short termed, and in technological development, the overriding interest is time<sup>[3]</sup>.

University faculty lack industrial experience and thus there is a mismatch between industry expectations and the type of education provided by the University. In spite of the above advanced viewpoints, the truth is still there watching us. That there is more than good reasons while the University –Industry gap be narrowed and ultimately bridged. This will also be looked at from the two party's perspectives. From the University's end, an urgent need for financial assistance, particularly now that government is driving for university autonomy with minimal funding. Enable easy access to sophisticated and expensive industrial equipments and facilities for research work. Industry can provide valuable co-operation and guidance for courses and students projects which are relevant to the industry like the area of design and implementation of technology. Liaising with industry provides an excellent opportunity for faculty to acquire some firsthand industrial experience. Attract graduates from industry and government by developing a strong continuing education programme which is practical

oriented (Diploma Courses) and in which experts from industry and government can co-operate with faculty and staff in specific topics. The Industry need to be interested in closing the gap because of the following reasons; Industry is the most direct beneficiary of Chemical Engineering graduate programme as over 80% of them are absorbed by the industry and government. Any company's most important asset is itself. Chemical Engineers and Scientists must be kept abreast of the rapid advances in science and technology and the best way of doing this is through sponsoring its staff for professional advancement courses. Industry will be in position to utilize University talent and facilities at a maximum cost – benefit ratio. Moreover, consulting is an excellent way for faculty to have a close relationship with industry and generate money in the process. Universities are best suited to carry out long-term research on problems which require a high degree of sophisticated theoretical knowledge in specific fields. Interaction with Universities provides industries with a window into leading-edge scientific research.

### **CASE STUDY TO HIGHLIGHT THE BENEFIT OF PARTNERSHIP**

A case in hand is the Indian Institute of Science which has 22 projects with eight Universities, seven colleges and seven national research institutions in aerospace, IT, defence and space research. Similarly, the society for Innovation and Development located at India Institute of Science (IISc) has University- Industry programs in numerous R&D areas as well<sup>[12]</sup>. Other explicit University- Industry relationship (UIR) have been created between IISc and foreign and domestic companies such as Nortel, Motorola BPL and Satyam Technology in Chennai successfully implemented UIR, with faculty members forming a new IC design company and teaming up with Analog Devices of the US to manufacture chips<sup>[1]</sup>. Former IIT faculty and its engineering doctorates are also working in a handful of firms such as Saskaen and Softjin, which develop complex embedded system for the Japanese telecom market<sup>[13]</sup>. However the number of projects is still low and confined to a handful of research universities and technical institutes and their collaborations tend to be mostly with foreign firms<sup>[14]</sup>. This notwithstanding could lead to a fruitful utilization of the personnel in both sector, and consequently a positive drive for industrial development<sup>[1]</sup>.

### **THE WAY FORWARD**

In addressing this problem with a view to creating a system with strong Chemical Engineering education that will translate into a virile workforce and of course a strong industry, the three stake holders : academia, government and the industry must wake up to the challenge and play their role effectively.

### **THE ROLE OF THE ACADEMIA**

In line with the above defined need, the academia obviously has a great role to play in enhancing good interplay between it and the industry. The following suggestions will place the academia in position of readiness for such meaningful collaboration.

1. One way is for the academia to embark on effective intervention with a view to understand the present industrial/employers needs, variable sector specific skills, training requirement that improve business performance, articulation of business

expectation in the educational institutions and engagement of industry leaders with higher education institutions.

2. After proper evaluation of industries present needs, the academia must re-evaluate its curriculum/course content and areas of possible application with a view to having a system that addresses specific needs of the industries such that its products (graduates) meet basic industries requirements. Otherwise the industries will still be saddled with the responsibility to train graduates from the academia to meet their basic needs and this is extra cost for them thus suggesting that the industries is not completely dependent on the academia's finished product as its feed.
3. Another area of great importance is the quality of graduates. For the industries to be fully dependent on the academia for its operations, thus scraping off the initial training process and for enhanced industries – academia relationship, the quality of graduates from the academia must be such that they can always speak for themselves. This depends on the course content, mode of teaching, level of exposure to real industrial practice, conviction of professional attachment, level of academia – industries interaction, academic – industry mentoring, and a host of other factors. It therefore implies that if the quality of the graduate is high enough, the industries can have sound confidence on the academia and this will continue to help foster good relationship between them.
4. It is also of great importance for the academia to constantly keep pace and close track of the industries so as to be able to get a good knowledge of industries specific need and incorporating it into its programme for research purpose. If the academia is not aware and part of these specific needs from time to time, the possibility of producing graduates designed to address specific industries needs with a view to playing their role in the partnership will become a utopian target. Thus, the academia should continue to be part of the industries not passively, but actively for the essence of the partnership.

Various studies, research and discussions between high profile Chemical Engineers in the industry and those in the academia have shown that the following areas are needs for the academia:

- Ensure curriculum adaptations moves as fast as the pace of industry change<sup>[5]</sup>
- Build up relationship with industry and career advisors
- Tailor make education for the unemployed in shortage areas, for small and medium size enterprises (SMEs)
- Collaborate to develop Learning models
- Develop joint academic -industry degree models
- Development of research based teaching materials
- Alumni networking and developing broad based relationships, not one of associations
- Mutually enabling processes for capacity building of the faculty, students and the companies
- Explore possibilities of endowed chairs in specific areas of management, and

- Appointment of senior and experience member of the Chemical Engineering industries as members of Departmental management team, so that the department can move at the speed of such companies.

## **THE ROLE OF THE INDUSTRY**

While the academia is trying to sort out its role in bridging the gap, the industries obviously still have its own responsibility in ensuring that this unwholesome gap is bridged. This can be achieved via different means as highlighted below.

1. Proper need analysis: where is it going, and what are the human resources it needs to drive it there. This is essential as it will help the industry properly define its need and channel such request in terms of R&D assistance to universities, collaboration in designing project topics/proposals and the injection of basic scientific /engineering concepts into university curriculum if not already there<sup>[7]</sup>.
2. Sponsor long- term research: Industry will help greatly in bridging the gap if they undertake sponsorship of long term research. Obviously, these researches will be those designed to address company specific technological need or one with good potential for driving the company in the right direction on the long run. It is important to note that industries should not shy away from identifying with long term research projects because of the time, money and relative uncertainty associated with it. When these researches are well directed, there is always positive outcome<sup>[11]</sup>.
3. Organise periodic seminars in collaboration with universities: Organising of periodic seminars (not one in a blue season) is clearly another viable means through which the industries can contribute to bridging the gap. When industries organise directed or skewed toward specific areas of interest , immediate and long term needs in collaboration with universities, it will create a forum or platform for meaningful interaction, positive criticism, analysis of opinion, orientation and re-orientation, setting of specific targets and identification and assessment of challenges. In the long run, it will mean well for both parties and the chemical engineering profession.
4. Share equipment and facilities with universities: For industries to say it is really supporting university in bridging the gap, it must be ever ready to share its equipment and facilities with universities for the purpose of research. Because some of these facilities are expensive for most universities (chemical engineering department) to afford, there is need to allow process engineers and process engineering students to access them. This collaboration will ease cost of research for students and process engineers and will erase discouragement in venturing into certain capital intensive research areas. It is also good that industries help universities by sharing in modern chemical engineering software that are the key drivers in chemical engineering operations so as to make both students and teachers industry compliant<sup>[9]</sup>.
5. Provide support for student projects: Industry can support university by supporting student's projects. This can be done by providing topics that addresses specific industry need, providing research facilities and necessary exposure. They can also help by allowing research students access data if there is need for such for proper analysis, evaluation and conclusion.



## **THE GOVERNMENT AND THE NIGERIA SOCIETY OF ENGINEERS (NSCHE)**

**Massification of Education:** In more recent times, there has been an increasing awareness about the role and responsibility of education, and with it, a growing concern in many countries about the manner in which educational systems were organised and administered. The beginning of this concern was, perhaps, the transformation of education from an elitist pursuit to mass activity. With elementary and secondary education becoming universal in most developed countries, higher education also got transformed into a mass education initiative.

According to the Robbins Committee (Committee on University education, UK, 1963), it advocated the view that University should respond to the social demand and that they should provide for the education of all those who wish to pursue it and were eligible. To this end, University education in the UK expanded rapidly and much larger population of students passing out from schools got enrolled in the Universities. The percentage of students belonging to the age of 18 to 20+ enrolling in Universities went up quickly to 17% in the eighties and 32% by 1995. It therefore means that the Nigerian government either directly or through its relevant agencies will want to see the need to encourage more young once to the study of Chemical Engineering in the wake of the recent population explosion. Chemical Engineering professional bodies like the Nigerian Society of Chemical Engineers (NSCHE) also has a deal here as they can still help increase the awareness s to the public and help them see the role of the Chemical Engineer in the outworking of technological innovations and industrial growth.

Inevitably a question about the way of organisation and management will arise since education still depends largely on public funding in Nigeria and the Chemical Engineering programme is not left out in this. It will be normal therefore to ask whether task payer's money was being wisely spent, whether the institutions in which public money was spent were accountable to the society and government and whether the resources allocated to these institutions were effectively utilised. The search for the answers to these questions will naturally require the use of known management tools and the concept of performance, productivity, accountability and so on and shall lead us into the field of education management.

It is worthy of note that while education management will not be extensively address in this paper, it will be recommended to Chemical Engineering education managers to pay kin attention to these aspects of modern management practices like planning, strategic development, performance measurement, quality control and improvement, professional development, infrastructural and cultural change, resource mobilization, marketing, public relations which are essential tool kits of today's education managers<sup>[6,7]</sup>.

## **OVERALL BENEFITS OF THE PARLEY**

To say the least, when the academia and the industry stay close, the benefit will be immeasurable. For our Country Nigeria, and the two sectors, they will experience growth unlimited in different ways. One way is the enhancement of research bases, scope and purpose. Instead of engaging in researches as mere academic exercises or means for earning promotion, Chemical Engineers in the academia will be able to properly define each research need and scope which will eventually be the driver that will determine the pace and target of any research. Thus each singular research once completed, will fill a void, correct an error enhance or redirect the Chemical Engineering profession and practice positively. Thus, within a short time, the profession will begin to witness unprecedented changes in the right direction in line with global practice and trend.

Another way is the availability and access to finance and other forms of support in both ways. The fact that the academia can gain financial support from the industry has been highlighted before in this paper. When there is good relationship between them is good, the industry can help the academia in financing certain research because they know it will also be of immense benefit to them. Thus the academia will leverage on the financial strength of the industry to enhance its research capability and contribution to knowledge and development. The support can also be in the form allowing the academia to access the industry's facilities/equipments that may be too expensive for the academia to afford in the laboratories. When there is no restriction of access to facilities in research, there will no restriction as to the area of research to delve into. Also, industries can support academia by providing resource persons regularly at no cost to help in shedding light on certain applications in the profession, or experienced hands can be visiting or even industrial professors if they are qualified as such. Thus Chemical Engineering students will not see any seeming lacuna between the theory and application in the study of Chemical Engineering.

This no doubt will affect the quality of graduates and feed for the industry. Overall these will translate to the industry as it will eventually strengthen, broaden its R&D and reduce pressure on it, reduce cost of retraining new staff, enhance its development and growth, and improve on service quality. Time and space will fail us if will go on and on. But we will summarize as that strengthening the relationship between both parties will eventually lead to good for both equally. Consequently, there should be no going back on this as steps need be taken in the right direction to ensure that the seeming gap is bridged.

## **CONCLUSION**

This paper examined the state of the Nigerian Chemical Engineering University system, present needs of the Chemical Engineering industry and has been agreed upon that there is a gap between these two sectors that need urgent attention and the partway to bridging this gap was also highlighted. It has also been agreed that there can be no science without industry to apply the findings of science and there can be no industry with the findings of science and that these findings is a function of continuous R&D. Consequently, the academia, government and the industry need not wait for anyone or party to drive the bridging process.

Each one should see it as a prime responsibility to initiate and sustain it if there will continue to be the Chemical Engineering entity which we all identify with. This, if done will mean well for all of us who are Chemical Engineers both in the academia and the industry and will in turn translate into good for humanity.

## **REFERENCES**

- 1 'Industry- academia convergence: bridging the skill gap' [www.ugc.com](http://www.ugc.com). Accessed June, 2010.
- 2 'History of Chemical Engineering' [www.pafko.com/history](http://www.pafko.com/history), April, 2010 accommodate the current needs of Nigeria.
- 3 Abubakar, B.A, and James, K.: Bridging the University – Industry gap for effective research and development
- 4 'Council for the regulation of Engineering in Nigeria (Coren) accreditation status' [www.coren.com/accreditaion](http://www.coren.com/accreditaion). Accessed August, 2010.
- 5 Byrne, E.P, Department of Process and Chemical Engineering, University College, Cork, Ireland.: 'The role of specialization in the Chemical Engineering Curriculum'
- 6 Valentin, P; Reluca, I; and Alexandra, W; University Politehnical of Bucharest, Bucharest,
- 7 Romania.: 'Developing Chemical Engineering Education to enhance employability of young specialist'
- 8 Onwuka, E.N, Electrical and Computer Engineering Department, Federal University of Technology, Minna, Nigeria.: 'Reshaping Engineering education curriculum
- 9 Luria, S.E, and Luria, Z.: The role of the University Ivory tower, Service Station, frontier post ' Daedelus ; 1970,99,pp.75-83
- 10 Battenburg, J.R: Bridging the gap; University- Industry problem. ; ASEE Conference proceedings, 1980, pp. 373-377
- 11 Fairweather, J, ; Academic research and instruction- the industrial connection; J. Higher Educ. 1989,6,(4) pp.388-407
- 12 Zaky, A.A; and El-Fahami, M.M.; The University – Industry gap and its effect on research and development; Engineering Science and Education Journal, 1998,7,(3),pp. 122-125

- 13 Society for innovation and development, IISC,; University-Industry programs' [www.sid.iisc.ernet.in](http://www.sid.iisc.ernet.in), 2005
- 14 Field Research, Bangalore, February 2005 , pp 15
- 15 Anthony D' Costal.; World Bank Report, 2006, pp 22