New Orleans JAZZED about Engineering Education

Paper ID #17150

On Bridging the Gap between Academia and Industry in the Arab Gulf States: Views, Challenges, and Potential Rewards

Dr. Waddah Akili, Iowa State University

Waddah Akili has been in the academic arena for over 40 years. He has held academic positions at Drexel University, Philadelphia, Penna (66-69), at King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia (69-87), and at the University of Qatar, Doha, Qatar (87-00). Professor Akili's major field is geotechnical engineering and materials. His research work & experience include: characterization of arid and semi arid soils, piled foundations, pavement design & materials, and concrete durability. His interests also include: contemporary issues of engineering education in general, and those of the Middle East and the Arab Gulf States in particular.

On Bridging the Gap between Academia and Industry in the Arab Gulf States: Views, Challenges, and Potential Rewards

Abstract: The paper focuses on the current stance of industry-academia relationships in the **Arab Gulf States**(Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), and argues that meaningful, long-lasting relations have begun to develop. But, there is much more that can and must be done. The paper calls for increased "relevancy" of engineering education with greater industry-academia collaboration on many fronts. It was inspired by a round table discussion, where engineering graduates of Region's colleges have suggested ways to start developing viable and enduring connections between local industries and the academic institutions of the **Arab Gulf States**. Strategies to help promote the collaboration effort are outlined. In particular, activities (plans, and scenarios) perceived as effective in closing the gap between academia and industries are described. Training, capstone courses, consulting by faculty members, and joint research projects, aimed at serving the interest of both parties (academia & the industrial partners) are also addressed. The paper sheds light on: the mission, the nature, and relevant benchmarks of this collaborative effort. Modifying curricula and programs toward industrial relevance and the "practice", regarded by many as a step in the right direction, will help equip graduates with the "tools of the trade", thus lessening the burden on the industry in the locale, in having to spend time and effort preparing and training employees at the start of their career. If engineering faculty and program planners would slant curricula and programs more in the direction of "industrial relevance" and the "practice", it would help a great deal in equipping engineering graduates with the "tools of the trade" , thus lessening the burden on the industries. In this endeavor, the author draws on his own experience as a faculty member in the **Arab Gulf States**; in addition to views and suggestions of: colleagues, students, graduates, and business leaders in the Region.

Introduction

Engineering education in the Arab Gulf States (Saudi Arabia, Bahrain, Kuwait, United Arab Emirates, Qatar, and Sultanate of Oman) faces many challenges today. Changes in the external environment (e.g. reduced funding, increased costs, demands by industry for well-seasoned graduates, and rapid advances in technology) coupled with the quest for educational relevance in undergraduate engineering, are forcing colleges of engineering in the Region (*the Arab Gulf States*) to "rethink" engineering education and to undertake constructive steps towards reforming the current systems. [1, 2, 3, 4]

The higher education arena interacts in a complex way with a variety of external partners whose role, participation, and expertise must be harnessed to help overcome some of the challenges that have beset engineering education in the Region. Perhaps the most notable partner in this endeavor is the industrial sector whose role and participation in shaping engineering education has, unfortunately, been extremely modest by best estimates. Establishing a beneficial working relationship between colleges of engineering in the Region and industries at large, has proven to be difficult, often short-lived, and appears at the outset, not to be rewarding to either side.

Among the many factors contributing to this failure, is the tremendous inertia of the educational systems of the Region. [2, 3]

The paper sheds light on the seemingly complex issues that have curtailed proper "connectivity" between academia and industry in the Arab Gulf States, and argues for the urgent need to work together towards developing mutually beneficial and long-lasting relations, at the grass root level, so that the interests of people on both sides (students, graduates, faculty members, industrial staff, industry managers, research proponents, etc) will be properly served. Perhaps the greatest achievement in such an endeavor is to improve the "relevancy" of engineering education, by bringing the college closer to the "realities" on the ground. There is a tremendous need for faculty and students to be involved with "real problems" and to share in providing solutions. Drawing materials out of textbooks is not enough. We, *as engineering educators*, need to bring our own contributions to the classroom! Academia's reluctance to work with industry and industry's indifference to those issues that have beset academics, has been a major cause of the "malaise" that has gripped the colleges of the Region. Unfortunately, this "detached" role of the university is seen by some as justified; partly because they feel (and wrongly so) that the role of the university is to teach the fundamentals, and not necessarily applications. These misconceptions need to be corrected, and industries have to be "lured in" to participate in shaping the academic programs, and have "a say" in what kind of skills and aptitudes are transmitted by the colleges of engineering. By having a stronger voice in academic matters, industry would keep the "taught skills" in check, and, at the same time, provide more appropriate "on the job" training to students and fresh graduates.

In this paper, strategies to help promote collaboration between the colleges of engineering and neighboring industries in the Arab Gulf States are examined. Those activities (plans, and scenarios) perceived as effective in closing the gap between academia and industries are explored. In particular, the paper focuses on: the mission, the nature, extent, and relevant bench marks of this collaborative effort (i.e., effort to close the gap between academia and its industrial partners). Training, capstone courses, consulting by faculty and joint research projects, aimed at serving the interest of both parties (academia and the industrial partners) are also addressed. At this critical juncture, if engineering faculty and program planners, would usher curricula and programs more in the direction of "industrial relevance" and the "practice", it would help a great deal in equipping engineering graduates with the "tools of the trade" thus lessening the burden on the industries in the Region.

In this endeavor, the author draws on his own experience as a faculty member in the Arab Gulf States (recently in Qatar and earlier in Saudi Arabia); in addition to views and suggestions of: colleagues, students, graduates, and business leaders in the Region.

A Brief Review of Engineering Education in the Arab Gulf States

Engineering education in the Arab Middle East is relatively new, as organized educational endeavors go. It had its early start shortly after World War I. Colleges of engineering (or schools of engineering as they were labeled) were founded then, in Cairo and Alexandria, Egypt, and also in Beirut, Lebanon. By the end of World War II, colleges of engineering sprung out in Iraq and Syria. And two decades later, Jordan had its first college of engineering in its capital,

Amman. The colleges in Lebanon and Syria paralleled, by and large, the French schools of engineering; except for the American University of Beirut (AUB), typically a North American school, looked after by a consortium representing colleges on the East Coast of the USA. Colleges in Egypt and Iraq were influenced, at the time of their establishment, by the British system of education. [1, 2, 3]

Engineering education in the Arab Gulf States started, in earnest, during the early to mid sixties. Initially, colleges of engineering were founded in Riyadh, Jeddah, and later, in Dhahran, Saudi Arabia. In the other smaller states of the Region, other engineering colleges were founded soon after these states had gained their independence. Although many of the recently established engineering schools in the Region have been affected (positively and/or negatively) by events in neighboring Middle East countries - the fact that the Region has always had strong ties to some western countries, and in particular the USA- has helped enormously in setting up, manning, and providing needed guidance to these fledgling institutions during their early years.

The dramatic increase in oil revenues during the 70s, and 80s, coupled with lack of skilled professionals in areas deemed necessary for growth and development of oil-related industries, has been pivotal in the start up of higher education in general and engineering in particular. There are today eight main public colleges of engineering in the Region (Table 1) in addition to several, recently founded, private and semi private colleges and/or universities that offer engineering degrees. These eight public colleges have, since their inception, been guided by advisory boards made up largely from faculty members drawn from US colleges. Previously, the Grinter's Report [5] and the Goals Report [6] have been used to guide the educational process. Recently, ABET Engineering Criteria 2000 [7] has been the subject of seminars and workshops, intended to shed light and assist engineering colleges in the Region in making use of the EC2000 whenever possible. Indeed, the EC2000 has generated a lot of interest and challenges in the Region. Whether or not it will be implemented, would depend on: institutional vision, available resources, students' preparedness, and prevailing traditions and norms.

The main public colleges of engineering -eight in all - are part of the public university systems in the Region, and thus are government run and almost totally government financed. The organizational structure is nearly the same in all. Students are mostly nationals of their respective countries and graduates of similar public education systems. Admission policies, for all eight colleges, are based on grades obtained in an official examination sanctioned by the Ministry of Education, upon completion of the 12^{th} grade. Additionally, an entrance exam and evidence of proficiency in English, a requirement imposed by many of these colleges, may exempt the applicant from a pre-engineering "prep year" administered as a separate unit from the college. Statistics have shown that over 80% of first year students attend the "prep year," during which students are to embark on: learning English skills, revisiting math and science in preparation for engineering "gateway" courses, and acquiring desirable attributes such as: analytical skills, curiosity and desire to learn, creative thinking, and the importance of team work. [2, 3]

Thousands of native Arabs - citizens of the Gulf States - have completed their engineering education at one of the eight public colleges (Table 1) of the Region, and have occupied government positions or joined the private sector, side by side with expatriates. Some have established their own business, and many have moved up the ladder into responsible managerial

positions. In a recent attempt to poll some graduates of the Region's colleges, on: *the relevance of their engineering education, and any advice they may be willing to share*? Many expressed a desire to see better relations with local industries as a means to improve relevancy of engineering education. [8] Therefore, the impetus behind this paper has been, the remarks made and suggestions offered by these graduates, who have voiced their concerns about the relevancy of their education, in general, and their wish to see a "working and sustainable" customer-supplier relationship with the employers of engineering graduates, in their locale.

Country	*College of Engineering*	*Year Established*
Saudi Arabia	King Saud University - Riyadh	Early sixties
Saudi Arabia	King Abdul-Aziz University - Jeddah	Early sixties
Saudi Arabia	King Fahd University of Petroleum and Minerals (KFUPM) – Dhahran	Late sixties
Bahrain	University of Bahrain – Manama	Mid seventies
Kuwait	College of Engineering and Petroleum at Kuwait University - Kuwait City	Mid seventies
Qatar	University of Qatar – Doha	Early eighties
United Arab Emirates	UAE University - Al-Ain	Early eighties
Oman	Sultan Qaboos University – Muscat	Mid eighties

Table1. The Eight Main Public Engineering Colleges of the Arab Gulf Region.

Academe and Industry

When universities and industry find common ground to meet each other's needs, the mutual benefits can be substantial. Not so long ago, most industrial firms' involvement with engineering education in North America was limited to a few activities: hiring graduates, occasionally funding research projects, and, from time to time, donating some funds from their foundations. Today, industry partners appear to have a great deal to offer to universities, particularly when educators become willing to descend a few flights of the ivory tower to embrace the new realities of engineering research. The most significant challenge to any engineering college is: remaining relevant to the profession, a quest that is challenging enough during times of relative stability. Today, with the engineering profession undergoing dramatic changes on many fronts, including: less predictable employment patterns, globalization, reduced job security, shifting funding opportunities, broader intellectual alliances, and changing accreditation expectations; remaining relevant has become far more difficult under the circumstance. Despite the many uncertainties that surround engineering education, industry could assist engineering colleges' accreditation efforts and challenges. *Engineering Criteria 2000* has two basic parts: it gives each engineering

college the opportunity to define its unique mission, and also requires that the college assesses the outcomes of its educational process, determine whether it is meeting its own objectives, and take corrective actions if and when necessary. People of the industry are ideally positioned to render a helping hand to an engineering department in defining its mission, in a way that is relevant to the "real engineering world" that majority of graduates will eventually find themselves in. Also, industry has a great deal of experience assessing outcomes, and could suggest effective assessment mechanisms to assist academic departments.

It was a logical progression for some of the colleges of engineering in the Gulf Region to turn towards industries of the Region and attempt to build bridges and set up advisory boards. Establishing a working relationship between selected industries and the engineering college, by and large, has proven to be difficult and often short-lived. It seems to take more than an enthusiastic faculty member acting alone, or a single joint project that has seen daylight, to claim that a long-lasting and beneficial relationship has been achieved.

Unlike North America, academe and industry in the Gulf States, reaching out and attempting to work together, is a relatively new experience. Except for oil and oil-related industries, the bulk of the industrial sector in the Region is small-size entrepreneurial, and sees no direct benefits in opening up to the College of Engineering. In all the states of the Region, major industries (oil industries in particular) have maintained some lines of communication with the University in general and the College of Engineering in particular. With one or two exceptions, the industry-college relations can be described as intermittent, short-term, and does not seem to be rewarding to either side. Who is responsible for the status quo? What would it take to build long-lasting, mutually-beneficial relations? While there are no clear-cut answers, certain factors may have contributed to the state of "malaise" that tends to exist today. Some of these factors include:

- lack of interest (to the extent of indifference) on the part of many industries to get involved with engineering institutions;
- clear differences between the two cultures - that of industry versus academe;
- inability of the College to market its services and products;
- reliance of most industries on expert opinion and/or technical support from abroad, thus reducing potential collaboration with the College;
- the prevailing misconception that expatriate faculty should not be allowed to consult or engage in after-hours activities; and
- the petty attitude of intermediaries (civil servants, administrators) that hinders collaborative effort and often adversely affects the outcome of a joint venture.

On the bright side, some of the industries of the region have responded rather well to students' training and cooperative education programs in general. All present curricula require successful completion of either an eight-week training period, or two consecutive semesters of cooperative education. The major industry players in these domains are primarily: oil and gas companies, chemical and steel companies, large-size building and road contractors, electric utility companies, some government agencies; and, to a lesser extent, small engineering service firms. Despite some setbacks, misjudgments and unpleasant outcomes experienced by some - the vast majority of students has positive impressions and believes that the training or co-op period is time well spent. [2, 3]

Benchmark Assumptions of Engineering Education in the Gulf States: Studies of education and specifically of engineering education in the Arab Gulf States, have pointed towards omissions and weaknesses in undergraduate engineering education. Some believe that better preparation of graduates could result in tangible advantages upon entering industry. Unfortunately, the majority of faculty members of the Gulf Region - expatriates and nationals - have hardly practiced engineering any where prior to becoming faculty members! And personal experience based on *practicing engineering* - at least for sometime - has never been a requirement to become a teaching faculty. Fortunately, more and more educators are becoming aware of this "acute" problem; and some are taking steps to remedy the situation. One approach has been to form symbiotic partnerships between a "willing" industry and a respective engineering department through "capstone" projects. While little if any has been reported in the Region on the extent and success of this type of partnership, it appears that much could be done, to bring *the practice* into the classroom. A particularly exemplary US institution, that has been successful in this domain, is Harvey Mudd College [(9)], where industry-academia projects, known as Engineering Clinics, have been conducted for nearly 40 years.

A list of weaknesses of Gulf States engineering graduates (Table 2) has been agreed upon and compiled by a group of industry personalities who have had a chance to interact with recent Gulf graduates. The consensus of these leaders were inspired by an informal roundtable discussion addressing the relevancy of engineering education in the Arab Gulf States [(8)] .Evidently, from the perspective of industry, the definition of a quality graduate is markedly different from the way academia views it. Industry, by and large, looks forward to a graduate who is flexible, versatile, fits well within the company (trainable), and is able to exercise engineering judgment on his/her own.

- Thoroughly deficient in thinking critically and independently
- Lack of design capability and/or creativity
- Lack of appreciation for considering alternatives
- No knowledge of value engineering
- Lack of appreciation for variation
- Majority wanting to be analysts
- Do not know how to utilize time and/or resources properly
- Poor perception of the overall "engineering" process
- Inadequate communication skills
- Do not desire to get their hands dirty
- Trained to work as individuals. No experience working in teams
- Do not have the desire and/or the skills to do their own search or learn on their own

Table 2. An Industry Perception of Weaknesses in New Graduates of Gulf Region's Eng. Colleges

To try to understand today's state of engineering education in the Region, it is important to come to grip with the challenge that the Region's pre-university educational systems are facing today.

Pre-University Education in the Gulf Region: The most significant change in the pre-university systems occurred in the decades of the 70's and 80's, as a direct result of the substantial wealth derived from oil revenues, which have found its way to the Region. Public schools, in particular, were substantially and positively impacted by the increase in revenues. The major improvements realized, as a consequence of increased funding, have included :(i) substantial increase in the number of well-equipped modern school buildings; (ii) significant modifications to curricula and academic programs, in conformity with standards and guidelines prevalent (at the time)in some other Arab countries(Egypt, Jordan, Syria); (iii) provision of qualified teaching staff drawn from neighboring countries;(iv) improved management;(v) introduction of special education for physically and/or mentally challenged students; and,(vi) the emergence of a more concerned general public with education issues.

Public schools, by and large, are under the auspices of the Ministry of Education which is solely responsible for planning, operations and budget. Hardly any difference exists among schools of the same category in any of the states of the Region. Admission policies, teaching materials, teaching methods, counseling, and testing and grading standards are nearly identical in all the public schools of the Region. Schools, at all levels, are free (i.e., free tuition, no fees, free textbooks) for Gulf nationals and expatriates alike. In addition, a stipend, equivalent to US $200 per month, is provided to most students who are in need. [1, 2, 3]

Despite the progress made and the many positive aspects that have been introduced to many facets of the K-12 educational arena over the last three and a half decades; there are those aspects that seemingly are extremely difficult to modify despite some efforts on the part of some concerned individuals. The main issue we are concerned with, is: the *traditional* methods of teaching that have persisted over many years and appear to be "immune to any change!" Practiced on a wide scale, the traditional approach embodies the following: (i) students are bombarded with information, drawn primarily out of textbook(s); (ii) students do not participate! The process is "one way," with minimum interaction between students and instructor; (iii) emphasis on *rote memorization* - over all other kinds of learning - has always taken precedence; and (iv) most students study to get the grade rather than "to understand" and retain knowledge. Their shallow approach to learning is decidedly incompatible with engineering education, in general, and in direct conflict with the "ethos" of the engineering profession.

The main difficulty with pre-university education in the Gulf Region, as seen by both insiders and outsiders, is that it *promotes rote and uniform learning over independent thought*. In fact one can go as far to say, that it suppresses independent thinking. While these systems appear effective in developing students who are able to learn vast amount of "testable" information, it falls terribly short in fostering creativity and analytical skills that are more difficult to monitor and test. The skills referred to here are those that need to be acquired by students who wish to get into engineering. The author's perception of some of the weaknesses and deficiencies in high school graduates, as they prepare to get into science and or engineering, are listed in Table 3. As previously noted, [2, 3] the reluctance or inability of decision makers to reform public education in the Region has continued to adversely affect outcome. Students finishing high school and applying to engineering are only marginally prepared. To rectify the current situation and rid the schools of the Region of the "malaise" that has gripped public education, at all levels; bold steps have to be taken by policy makers, i.e., to start a "reformation" process that will eventually do

away with the existing "traditional" methods in favor of "student-centered" approach that has "active learning" as a prime feature. [4]

- Insufficiency in math &science and lack of real understanding of basics in both! There is a "disconnect" between pre-university courses and first year engineering.
- Their "thinking" process is primarily confined to what they have been tutored to respond to. They remember only what they have memorized!
- Their communication skills (including English language) are well below the required levels for entering engineering.
- Inability to improvise and/or consider alternatives.
- Trained primarily to work as individuals. No experience working in groups.
- Do encounter difficulties: when integrating knowledge, connecting previously acquired knowledge with more recently learned, in seeing interactions between different concepts, and in conceptualizing in general.
- Do lack the drive, the patience, and the discipline to carry out independent tasks.

Table 3. Author's Perception of Weaknesses in High School Graduates Applying to Engineering.

Proposed Measures: Forging long-lasting relationships with industry is a quest that colleges of engineering in the Region should embrace and work hard to achieve. As faculty members, we cannot be professionally satisfied with teaching only. Today, with the engineering profession undergoing dramatic changes on many fronts – there is need to be involved with real problems and to share in providing solutions. We owe it to our students to prepare them to meet the challenge ahead by focusing on real issues derived from tangible situations. Drawing materials out of textbooks is not enough – we need to bring our own contributions to the classroom! Therefore, we do need to communicate with industries around us and genuinely attempt to understand their point of view. It is argued that: constructive measures have to be taken to rectify the current stalemate and turn things around. The measures referred to would include the following:

(i) Introduce sweeping changes to current regulations and bylaws, to reduce red tape that impedes the process. To be effective, these changes have to be recommended by the university administration and mandated by the Government.

(ii) Encourage faculty members (expatriates and nationals alike) to reach out to the industrial sector to cultivate meaningful contacts, develop (one on one) connection with their counterparts, and attempt to gain experience in their area of specialization.

(iii) Institute a Faculty Fellowship Program, where tenured or tenure-track engineering faculty could spend 10 weeks, a semester, or an academic year gaining valuable industrial experience in their field of technology.

(iv) Facilitate the formation of "symbiotic" partnerships between selected people of industry and faculty members through: senior capstone projects, and research projects in selected domains.

(v) Set up advisory boards to facilitate collaborative efforts and to provide logistical support to collaborators; and restructure programs, redefine mission, and provide resources to meet industry' needs.

(vi) Encourage talented engineering personnel from surrounding industries, who may be interested in working with students, to become part-time adjunct faculty.

The most probable areas for such collaborative ventures in the foreseeable future are:

- short-term, stop-gap consultation, trouble shooting, and professional advice by experienced well-seasoned faculty;
- longer term joint research studies aimed at resolving chronic problems of industry, and help find longer lasting solutions;
- Help the industry in setting up appropriate analysis and design methods, and help develop applicable standards and relevant testing methods.

The author is of the opinion that the initial hurdle is to get started. Faculty and staff members with industrial experience are ideally positioned to play a major part at the start of a collaborative joint venture. Their insight and experience would help greatly in defining the mission and chartering an appropriate course of action.

Contrary to what some entrepreneurs in the Region believe, joint participation need not be for philanthropic reasons; nor should it be undertaken to gain favors, improve a company's image, or win government approval. These ventures can, and thus should, provide real benefits for all involved. Industry can benefit by gaining access to university facilities and its human resources, and by receiving the services and products that faculty and staff generate. In turn, joint collaboration can provide the College with additional revenue and access to industrial equipment and setups not available on campus. Successful ventures also help overcome the complaints about engineering education: lack of hands-on experience, not enough teamwork, and textbook problems rather than real-world applications. Students' involvement in such collaborative efforts can boost their self-confidence and help in improving their communication skills. Joint undertakings could provide professional development to faculty members as well- by exposing them to practical situations and relevant technologies. As an added benefit, and when conditions are right, project data and outcome may get published, thus enhancing faculty members' list of publication.

***Some Encouraging Results**:* Although the overall impression portrayed here, on collaboration of engineering colleges and surrounding industries of the Region, has not been positive to say the least; there are, nevertheless, some success stories that deserve to be reported.

During the late seventies, the Research Institute of King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia was founded. Housed on campus, with its own skeleton staff and facilities, began to reach out to potential partners (industry and government) with a well-defined mission. Despite some setbacks in the beginning, the Institute became fully operational within a few years. It has been rendering services to participating industries and Government agencies in the domains of: economic modeling, oil and gas technologies, water resources management, environmental impact studies, characterization and testing of materials, and setting up new standards. [(10)]

In the author's opinion, the Research Institute of Dhahran, Saudi Arabia is a success story by all measures. Factors contributing to its success have included:

- its well-defined mission and appropriate organizational structure;
- its proper administrative setup with staff that can relate to industry, thus help foster collaboration; and,
- Having campus as home-base has helped provide easy access to university's vast resources.

Perhaps additional factors that may have come to play in the case of KFUPM Research Institute, is its unique position with, and close proximity to, Saudi Aramco, the largest oil producer in the Middle East. KFUPM has always enjoyed the tremendous support provided by Saudi Aramco, since its establishment.

Potential Adoption of Service Learning: Many engineering institutions, worldwide, have introduced a range of educational strategies in order to bridge the gap [11, 12,]. A subset of these strategies, characterized as Learning through Service (LTS) use community engagement as a way to enhance students' experience. Service Learning programs have been shown to provide many benefits, including: academic performance, motivation, ability to comprehend and work with others, leadership, adoption of new strategies, and preparation for future work. [13, 14]
In addition, these engagement programs and service learning activities do appear to play a significant role in preparation of the core skills for engineering practice. Yet can professional skills required by engineers be acquired through community-based projects that do not resemble traditional corporate work? The literature, in general, is supportive. The service learning program implemented at many institutions including Purdue University, referred to as: the Engineering Projects in Community Service (EPICS), has substantially grown since its inception. EPICS is a service-design program where students earn academic credit for partnering with nonprofit organizations to meet local or global community needs. The program encompasses students from all undergraduate classifications, from first year to seniors. Also, the curricular structure allows students to enroll multiple times in different academic terms and supports long-term, reciprocal community partnerships. [15]

The flexible structure of the EPICS allows students to experience the program in a variety of ways. Some participate for one semester while others participate for several semesters, making the program a major part of their undergraduate experience. Some participate during their first year on campus while others use EPICS to fulfill their capstone design requirements. Students work in teams. Some have specific roles on the team, such as team leader, project manager, webmaster, or recorder. Although service learning strategies are widely accepted within engineering disciplines, they are considered by some as complementary to the core engineering preparation [15] .The author is of the opinion that project-based service-learning experiences can play a significant role in the preparation of future professionals. Therefore, it is highly recommended that **service learning strategies** be considered, and eventually adopted by the colleges of the Gulf States, as a means of gaining workplace experience and acquiring a variety of professional skills.

Concluding Thoughts

Engineering colleges in the Arab Gulf States (Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates, and Oman) - established in the late sixties, seventies and early eighties, and

modeled after North American colleges- have many of the symptoms that "beset" engineering institutions in their natural sequence of progression. Changes in the external environment (increased costs, reduced funding, technological innovations, and demands by industry for better prepared graduates) coupled with the quest for educational relevance in undergraduate engineering education, are ample reasons for the colleges of the Region to "update" and "revise" current systems in a direction consistent with societal needs.

Amongst the many issues being debated on college campuses today, is the need to collaborate with industry in the Region, in order to meet common goals and work harmoniously together in equipping graduates with the skills and traits desired by the industrial sector. In order to better prepare young graduates, and foster improved technology transfer practices and policies, the industry of the Region will need to seek stronger voice in academia. Unfortunately, academia has been reluctant and slow in "opening up" to industry. Apparently, engineering educators in the Region have not as yet conceived of working with industry to increase "relevance" in higher education, and many see no motivation for change at this time.

These problems are ripe for change, but, in the short-term, the outlook is not very encouraging. On the whole, industry in the Region is not calling on engineering educators and educational policy makers, to reform higher education. Also the rigid education system, that currently grips the Region, seems to perpetuate itself. Challenging times await!

The paper sheds light on the complex issues that appear to have curtailed proper and enduring connections between academia and industry in the Arab Gulf States, and argues for the urgent need to establish proper relations, at the grass-root level, so that the interests of people on both sides of the isle (students, graduates, academics, industrial managers & staff, researchers, etc) will be properly served. Making headway, through collaboration, would eventually "bridge the gap" between academia and industry, resulting in better prepared students for the challenges ahead.

References

1. Akili, W., "Engineering Education in the Arab Gulf States: Stagnation versus Change," *Proc. The 2002 ASEE Annual Conf.,* (Session 3160), Montreal, Canada, June, 2002.
2. Akili, W., "On Reform of Engineering Education in the Arab Gulf States: A Focus on Pre-Engineering 'Prep-Program," *Proc. The 2003 ASEE Annual Conf.,* (Session 2160), Nashville, Tennessee, June, 2003.
3. Akili, W., "Restructuring Pre-Engineering "Prep-Program" to Bridge the Gap: A Proposal for the Arab Gulf States," *Proc. ASEE North Midwest Regional Conf.,* Ames, Iowa, October, 2003.
4. Akili, W., "Improving the Classroom Environment: With a Focus on the Arab Gulf States," *Proc. The 2004 ACEE Annual Conf.,* (Session 3560), Salt Lake City, Utah, June, 2004.
5. Grinter, L.E., "Report on the Evaluation of Engineering Education (1952-1955)," *Journal of Engineering Education,* vol. 46, 1955, pp. 25-63.
6. Walker, E.A., J.M.Petit, and G.A. Hawkins, "Goals of Engineering Education," *American Society for Engineering Education*, Washington, 1968.
7. *<http://www. Abet. org.>*, Accessed March 20, 2004.
8. Akili, W., "The Pros and Cons of Engineering Education in the Arab Gulf States: Views and Perceptions of Industrial Leaders," *in-house document, University of Qatar,* Doha, Qatar, July, 2000.

9. Bright, Anthony, "Teaching and Learning in the Engineering Clinic Program at Harvey Mudd College," *Proc., Advances in Capstone Education August 3-5: Fostering Industrial Relations*, Provo, UT, 1994, pp.113-116.
10. KFUPM, The Official Bulletin of the Research Institute, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia, 2007.
11. National Academy of Engineers, "Infusing Real-World Experience into Engineering Education," Wash.D.C. The National Academies Press, http: www.nae.edu/65099.aspx, , 2012.
12. Sheppard, S., Macatangny, K., Colby, A., & Sullivan, W. M., "Educating Engineers: Designing for the Future of the Field," San Francisco, CA: Jossey-Bass. 2009.
13. Beilefeldt, A.R., Paterson, K.G., & Swan, C.W., "Measuring the Value Added from Service Learning in Project-based Engineering Education," *Int. Journal of Engineering Education*, 26(3), pp.535-546, 2010.
14. Beilefeldt, A.R., Paterson, K.G., Swan, C., Pierrakos, O., Kazmer, D.O., & Soisson, A., "Spectra of Learning Through Service Programs," Paper presented at ASEE Annual Conf., Atlanta, GA. http://peer.asee.org/22465,2013.
15. Huff, J.L., Zolttowski, C.B., & Oakes, W.C., "Preparing Engineers for the Workplace through Service Learning: Perceptions of EPICS Alumni," *Journal of Engineering Education*, 105(1), pp.43-69,2015.