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Gearing academic research endeavors towards achieving sustainable development in third world countries

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Gearing Academic Research Endeavors towards Achieving Sustainable Development in Third World Countries

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Abstract

Tertiary education in the developing world, in general, and around the Arab world, in particular, has witnessed a pronounced downturn in recent years. The decline in the quality of delivered product from these tertiary systems serves as a direct indicator as to the lingering issues that pose some pressing needs to be addressed and coped with seriously and adequately.

As most university systems in third world countries are comparatively new, and are more qualified to join the domain of teaching-only institutions, it is rather difficult to find academic institutions in the developing world that can readily fulfill the status of research-strong institutions. With the witnessed recent downturn, academic institutions in the third world can neither reap properly the status of teaching-only nor research-strong institutions! Furthermore, because of the lack of stringent requirements by legislative bodies in developing countries on academic accreditation, a great many number of academic curricula have gone off-track in keeping apace with what a given academic curriculum under a specific domain should be like. This has drastically impacted the academic performance of university systems in an adverse way; where the binding force to update academic curricula in the developed world lies primarily with efforts undertaken to keep academic curricula current and coherent with standardized accreditation requirements, one would find little reason to pursue such venues in the developing world, especially that acquiring some form of recognition by means of international-grade accreditation normally requires prohibitive budgets and efforts that only few of the academic institutions involved are willing to undertake.

In the absence of stringent requirements on acquiring accreditation, the end product of the process, being the graduates, ends up in many cases not market worthy and faces many challenges in securing and retaining jobs in highly competitive job markets. The issue is further compounded by a lack of industry-grade research since the underpinning economies cannot support real industries, and where industries exit, they only are considered as light industries that cannot rise to the status of real or core industries; traditionally, research-strong institutions have worked around industry bases that can, also, foster academic research. Academic institutions with strong industry-grade research bases have long been known to support quality teaching efforts and to produce the graduate of the right quality to suite the job market needs.

Countries with no core industry bases can still compete satisfactorily when properly guided, initially, through partnerships with countries that have them. When India, around the Mid 50's, for instance, decided to industrialize its economy it set out by creating links with world-class academic institutions in the US. In just under three decades, India managed to get hold of a significant share of the global Software Industry market that many countries in the third world aspire to follow the Indian model. Ireland poses yet another example at transforming its economy into an industry-supported one; in just few years Ireland, with its tiny population of 3+ Million, managed to transform itself into one of the largest software exporting nations world-wide towards the late 90's. Ireland now exports around $40 Billion worth in software annually, where its economy once depended heavily on agriculture

In this paper, we propose a model, which when followed by the incumbent third world countries, is bound to transform agriculture-based or natural-resource based economies into industry-supported ones. The focus would certainly be on tweaking existing academic systems in third world countries towards fulfilling the

needs of some suitable industry bases for the underlying economies and the supporting markets. This paper will directly address Research Capacity, Productivity, and Utility within the underlying academic institutions as applies to transforming rather primitive economies into economies that can foster some core industry that would eventually lead to some form of sustainable development for the given country/ies involved.

I. **Introduction:**

In countries of the developed world tertiary education and scientific research have in most cases been at the forefront of national development efforts and innovations. Here, there was always close proximity between ongoing academic efforts and various industrial outcomes. In fact, industries had always flourished around colleges and university campuses; living examples in the US include industrial parks such as Research Triangle Park (RTP) in North Carolina, and Silicon Valley in California. It has been through academic research, in great part, that western industries have sustained their pace of growth, where in most cases military research took the lead.

Industrial economies have it that in order to lead sustainable growth academic-industrial collaboration must exist at significant proportions. Under economies like these research budgets, be it directly through the academia or via funding coming in from supporting industries, have hit a visible share in the GNP of the underpinning economies involved; in a number of cases research budget allocations exceeded the 5-7% mark of the gross GNP.

In the industrial world it is industrial-academic collaboration that contributes significantly to market forces: Industries provide openings in the job market while universities pump out the professional workforce to fill in the eminent needs. Here, various industries together with academic entities shape up the job market according to prevailing economic needs. From this, it is quite evident how academic institutions would tailor their curricular offerings to fulfill the market needs based directly on input from the industries involved.

In less developed countries, in general, and the developing world, in particular, the whole picture is totally different in most cases; one would find little, if any, industrial-academic collaboration taking place. In fact, the prevailing market forces and the holist industrial model are quite different. Here, universities are always in some sort of a race in trying to build a model of collaboration with the industry like the one usually found in more developed countries. But for a long time, now, most of these efforts did not bear much fruits. This is attributed, in large part, to the level of predominant industries, which are mainly of the light or transformational type, where academic research efforts undertaken usually strive to emulate something that might well suite a totally different economic model. It had always been the case under regimes like these that research efforts expended do not directly match the local market needs, but, instead, could be better suited, if any, to more developed economies.

Due to the lack of the type of collaboration between the incumbent industries and local academic institutions in the developing world that would foster a marked economic growth, university systems and indigenous industries would always find themselves falling prey to a catch 22 situation; each party would always blame its faltering on the other or on outside forces, who, by conspiracy theory, are thought to have planned all types of economic disarrays for the country in question.

As a result, market forces in the developing world play out differently! Where the local market needs take on a certain shape, universities are only graduating people who would have been okay until a decade and a half ago or those, based on the curricular offerings they undertook, who would inadvertently suite some other job market! Worse yet, curricular offerings at a good number of academic institutions had gone obsolete since they neither satisfied the local market needs nor did they undergo tangible reviews to keep them current. This is further complicated by the fact that many of the university systems in these countries do not run industry-grade research to satisfy the needs of the local industries, for without significant valid research, teaching standards would continue to be on the decline. This has manifested itself quite drastically in a recent survey conducted by the Times Higher Education Supplement to rank the top 200 world institutions, where most universities in the developing world showed a marked absence from the listings [1]!

In the survey, the results were tabulated according to rank of the contesting academic institutions, world wide. These are summarized in Figs. 1 & 2 below.

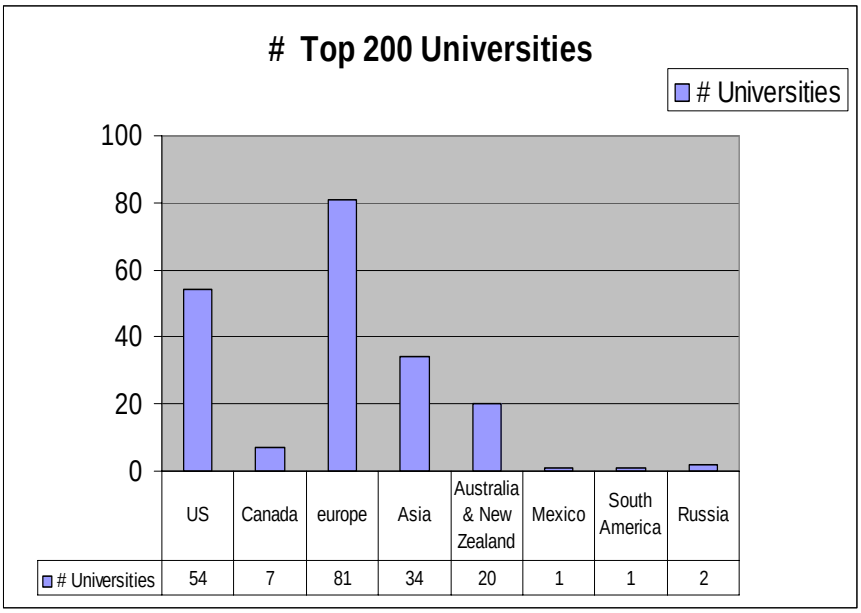

Figure 1: Ranking of top 200 universities across continents

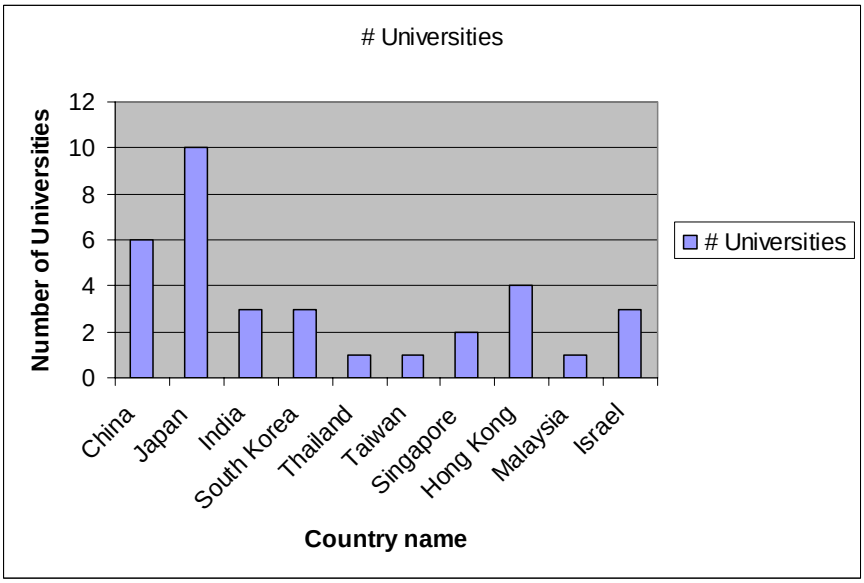

Figure 2: Number of top world universities across Asian countries

According to study results the top 200 universities which appeared in the rankings were, for the most part, universities which resided in industry-based economies, where, by necessity, the economies involved possessed some form of core industries. Here, the study took many factors into consideration before the results were announced; these factors entailed Number of Citations, Employer surveys, Peer Institution reviews, Number of International Students, Number of International Faculty, and Faculty-to-student ratios for the academic institutions, subject of the survey.

In a most recent study [2], COMSTECH, *OIC Standing Committee on Scientific and Technological Cooperation*, presented results which ranked universities of the OIC member states according to the number of research publications by each institution. Universities which showed up in the report spanned countries like Turkey, Malaysia, Egypt, Iran, Saudi Arabia, United Arab Emirates, Lebanon, Kuwait, Uzbekistan, and Jordan. No university in any of these countries had shown earlier in the Times Higher Education Supplement top 200 rankings, apart from Malaysia which exhibited presence of only one

academic institution, *Malaya University* [Rank 169]. In none of the countries subject of the study, apart from Malaysia, of course, one would find presence of a real core industry. The fact that Malaysia was represented, by its one institution, in the 2005 top 200 rankings in the Times Higher Education Supplement would readily indicate that it was achieved by the sheer presence of some core industry/ies in that country.

The fact that COMSTECH study showed some figures on universities in the OIC member states does reflect that the potential for research capacity is there. This means that, to varying degrees, the ranked institutions, in terms of research productivity, do possess the aggregate of human, institutional, and financial conditions for pursuing research. The number of research papers per academic institution in the study is also a true reflection of the motivation and commitment of the research staff who undertook the work. Here, research utility is yet another issue to ponder upon! From the study it seems that the type of research work undertaken was neither useful enough for the local community to trigger some form of a core industry that would be driven by the research work done, nor was it sufficient to grant the researchers involved the visibility that would place their academic institutions on the academic scene via the number of citations associated with their work.

It had been, to some extent, the case that faculty members at universities in third world countries, in general, and Arab countries, in particular, would embark on research work only when it would be directly connected with efforts leading to their promotion. It is noted, in many cases, that once a faculty member in any of these countries attains his full professorship goals, he/she would tend to retire from doing research altogether, or do little, if any. In the absence of any targeted direction for research from one nation's strategic planning, this is even worsened further by the fact that research conducted by incumbent faculty members does serve the needs of no viable industry that would serve the local community.

Many communities in the third world would aspire to possess some form of an industrial infrastructure. In today's world, countries that would be forward looking in joining the industrial world would immediately think of establishing clusters of software producing communities here and there in the hope that one day the country of which they are citizens would join the industrial club. However, countries which have managed to embark successfully on such ventures are only a handful; amongst these, are India, Ireland, the US, and Canada. Other countries who aspire to have some form of similar industry/ies are hardly stricken by the fierce competition of countries who have become the main suppliers of software work products. Hence, the only recourse for aspiring countries like these would be to find some local market/s to what can be produced locally, in the hope that some day they might be on the verge of competition when they will be able to export their technologies. In the meantime, and for the time that would take these countries to attain some minimum level of competition, they have got to create their own industrial core that would fulfill the immediate needs of the local and regional markets.

Now, in the absence of any real research work that upholds any core industry would ultimately mean that these countries would continue to roam about in their vicious circles until some bold move from high authority or from motivated community leads would set in. Once some core industry is established the stage would be set for various possibilities to take place.

In the next section we propose a visionary model which could serve as the long-awaited gateway/s for the formation of some industrial base/s that would fulfill the ambitions of communities that have long aspired to have some significant stake towards building some form of sustainable economies for their societies.

II. **An Integrated Model to Guide an Industry-Supported Economy:**

To overcome the difficulties occurring as a result of foreign competition, which usually impede any real economic growth and stand in the ways of any technology yield and export, in third world communities, we propose the model shown in Figure 3 below:

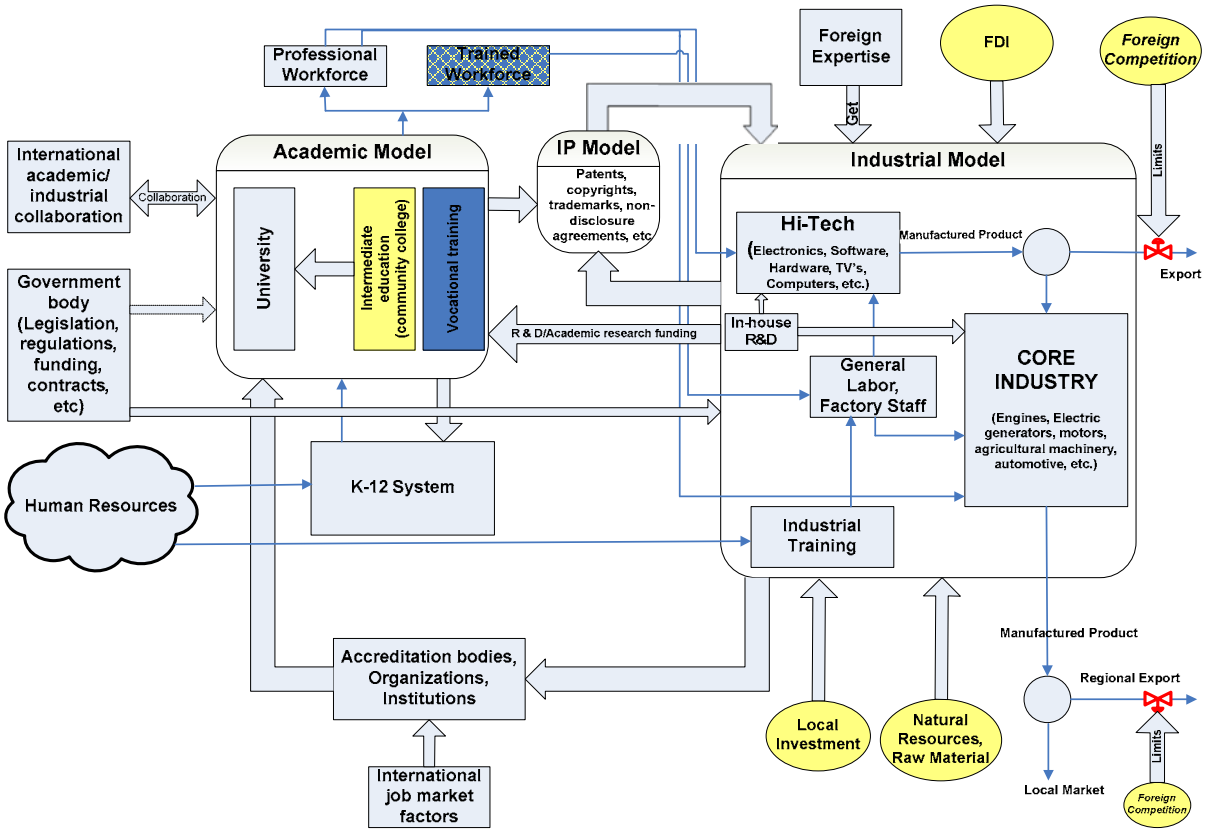

Figure 3: A Proposed Model to Achieve Integration for an Industry-Supported Economy

The diagram of Figure 3 is a conglomeration of a number of various components that by nature are closely coupled in an already industry-based economy, which need to be so in countries aspiring to achieve sustainable development based on some industrial base. In the less developed world and countries of the third world, the picture shown in the diagram could be, at present, significantly different with varying degrees from one country to another.

For their economic development, third world countries have either relied on availability of natural resources, *viz.*, *Oil*, *Natural Gas*, *Minerals*, *etc.*, tourism, educational services, service industries, amongst others, or on foreign aid for the most part. Countries like these, especially those relying on natural resource export such as Oil and Natural gas, have long relied on their ability to export these resources to countries around the world, which need these resources for industrial production, to achieve economic growth. Just a few of these countries started to realize that reliance on export of natural resources alone would not guarantee economic stability or sustainable development on the long run. In their effort to safeguard their economies against inevitable failures, some of these countries started, just in recent years, to launch initiatives that would create some "industrial models" to help lead them, at the end, towards achieving sustainable development. In many cases, however, industrial models developed, as such, are still rather crude and are of the transformational industry types. Furthermore, tertiary systems possessed by these countries are still of the teaching-only type, which would not support industry-grade research to uphold an industry in the real sense of the word.

To give a real industry a kick start in any developing country would, in most cases, require the assistance and possibly guidance of already established industries in the developed world. It, also, would require the refurbishing and complete review of curricula of existing tertiary systems to re-tool them to give them some level of competence/credibility that would lead to outcomes (both quality of graduates and research

outcomes) that would uphold any imminent industries; something which requires collaboration with world-class academic institutions in industrial nations, initially. The model shown in Figure 3 above does, indeed, reflect the need for these components. The model, as presented above, shows the level of coupling needed between the academic and industrial components, through collaboration, provisioning of trained/skilled workforce, industrial feedback, etc.

The model shows that for a developing country to be a stakeholder in any Hi-Tech industry, *viz., Software, Electronics, Computers, etc.,* and to sustain itself in the face of international competition, would require that the concerned country, also, develop some form of core industry that would serve its immediate needs and, possibly, the needs of the immediately neighboring markets. For example, if country *x* desires to develop a software industry, in anticipation of some global market share, then it might also want to consider having other associated industries (Core Industries like engine industries, agricultural machinery, electric generators, etc) that would, naturally, absorb part of the work products from its projected software industry. This would ultimately provide the indigenous Hi-Tech producing industries the relief needed in the face of international competition, since international competition would initially step in as a significant limiting factor on exports of globally unproven industrial work products. The model also requires the existence of in-house R&D of the associated industries which would be directly linked up to ongoing research efforts at academic institutions. This, in turn, requires direct industrial-academic collaboration through industrial funding of industry-grade research at academic institutions who would-be stakeholders in the whole process.

In the model, there is a significant component that is usually missing, altogether, in the strategic planning of any given country in the developing world, *viz.* the Intellectual Property (IP) component [3]. An IP component is an integral part of any industrial framework to be successful, for without IP rights many researchers and industrialists would automatically refrain from putting out work products on the market without the legislative framework that would protect them against patent, copyright, trademark, and other intellectual infringements. It would also hinder efforts to bring in potential foreign investors via Foreign Direct Investment (FDI) or lure multi-national firms to set up manufacturing facilities in the countries affected.

Since in third world countries possibilities for uneducated workforce still exist, the proposed model also calls for some form of industrial training to those people who did not have a chance to go through schooling, and hence ended up illiterate, by choice or due to hardly pressing economic circumstances, to create possibilities for them to be part of any industrial development process/es.

In the following sections we discuss the roles of various entities involved; government, universities, industry, etc., in the overall developmental process, as shown in Figure 3.

III. **How can the role of universities be like towards improving industry-related education?**

The role of an academic entity towards improving educational outcomes under a particular discipline usually takes an early start in the process; in particular, its role starts right about the stage of admitting the student into his/her desired program of study. Universities usually admit students into their programs of study based on their achievement in the final year of high school. Countries that have fully developed educational systems confidently rely on the student achievements in the high school achievement tests, or equivalents thereof. In less developed or developing countries, the High School (or secondary school) achievement tests do not usually truly reflect the actual potentials for student candidacy to gain admission in a university system. As such, countries like these could possibly resort to international assessment and evaluation bodies to gauge student potentials, capabilities, and suitability for admission into a university system. Even in well developed nations like the United States you would find students undergoing assessment procedures through recognized testing bodies like ETS; the Standard Aptitude Test (SAT) is one of the instruments US academic institutions rely on for admitting students into educational systems at the tertiary level. However, in a number of cases internationally recognized/standardized testing processes might not rightly be well suited for countries whose languages of instruction are different from that of the assessing bodies. For these reasons, amongst others, countries like these have lived with their own methods of assessing students for university entry. In time, assessment processes like these tend to become obsolete and do not serve the purpose for lack of a proper review and system update due to the limited resources of the underpinning economies of these countries.

Therefore, one can readily envision the necessity for universities to design other alternatives to assess students entering the various disciplines for undergraduate study. Although such tactics are not in

widespread use by universities, one tends to find a limited number of academic institutions applying such procedures on select fields of study, such as law and medicine. On the other hand, academic institutions which have standardized entry tests into all fields of study, have also instituted preparatory programs of study which some call "Readiness Programs" [4, 5, 6]. Based on the result of a student's performance on a university entry exam, the student is required to undergo a preparatory phase to tackle the areas in which the student exhibited certain deficiencies.

Any preparatory, or readiness, phase fostered by an academic institution is commonly designed to treat the student weaknesses and, in certain cases, bridge the gap between a K – 12 educational system and the tertiary one. Universities which foster such readiness programs usually charge their administration to colleges of Arts and Sciences. Without a dedicated readiness phase to re-tool newly admitted students, colleges of Arts & Science have been observed in a number of cases to have done quite a sluggish job at preparing students for their major fields of study of which engineering and IT are areas of concern. Due to the large number of students who have to be serviced by colleges of Arts & Science, colleges like these find themselves in a rather awkward position in the ways they use to prepare students for later stages of the academic process, due to limited resource and budgetary constraints.

Historically, colleges of Arts and Science have been the entities responsible for delivering General Education (GE) packages to students before they are ready to join their desired college majors. As such these colleges have had upon their shoulders the charge of preparing students for their respective majors. It is noted, as of late, however, that at a number of universities in developing countries colleges of Arts and Science are doing a rather poor job in preparing students in fields like Mathematics, Physics, and other basic sciences that are readily applicable in other major disciplines; this is due, in part, to a lack of a proper review mechanism that would sufficiently address the needs of college majors against what is being offered in the GE courses. This means that colleges of Arts and Science are not apace with the ongoing progress in areas of applied science and technology. Should this phenomenon continue unresolved, it would directly impact, in an adverse way, student preparations for their college majors. This issue is best addressed with the institution of the proper review mechanisms that would allow college majors like engineering and Information Technology to clearly outline their specific needs in the areas of GE, which, in turn, would dictate that colleges of Arts and Science tweak their curricula to better meet the standing demands.

Furthermore, colleges of Arts and Science have it upon their shoulders to re-tool those students who got admitted with a lower High School average to accommodate certain social pressures, or those students coming from under-served schools, or students admitted into the university from an Arts stream into academic areas of science-oriented majors, by providing the needed bridging to allow students with certain academic deficiencies to cope up with their newly introduced environments. This naturally falls under the realm of a readiness phase, which requires the student to spend up to one year taking preparatory courses in English, Mathematics, Physics, Biology, etc. Without such a preparatory phase, private universities and even state-owned institution running "parallel programs"[1] will continue to have to suffer the consequences of having to accommodate poor student performance by inflating their grades [4, 6, 7]. This will have the grave consequence that the end product of the process will not be job worthy!

A recent assessment conducted in an Arab country reflected precisely just this fact! In January 2006, Jordan for the first time instituted the requirement that no university student would be eligible for graduation from their majors before undergoing what is now termed the "University Achievement Exam" [7]. Results of the exam were staggering; while Jordan is considered as one of the leading countries in engineering education in the Middle East with graduates who usually compete well for jobs locally and regionally, the arithmetic average for students who sat this ETS exam for the first time in any Arab country were only in the 50% range! This would automatically mean that an all out review of academic curricula, in engineering and Information Technology in particular, taught at universities throughout the Arab world is in order.

The issue of student preparedness for graduation from engineering and IT colleges is further complicated by the lack of students for the much needed soft skills by the job market! Interviews conducted with a number of employers in the private sector have confirmed that these businesses would have to invest some significant budgets towards building the soft skills without which engineering and IT graduates would not

[1] Some state-owned institutions around Arab countries are running what they term "Parallel Programs" or "International Programs", which are essentially business generating operations within the realm of these state-owned institutions. Disadvantages of programs like these entail allowing high school graduates with grades lower than the required minimum by a university system to gain entry at institutions of higher learning; a possibility not otherwise permitted.

attain much success in their professional careers. This demonstrated weakness on the side of the soft skills has its roots naturally embedded in the poor design of the curricula of the college majors. While ABET emphasizes that a certain percentage of a curricular offering must contain 14 – 24% of courses that would broaden the student knowledge in areas other than their technical domains of expertise, you tend to see a great many number of universities in the developing world allocating less than 4% to this side of the knowledge domains. Furthermore, engineering and IT colleges at universities in the developing world are not placing sufficient emphasis on technical writing and the development of the student presentation skills, and, as such, engineering and IT graduates are not well prepared to compete globally.

Major colleges, in general, and Engineering and IT colleges, in particular, ought to review their curricula, and while they do, re-design them to incorporate into courses materials that would enhance students' soft skills to bring them to a level where they can compete globally upon graduation. Universities which have already adopted compulsory readiness programs would now need to tweak their readiness plans to initiate certain measures to fulfill certain soft skills building standards for later stages of a student's academic career.

Finally, universities ought to bring about some level of flexibility and malleability in their curricular planning by allowing room for an ongoing review process of their various curricula to keep them up-to-date with the rapidly changing market directions, and, where possible, use feedback from the market and/or conduct periodic market surveys locally, regionally and globally, and incorporate the results of their findings towards re-designing their curricula to stay abreast with the rapidly changing market needs.

3.1 **Why is academic accreditation important?**

Consistency in the performance of an academic system is jeopardized in the absence of a standardized, uniformly applied assessment procedure. In the presence of a standard assessment and evaluation process, while allowing periodic reviews, an academic system is bound to be kept in unison with the market needs, and maintained up to date with known academic standards and procedures.

ABET, IS97, IS2000, Middle States, IEEE, in the US, and IET, IEE, in the UK, amongst other accreditation bodies, for various academic disciplines [4-9], have laid out policies and standards for accreditation of the academic discipline under consideration. They originally started out with operations confined to the continental United States and the United Kingdom; later on, these bodies allowed their operations to expand to other parts of the world, to help other countries develop academic systems according to known standards and specifications.

IEE is one body of accreditation, but confined to Electrical Engineering, for academic departments in the United Kingdom; they, too, have expanded their domain of operations to other countries. While an academic system in one part of the world might satisfy accreditation requirements by one accreditation body, they fail to do so under another. This is due to the diversity of ways academic entities are administered across countries around the world.

In third world and developing countries, you rarely find academic entities who can readily meet any international accreditation standard for inherent limitations of their own. For these reasons, amongst others, a number of developing countries, in their efforts to attain some minimum standards with their academic systems and preserve their integrity, have developed accreditation bodies of their own, and/or have instituted some assessment and review processes to measure the educational outcomes of their own academic institutions. Jordan, being a developing country with limited financial resources, has instituted an accreditation body of its own, and refers to it as the "University Accreditation Council" [7]. This local accreditation body operates in pretty much similar ways to their peer organizations around the world by conducting periodic reviews of curricula in the various academic disciplines, assessing the faculty-to-student ratios, reviewing allowable institutional capacity in terms of number of students and equipment that they must avail for student use, etc. Furthermore, and due to the multitude of universities, both private and State-owned, Jordan has, also, come forward with the requirement that university graduates, including, of course, those of engineering and IT colleges, sit for what is referred to as the "University Achievement Exam". This exam is administered by the Educational Testing Services (ETS) in the United States in coordination with Jordan's Ministry of Higher Education and Scientific Research. These two assessment processes are now helping Jordan to properly review the educational outcomes of its academic institutions, and steer the academic models of the diversity of academic institutions to meet a bare minimum of global academic standards.

IEEE, as of late, has, in fact, started out programs [10] that would guide members in its sections/chapters worldwide to set up local accreditation bodies that would provide the type of accreditation to academic institutions in a manner that would suite the particular markets and cultures involved, while preserving the integrity of an academic process according to acceptable standards.

Additionally, and due to globalization, today's engineer is expected to be skilled and experienced enough to operate under a variety of environments. Due to the breadth of a growing job market around the world, engineering/IT graduates need to be equipped with the type of technical expertise and global awareness that would grant them a footstep into any job market with little adjustment, if any, where needed [4, 5, 8]. It is for reasons like this one, in addition to others dealing with the level of technical expertise an engineering/IT graduate acquires during his/her years of academic study, that academic accreditation is essential to preserve the integrity of both the academic entity as well as the graduate it sets out.

IV. **Why is the role of the industry and other external entities so important?**

In the industrial world, industry and academia have traditionally been closely intertwined; industry has had a marked presence in areas of significant academic concentrations, where academia always contributed their much needed consultation and R&D services. To receive solutions from the academic sector, industrialists were always supportive of academic research efforts through direct funding, or by supporting lab facilities and equipment to researchers.

Today, no industry can survive without R&D, which cannot be separated from ongoing research efforts at academic institutions. For that reason, you tend to find huge industrial parks clustered around major academic concentrations. In the United States, for instance, Research Triangle Park in North Carolina and Silicon Valley in California are living examples of the close coupling between the academic and industrial sectors. Here researchers from the academia can receive funding from the industry for their projects, and people who are affiliated with R&D departments around industries find it quite handy to collaborate with academic researchers. Moreover, universities nowadays rely heavily on industries for entertaining their interns.

Job markets anywhere around the world are governed primarily by the needs of the industrial and service sectors. Hence, in well developed academic programs, the various curricula are usually geared towards fulfilling the needs of these sectors. As industries evolve, academic institutions continually go about curricular reviews using feedback coming in from the industries involved. This serves both ends of the spectrum: fresh university graduates are better suited for the prevailing market needs and better prepared to readily be productive on the job; and industries no longer need to allocate significant budgets to train these new university graduates.

In the less developed world, and in their efforts to encourage links with the industrial sector, universities have gone about hosting industries right within their premises in the form of industrial (or research) incubators. These incubators are used to both train potential graduates in certain disciplines and for conducting joint research of immediate benefit to the participating industry [7]. In the Arab world, Jordan is one country that has started doing just that; at Yarmouk University, for instance, research incubators have now existed for around a decade; Jordan University of Science & Technology is now hosting a handful of industrial incubators for similar purposes. On the other hand, evolving service industries are now sponsoring labs and research facilities on university premises; Fastlink, Jordan's largest cellular service provider has already established two research/training labs at both University of Jordan and Jordan University of Science & Technology. In many Arab countries, which have realized the importance of linkage between academia and industry, you tend to find serious efforts, in many forms, taking place to create links between the two. However, and mainly due to the still evolving nature and the disorientation in the industrial sector itself, you tend to find many of these efforts bearing little fruits, if any, or even not going to completion altogether.

On another front, some Arab governments have taken it upon their shoulders to create schemas that would encourage potential university graduates to conduct research projects that readily serve the needs of the local industry or the public sector itself. Under such schemas, students with their capstone supervisor come forward with a proposal to work on a particular project of interest to some local industry partner, which once approved, funding is granted and work on the project commences; Jordan is one Arab country which has come up with exactly one such schema under the Umbrellas of King Abdullah II Design and Development Bureau (KADDB) and King Abdullah II Fund for Development (KAFD).

4.1 The role of Multinational Firms at fostering development in Third World Nations:

The experience observed in India serves one of the most striking and living examples of industrial-academic partnerships, where multinational firms have contributed to the advancement of academy. India also provides another example of academic-academic partnerships and cooperation. The University of Illinois at Urbana-Champaign launched a program in 1958 aimed at establishing strong educational and research institutions in India. The outcome of the cooperation resulted in several Institutions of Technology in India ranking among the best in education and research worldwide. In the meantime, prominent corporations such as Motorola, Lucent/Bell-Labs, Microsoft, SUN, Intel and many others have established industrial parks in India as well as research and development centers closely associated with technical institutes. Today, India is one of the largest suppliers of graduate students to top universities in the US.

Research and development centers at university campuses allow both faculty and students to interact with state-of-the-art projects and enrich their academic experience with real world applications.

Recently, Jordan University of Science and Technology, and Yarmouk University embarked on a program of collaboration with SUN Microsystems in the USA. As a result, SUN inaugurated a joint center of excellence for both universities. The center serves the purpose of establishing strong participation between the giant server company and the academic body of students and faculty. The center allows students and faculty to take part in real world projects, which the company undertakes in the areas of reliable computing and architecture.

Another example of fostering education by industry is a program initially designed by Motorola Inc. to promote education in the areas of reliable computing and high availability systems. The company noted that the academic sector at large does not provide enough education in the areas of reliability and high availability until later stages into graduate programs. Motorola University and several academic personnel participated in developing special programs geared at building skills in reliable computing. The program was aimed at universities both in developing countries as well as in the US. The program is still, being tested in several places around the US. The outcome is the ability to graduate engineers who can plug into certain areas deemed necessary for the industry. One of the obstacles of applying such programs in third world countries is the lack of sufficient flexibility in curricular reforms. Academic institutions such as Carnegie Mellon or Stanford University have much greater flexibility in adopting new programs than universities in Jordan or Egypt, for example. One main reason has to do with available resources. Another reason is the bureaucracy which quite often renders changes in academic programs a slow process, such that the benefit of the program loses value over time. Another issue is that academic institutions in third world countries continue to live under the pressure of accreditation, and thus prefer to live with programs that have already been established and accredited. As such, the trial of programs as pilot projects can become an accreditation bottleneck.

The impact of industry on the overall progress of academia cannot be overemphasized. In order to fully utilize this opportunity, several factors have to be taken into consideration:

1. Academic systems can sometimes fall prey to excessive procedures falling under the realm of administrative bureaucracies. Any level of bureaucracy exercised in any form, and at any level within an academic domain is quite sufficient to render it ineffective and prone to eminent failures. Collaborative links between academia and industry require sufficient flexibility that would not put obstacles in the ways of progress of any collaborative measures. Competition amongst academic constituents often times manifests itself in the form of artificial bureaucracy. Any persisting collaboration between the two sectors should neither be entrusted with those who have personal stake/agendas in the matter, nor put in the hands of those who would extenuate the more qualified ones from the process altogether. One way to simplify the process of interaction between academia and industry is to create a high level office dedicated for this issue. The office should be run by personnel with high level of industrial experience.
2. In the developed world, industrial-academic collaboration takes place between parties who are equal. As such, universities in the Western world possess a minimum level of built infrastructure upon which any collaborative efforts with the industry

can rest solidly. In the developing world, however, the level of infrastructure within academic institutions that would uphold any level of collaboration with the industry is either insufficient or missing altogether. As such, collaborative measures, in developing countries, between academia and industry have it as requirement that some third party sits in with some level of much needed funding.

3. Commitment at the level of the people/teams involved is of paramount importance, for without this personal/team commitment any type of collaboration between academic institutions with the industry is bound to fail. In the developed world, such collaborative processes usually take championships at both ends of the treaty to exist. As such, each participating party would appoint some committed champion to take part in the process and lead such schema to eventual success. In the developing world, however, collaboration schemas like these usually lead to competition amongst the constituents, which often times, leads to eventual failure of the overall process. Here, one can attribute the witnessed failures in establishing any supporting industrial collaboration with the academia to this factor alone, being the absence of personal or team commitment. To go about inducing the needed changes in the attitudes of the constituents on this issue usually takes a significant cultural revolution in the way a given society conducts itself. In the Arab world, for instance, this particular venue would require a lot of dedication on the parts of societies and governments to alter the ways individuals and groups have long found themselves into.
4. Finally, academic institutions in third world countries, e.g. the Arab world, quite often fall dependent on the prevailing political/economic system. The much needed reforms in political/economic systems have adversely impacted the progress and development of academic institutions. Corruption, political instability, police and security-oriented governments, economic weakness, and human rights violations continue to impede the growth and prosperity of academic institutions. Performance and stability of academic institutions are not immune to influences in the surrounding political/economic environment, which end up impacting the quality of their graduates.

V. Conclusions and Recommendations:

Third world countries suffer some pronounced downturns both in the quality of tertiary education and the lack of industry-grade research at the academic institutions involved. This is usually augmented with the absence of any viable industrial-academic model that would bring forth some form of core industries to the incumbent economies of these countries. Situations like these have stood in the ways of any sustainable development in the economies of the countries involved; where, in many cases, countries were relying on export of natural resources to drive their economies forward, one tends to find very few of them developing any strategic planning to foster some form of an industrial core.

Research efforts were neither of the level required for supporting any local industry/ies, nor were they of the quality that would incite citation of the research work products. As such many universities within the realm of the developing world, now, lack the level of visibility that would allow them to compete globally. Here, it is well noted that without industry-grade research that would lead to real professional development of the faculty body involved, any teaching effort, conducted in ways of developing the learning abilities of the students involved, is bound to go off-track.

In this paper we addressed this issue from various perspectives, taking into account collaborative efforts that must avail themselves between the industrial and academic sectors, role of governments, R&D within the industrial sector itself, and assistance of outside parties, amongst many others. We presented a model which would set some practical niches for developing countries to conceptualize their own industrial infrastructure which would lead their economies towards sustainable development.

We strongly recommend for countries of the third world to move up the industrial ladder, while developing core industries of their own, which would ultimately open export markets to them, that they adopt the model proposed in this paper, or parts thereof. The versatility of this model allows it to be deployed in piecemeal fashion while lining up priorities appropriately, each country on its own, according to the national strategic planning and economic circumstances prevailing.

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