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Industry-Academia Partnership for Sustainable Development in Palestine

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Abstract

Signing cooperation agreements is considered as the first step in building industry-academia partnership, but it is not enough as far as they stay on paper. These partnership agreements have to enhance the economic prosperity, social equity, and environmental protection and global responsibilities, while solving the industrial technical and logistic problems. Cooperation may include carrying out scientific research activities and applying the results of these researches to solve real problems of industry. The current partnership situation in Palestine shows a weak cooperation, hence steps to improve the partnership are urgent. European experience of industry-academia partnership can be the base for developing similar programs and activities for Palestine and other developing countries. This paper discusses the existing status of industry-academia partnership with relevance to engineering education and the horizons of implementing new scenarios and strategies in developing countries particularly in Palestine. In order to close the gap between academia and industry it is suggested to implement curricula improvement by including sustainability concepts on one hand and improving teaching methods on the other hand.

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1. Introduction

1.1. Background

Mission of most universities includes teaching, research and community service. This mission would provide graduates with up to date knowledge, carry out applied and basic research for country and world benefit and finally serve the local/global community.

Engineers have the capability to balance the economic profit with the environmental and social benefits in their solutions. According to Accreditation Board of Engineering and Technology, ABET, program outcomes would include; using basic science and engineering science to solve problems, design of components and systems to meet needs, to understand the impact of engineering solutions in a global and societal context and ability to use the techniques, skills,

and modern engineering tools necessary for engineering practice[1].

Hence engineering programs aim to provide the knowledge, tools, experience to solve actual engineering problems subject to social, economic, and social constrains. Interaction with job market would provide the experience of solving problems in actual settings. Internship and training is one way of gaining this experience. Capstone and graduation projects would provide another opportunity of solving engineering problems in real life setting if the project involve real problem from local market. The exposure to jobs setting need to be built into the engineering curricula and should not be left to the interest of instructor and his own experience.

1.2. Status of higher education in Palestine

For Palestinian the education becomes as their visa for finding a job, improving their living standard and save them from poverty and refugee status. Students work hard in school

and university to earn their degree with the full support and encouragement of their families. In addition children education and earning university degree is a priority for Palestinian family spending [2]. According to Palestinian Bureau of statistics the unemployment rate in Gaza Strip increased from 38.5% in the 4th quarter 2013 to 40.8% in the 1st quarter 2014 while it was at the same level in the West Bank at 18.2% [3]. Palestinian Education Sector Strategy 2011-2013 built on the four core pillars: enrolment, quality of education, management, and linkage with the needs of the market and society [4]. Hence linking output of schools and universities to the need of local market and society is a priority of the Palestinian educational system.

The overall number of Palestinian graduates increased by 185% between the academic years 2003/2004 and 2011/2012[5]. Engineering programmes are the favourite choice of the Palestinian society; hence, engineering programmes along with health science attract the best students. In 2010/2011 11.2% of the students accepted in the universities in the bachelor programmes are accepted in engineering disciplines. On the graduation level 8.8% among bachelor degree university graduates are from engineering disciplines [6]. Figure 1 shows the increase in university graduates in Palestine for period 2003 to 2011 including engineering discipline. Higher unemployment or longer period of job search for university graduates including engineering, is mainly due to mismatch between the job market needs and the available qualifications of graduates [3, 7].

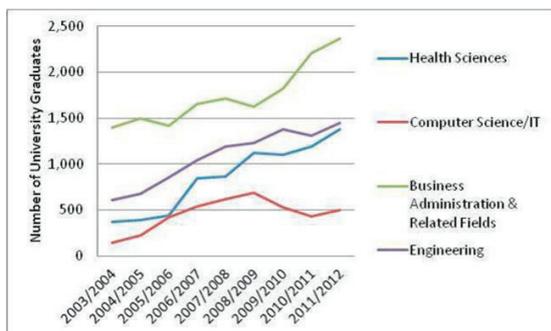


Fig. 1. Graduates from different bachelor programs[6]

Table 1 shows the registered engineers in Engineers Association in different specialization in Palestine. Civil engineers and then electrical engineers are the highest number while architectural engineers are the least.

Table 1. Registered engineer in Engineers Association, West Bank [6]

Engineering Specialization	2010	2011	As of June 2012
Civil	326	427	5,384
Architecture	142	109	2,077
Mechanical	233	199	2,343
Electrical	448	319	4,962

Engineering programs in Palestine are mostly based on the credit hour system. Bachelor degree requires a minimum of 160 credit hours and distributed into 5 year program. First year involves mostly basic science courses while basic engineering science is covered in the second year. Third, fourth and fifth year contain speciality courses. In addition engineering programs include general university requirement, faculty requirement and specialization requirement. Figure 2 shows a typical engineering program build up at Palestinian Universities. All engineering programs include practical training component 6 to 8 weeks usually in the summer. Capstone or final year project that normally is completed during the last year of study is viewed as an important part of the programs. Communication skills in Arabic and English are covered mostly through general university requirements.

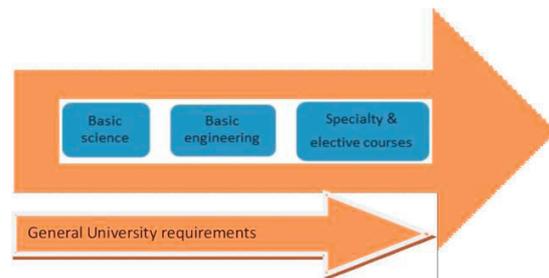


Fig. 2. Build-up of typical engineering programs.

All higher education programs including engineering have to be accredited by Palestinian Accreditation and Quality Assurance Commission, AQAC. Accreditation process requires providing market study and analysis for the new programs.

Figure 3 shows number of engineering programs in Palestinian universities. Programs include traditional engineering programs such as civil, electrical, and mechanical engineering in addition to modern and recent trend programs such as computer engineering, mechatronics, and automation.

Engineering curriculum at local universities contain good amount of lab and practical work. However because of difficulties imposed on importing lab equipment by Israeli occupation and adding to this the limited funding available for such equipment, some of labs and practical aspects are not covered properly in classes. Such situation assures the need for a stronger partnership between academia and industry in Palestine; this is to give student better opportunities to get hands-on experience in direct contact with the local industry.

According to MAS study [6] starting monthly salaries for all new engineering graduates begin at JD 420 = \$590. The overwhelming majority of engineers are graduates of local Palestinian universities (90%), followed by graduates of other Arab universities (7%) and the remainder receiving degrees from European and North American universities. Electrical and mechanical engineers are most likely to suffer in terms of job search, according to the Engineers Association, in many cases, waiting up to three years for employment in their field.

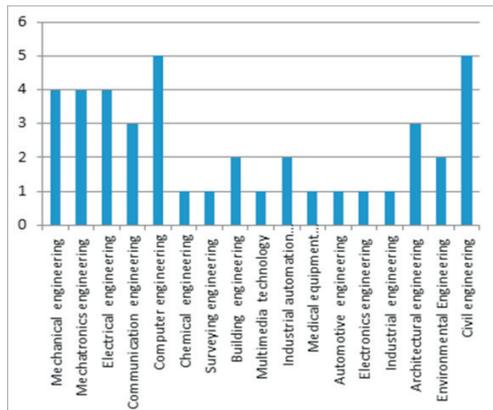


Fig. 3. Number of engineering programs at Palestinian universities

1.3. Status of Industry in Palestine

The Palestinian industry depends mainly on small and medium companies. Most of these companies are family business and based on personal small capital without implementing modern scientific and professional techniques in the administration processes. These companies suffer from weakness and shortage, even after the beginning of the Palestinian National Authority (PNA) in 1994, there was no significant improvements in the industrial sector. One of the main indicators on that is the flatness of exports and rate of employment.

The industrial sector in Palestine fluctuates rapidly due to several reasons. Restrictions and strict rules of the Israeli occupation are considered one of the main reasons besides to the lack of experience in technical and logistic operations. Other reasons can be summarized by the need to spread the culture of manufacturing instead of consuming. This can be partly the responsibility of the government which suffers from extreme poverty and disability to help the industry.

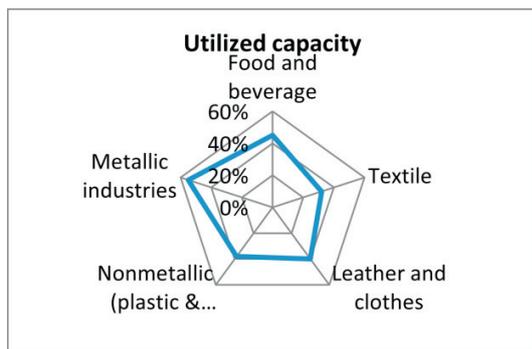


Fig. 4. Radar spider representation of the Utilized capacity of some Palestinian industries [8]

Figure 4 shows a comparison between the different industrial sectors in Palestine. The figure represents the percentage of active capacity of industrial sectors in the spider radar diagram.

The statistical data shown in Figure 4 prove that all Palestinian industrial sectors work with less than 50% of its real capacity which makes it difficult to create a successful industry without cooperating with the academic body in Palestine.

Table 2 depicts the contribution of the different economic sectors in the GDP and the employment in Palestine. This table proves that the construction and building sector has the highest contribution in the Palestinian economy [9].

Table 2: Percentage contributions of economic sectors to the GDP and employment in Palestine (Source: PCBS 2011) [9]

Sector	Contribution to GDP (%)	Contribution to employment (%)
ICT	6.3	1.6
Tourism	2.6	1.7
Energy & water	1.5	2.9
Light manufacturing	4.3	5.2
Agriculture	7	13.9
Construction & Building	22.1	16.3

The industrial sector in Palestine suffers from several problems. Lack of research development centers, shortage of skilled labor and dependence of the small and medium companies on the family business shape are considered main structural and management problems. Technical and financial problems can be summarized by having a bad infrastructure and high electricity and water expenses in addition to the shortage and high prices of raw materials. Restriction of movement by the Israeli check points is considered a main political problem accompanied by the weakness of the legal infrastructure of the Palestinian Authority. On the governmental level there is a deep shortage in investment incentives like tax exoneration and custom reductions. There is no unified system to govern and encourage small and medium size industrial sector and there is a lack of laws and rules that protect the rights of this sector.

2. Lessons Learned from Foreign and European Experience

The European experience is considered one of the main guidelines that can help in developing the industrial sector in Palestine. The major lessons that can be learned from this experience can be summarized in considering SMEs as part of a whole integrate system in which all companies are in complete cooperation. Regardless of the high competition between these companies, there is synchronization between their activities where the total production process is distributed between them and each company is responsible for part of this process. This reduces production time and allows big companies to benefit from these companies in an even distribution. Development policies and regulations are flexible

and dynamic where different coalitions are allowed and encouraged to strengthen the economic situation of these companies.

Governments in Europe and industrial countries are responsible for putting forward strategies and rules that aim at developing the industrial situation. Such strategies target the development and structural improvement of areas that suffer from slow rate of growth, training and rehabilitation of youth to create skilled labor, developing the skills of the existing labor to cope with the modern technologies. In addition to transferring technologies to improve competitive production, encouraging scientific and applied research. Also helping SMEs to enter new markets by improving their products, improving quality by providing technical and logistic consultations, and liberating the labor market for better employment.

In cooperation with partners from Europe and Middle East a workshop has been held in Berlin to discuss the business models of industry-academia partnership. Partnership best practices have been presented by each partner. Barriers and opportunities of industry-academia partnership have been discussed also. The following are some of the scenarios which have been highlighted by the group:

The first lesson learned from European experience is qualifying industrial PhDs. This qualification aims at training of young researchers for 4 to 5 years. These young researchers are aged up to 35 years; they have MSc and high average grade. The main objective of the program is to employ more researchers in the private sector and to increase industrial research group formation. Another objective is to link pure research with business needs that will foster innovation and research and increase competitiveness of enterprises. The business entity should be a single enterprise or a Technology Centre that is registered in the national Research and Development (R&D) base, it also should have at least 2 employees and have been working for at least two years.

The second lesson is establishing incubators for innovations. These incubators aim at connecting the academic and business spheres and marketing of research, thus facilitating the transfer of knowledge between industry and academia. These incubators hold workshops for “Enterprising Researchers” to facilitate the development of entrepreneurship among researchers and to offer early stage researcher an alternative path in their academic career. They also work in evaluation of business ideas and assistance in business plan writing (including workshops) and development of management skills for researchers and holding lectures on entrepreneurship and sale of technologies.

The third lesson is establishing a career center in each university. This center transfers knowledge from study to work practice, information on employment opportunities and to promote making contacts between promising students and their potential employers. Objectives of this career center can be summarized by advertising job vacancies and internships, publishing calls for industry scholarships, seminars and diploma theses, organizing visits of students to actual working environments and encouraging students to plan their career and helping students and graduates make a successful transition into the labor market.

The fourth lesson is urging the government to establish a technology park. This park is considered a leading entity and key national stakeholder in the development of knowledge based entrepreneurship. It includes companies and professionals in the following clusters: ICT, Cleaner production, Industrial Technologies, Life Science, Creative Industries, Automation & Production, Health, Medicine and New Materials. Potential members of this park are entrepreneurial groups with an innovative entrepreneurial idea. The full members include incubated innovative start-up companies. The associate members are the alumni companies and other rapidly growing innovative companies. The interested members are various service providers, R&D institutions and interest groups.

To improve the industrial sector in Palestine, the suggested solutions for this sector are:

- 1- Exchange experience and skills in the field of SMEs
- 2- Enlarging the basis of business investments in small industries
- 3- Supporting employments
- 4- Developing human resources
- 5- Encouraging Arabic and foreign investments
- 6- Implementing the standards of synergy and integration on most of the existing companies
- 7- Encouraging and supporting research activities related to these industries.

3. Proposed model for partnership

Figure 5 depicts a proposed model for industry-academia represented in integrated definition function schematic diagram. This figure shows that academia requires at least four inputs to fulfill the learning process from one side and the partnership with industry from the other side. Curriculum is considered the main input, courses and teaching plans should be prepared carefully to qualify graduates to be able to compete in the local market and worldwide. Moreover, the curriculum must take into account needs of the local market to contribute in its development. The second input are the students, these students are considered the core of the academic process where modern learning methods are student based learning techniques. University professors are no longer called teachers, they are called facilitators because their main job is to facilitate the searching and learning methods rather than lecturing. Other resources are required to support the academic institutes in their partnership with industry. Laboratories, ICT and technical facilities are considered significant part of these resources besides the necessity of libraries, books and search engines.

In order to establish a serious partnership between academia and industry, university must study carefully the needs of the market and feed it into its academic programmes and curriculum. These information help in building awareness of the necessity for a real cooperation that leads to social and economic development of the local society. Industry-academia partnership can take the following forms of activities:

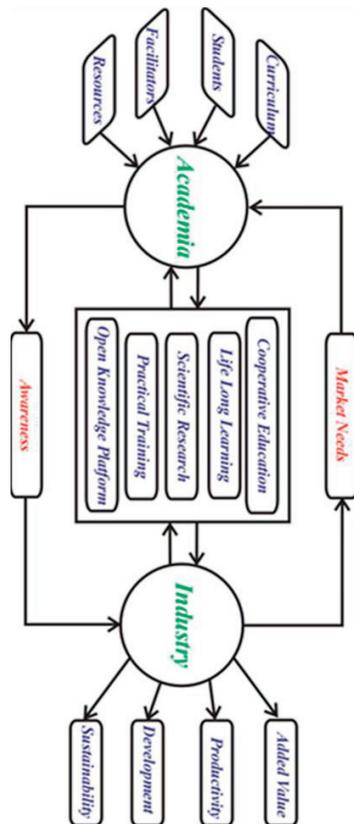


Fig. . Integrated definition model for industry-academia partnership

3.1. Cooperative education

Cooperative (CO-OP) education is considered one of the most important learning methods for Engineering, Information Technology and Business educational disciplines. CO-OP can be divided into two main techniques: In-class cooperative learning and in-market cooperative learning [10]. It helps students to share ideas and opinions, ask for reasoning, work in teams, encourage everyone to participate and energize groups. On the personal level, it leads students to learn monitoring, observing, intervening and processing [11]. In-market CO-OP learning aims at developing partnership with local market and industry and opening new opportunities for students and graduates in their future career and business. On the other hand, it helps in bridging the gap between theory and practice and qualifying students to be ready for work challenges from the first working day. It improves the level of education in Palestine and encourages students to continue their higher education in the region avoiding brain drain and leading to better development of their countries.

3.2. Lifelong Learning

Lifelong learning (LLL) is a very wide concept and has been defined by different people at different definitions

depending on the national context. It can hold the following definitions:

- Adult learning.
- Non-traditional students in a formal and informal environment.
- Supplementary (non-degree) study programmes.

The activities carried out under LLL can vary from part-time, distance, adult, mixed-mode, electronic and open learning.

Lifelong learning can be monitored either by HEIs or by topic providing private sector associations. Nevertheless, it is required from the governments to lay out rules and measures for the implementation of Lifelong learning in the frame of cooperation between higher education and industry [12]. In Palestine LLL contributes in educating and updating knowledge of engineers and technicians working in the local industry. This aims at providing these people with the state of the art about modern developments and innovations arise all over the world. In order to enhance LLL process it is necessary to make student, staff and technician mobility between Palestine and European countries. This mobility aims at transferring knowledge and know-how about recent developments.

3.3. Scientific research

Research is considered as one of the main building blocks used in the development of societies. This research requires a serious study of the requirements of local industry tackling practical problems in this industry to be solved. University professors must work together with their students on solving technical problems specified by the industry. Working on these problems requires deep knowledge of scientific theories and experimental processes to attach theory to practice.

3.4. Practical training

In practical and professional faculties every student needs to make a practical training after the fourth year of his study to fulfil the graduation requirements. Trainees are supervised by senior engineer working in the training company and followed up by a university professor from his faculty. A daily report should be written by the trainee, signed by the supervising engineer and submitted to the promoting university professor. This training qualifies the student for conducting the practical skills and tightens relations and cooperation between the university and industry.

3.5. Open knowledge platforms

Platforms for disseminating knowledge should be established and formed by people from universities and others from the industry. Each platform will handle the open distribution of knowledge in a specific topic. Forums, websites and social media can be used to build these platforms. The existence of these platforms contributes in increasing sustainability and improving resources efficiency in Palestine.

4. Industry-Academia Partnership opportunities

4.1. Curricula based partnership

Cooperative education requires the student to spend certain days, weeks, or semesters in a job position supervised by both academic teacher and industrial supervisor. Gained experience in the job position will be reflected in his learning in class at the university. Then student will bring real life and practical constrains in his engineering study specially in the design concepts. Project Based Learning (PBL) is considered as one of the suitable methods for engineering education. PBL is based on using practical projects on which students work in groups to implement scientific theories on real problems. Here, students are divided into groups where each group works on a specific project or problem to be solved. One of the major problems is to convince students to participate in these learning systems and to persuade their families that these learning techniques have high impact on their career. The other main problem is to find a way to integrate these methods in the teaching/learning process by evaluating the corresponding number of credit hours for the participating students. This also includes many problems of accreditation, since it is extremely difficult to convince ministries and official accreditation bodies in taking these new techniques into account. On the other hand, these techniques should be identified to the engineering syndicate to include them in the evaluation process. Once these modern learning methods are considered, there will be a need to involve the industry in the learning process by signing memorandum of understanding with them. Costs of learning can be even covered by industrial sponsors.

4.2. Structural Measures

Lifelong learning training courses can be considered a good solution on structural level. These courses can be prepared and trained by establishing Education and Training (ET) Centers in the higher education institutions. This ET center should be at strong relationship with other research and career centers to connect academia to industry and open future opportunities for graduates. Industrial companies can take the role of spin-off, where these companies take partnership with specialized labs and departments in research projects. The government has a major role here by its duty to establish new research and scientific parks [13]. The goal of these parks is to collect the industrial companies and connect them together to the academic institutions with research projects. These research projects should tackle specific local industrial problems and work on solving them in cooperation between academia and industry.

5. Conclusions

The foregoing study sheds the light on a very important problem facing industry and academia in Palestine. The problem is summarized by the gap existing between the two mentioned sectors. A brief study for the situation of Higher Education and related obstacles has been discussed showing

some statistical data and an overview of the different teaching/learning techniques followed in the different engineering education programs. The status of industry has also been discussed showing some data and problems that need to be solved. Some lessons learned from European and international experiences are depicted here for comparison purposes. To solve this problem and tighten relation between academia and industry, a proposed model has been suggested here. In this new model, the awareness and market needs feedback is used to create modern learning techniques capable of tightening the two sectors to each other.

Engineering main objective is solving real problems within real constrains. One of the constrainers is using available resources efficiently. Understanding the constrains and real life settings will be developed under strong industry – academia partnership and this will reflect on the solutions provided by engineering graduates to serve more sustainability. This can lead to improvements in sustainable development and significant increase in the added values. Finally, this partnership can have the opportunity to see the day light if it is applied on two tracks; the first track is based on curricula development while the second track is based on making modern structural measures.

References

- [1] Accreditation Board of Engineering and Technology ABET, Criteria for accrediting engineering programs 2013-2014. <http://www.abet.org>, retrieved July 14, 2014.
- [2] C. Fronk, R. L. Huntington, and B. A. Chadwick, Educational attitudes and trends in Palestine, Educational Studies, vol. 25, July 1999, pp. 217-243.
- [3] Palestinian Central Bureau of Statistics. Labour Force Survey (January – March, 2014) Round (Q1/2014). Press Report on the Labour Force Survey Results.
- [4] Ministry of Education, Education Sector and Cross-Sector Strategy “2011-2013”, January 10, 2010 Preliminary draft.
- [5] MOHE, Palestinian Higher Education Statistics, Ministry of Education and Higher Education, 2011.
- [6] Palestine Economic Policy Research Institute MAS. Employment Opportunities and Market Assessment for University Graduates in Palestine: The Relevance of HQSF Fields of Support, Ramallah 2012.
- [7] S. Abd-Elall, C. Reise, and G. Seliger, A dynamic model for matching job market qualifications demand and educational market qualifications supply, presented at the The 8th Global Conference on Sustainable Manufacturing, Abu Dhabi University, UAE, 2010.
- [8] Palestinian Federation of Industries, The current Status of Industrial Sector in Palestine, final report, USAID, April 2009.
- [9] Palestinian Central Bureau of Statistics, Contribution to GDP by economic activity in the Palestinian territory, 2011.
- [10] Smith, K. Cooperative Learning, University of Minnesota, <http://www.ce.umn.edu/~smith>, extracted 30/3/2013.
- [11] Southwest Consortium for improvement of Mathematics and Science teaching, Classroom Compass – Cooperative learning, Volume I, Number 2, 1994.
- [12] Adriana Jaramillo, Alan Ruby, FabriceHenard, and HafedhZaafrene, World Bank, Internationalization of Higher Education in MENA: Policy Issues Associated with Skills Formation and Mobility, Report No: 63762-MNA, 2013.
- [13] European Commission, Focus on Higher Education in Europe 2010, the Impact of Bologna Process, Eurydice, 2010.