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Improving Engineering Knowledge by Promoting Collaboration between Universities and International Companies in Developing Countries

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Abstract - *Several fields today are mainly dependent on cooperation among the different parties, and the education system one of these fields. Many agreements between local laboratories and local and international companies must be agreed. These agreements will be an initial stage in building corporation among the industrial community. However, these agreements should not remain on paper, and such partnership agreements should promote economic growth, social justice, protection of the environment and universal responsibilities during solving logistic and industry issues. Where in a country like Iraq which suffering from lack of job opportunities and the weakness of laboratories that lead to delay the education process. However, the partnership could include practical and scientific studies and then applying the research results in solving the real industry issues. This paper will discuss the effect of an industrial partnership with the importance of engineering education and expectations for the accomplishment of new strategies and scenarios in the developing countries and their applications in reducing the lack in the providing jobs for graduated students.*

Keywords *– engineering education, engineering outreach, developing countries, Collaboration.*
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1. Introduction

During the ninth century as it was the golden age of the Islamic Empire, Baghdad was becoming the Islamic world centre (Rodgers, 2008), and after the beginning of the Ottoman Empire in the sixteenth to the nineteenth century (Inalcik, 2013) until the State of Iraq was created at the end of the World War I and in spite all the conditions that Iraq was suffering from, successive Iraqi governments cared about improving the education system for different levels and for both genders. The Iraqi Republic has a strong educational tradition where the education is free for all citizens and in different levels (starting from primary education and until the postgraduate studies) as well as mandatory via the primary studying which is six years (UNICEF, 2017). It has been noticed that Iraq is committed to providing education for women and girls, which contribute to improving literacy to overall 80%. In addition to that, there are three main languages in Iraq instruction which are Arabic, English, and Kurdish wherein engineering and medicine colleges, English was used because of the spreading of this language worldwide and the availability and ease of reaching to an abundance of research papers. While Kurdish used as the main language in northern parts of Iraq (Kurdistan) and as a minor language in all educational levels in the other parts of Iraq (Wenger, 2016).

According to the (Worldometers.info., 2018), the Iraqi population increases by about 1,080,000 as an average yearly increment as shown in Fig. 1 which considered a very high rate in comparison with the total ground area of the country which about 434,320 Km^2. In addition, with the end of 2018, the whole population will be about 39,000,000 and that means additional resources required to cover the educational establishments. Therefore, because of the free educational system for different levels as mentioned by (Wenger, 2016) and with increasing the population rate that will put the Iraqi government under pressure to keep the free education system for the next generations. Moreover, the sharp price drop of crude oil and export

outcomes will reduce the development and the improvement of the education establishments (UNICEF, 2017).

The Ministry of Higher Education and Scientific Research accepted 127,474 students in the Iraqi universities for the academic year 2017/2018. In addition, the number of admissions in engineering colleges 8648 students in only Government colleges and the number will increase if we added the students of the private colleges. On the other hand, Recent statistics have shown that The Ministry of Higher Education and Scientific Research spent 350 million dollars in 2012 and 2013 for sending 10,000 students to study abroad in order to develop the educational system and gain research expertise which is not available in Iraq. Therefore, in order to improve the engineering educational system and reduce the expenses of this field, the local laboratories should be improved and have additional money resources such as international and local companies.

Engineers are usually able to strike a balance between economic profits and the environmental and social abstraction of their solutions. The use of basic engineering and science for solving problems and designing both systems and components to be suitable for the requirements and understanding of the impact of engineering solutions on the context of global and community and the ability of using modern technologies, skills and tools of engineering for the practicing of engineering (Rodgers, 2008). Therefore, engineering programs have been utilized in many applications that require more accurate and reliable solutions and to develop ideas for new products and their associated systems. Accordingly, they have been widely used in several trends that are subject to social, economic and social constraints. The cooperation between these programs and the labour market would provide a problem-solving experience in the actual settings without wasting a lot of time and cost. One of the major ways to gain this experience is by continues training on these programs. Moreover, the focus of recent research of the Engineering universities and labs has been on providing practical solutions for serious threatening engineering problems in real life (Hanieh et. al, 2015; Bachnak et. al, 2009).

Hanieh, et.al, (2015) studied the current conditions for the cooperation agreements between the industry and the universities in Palestine (which is one of the developing countries) and they found that most of these partnerships are just on papers and there is no real work on the reality. On the other hand, they found that if the two parties of the partnership have used the experimental work results in the reality that will have a great benefit for the engineering education, filling the gap between the educational system and the industry and improving sustainable concepts for education.

There are many examples of countries that applying initiatives supporting by providing a University-Industry link. The UK, for example, is one of these countries, which put strategies for innovation where many universities have become challenged to receive Funds. In order to support the research collaboratively, and to fund the research projects, about £60,000,000 were assigned in 1999 to fifty-seven universities. As well as the aim of this link is to transfer the knowledge between the partnerships where UK's premier technology-knowledge transfer program in order to help the young graduates by giving them high-level training. According to the (International Strategy Office, 2015) at the University of Oxford, the UK spends approximately £110,000 for each project, and 70% paid by the government while in the academic year 2004/2005, a total of £85,000,000 were spent by government and companies to support the education system.

Another country such as Canada (Innovation Foundation) established by the independent companies in 1997, for $ 3.65 billion, to fund the research infrastructure. The Foundation focuses on changing the way research is conducted by creating a strong and dynamic research environment across Canada. Attracting and retaining excellent researchers; enhancing research productivity, training highly qualified persons, and building new national and international networks and partnerships. On the other hand, funds up to 40% of project costs, in partnership with eligible institutions and their partners in public, private and voluntary funding. Depending on this equation, total invested capital will exceed $ 11 billion by 2010 (Kabir, 2014).

According to the American Universities, the partnership between the universities and industry has social advantages. The community benefits from research relations between universities and industry via innovating both technologies and products. In addition, the aim of the university research that sponsored by industry is to develop and improve the community by applying these practical applications into new medical devices, technologies, and therapies, develop energy supplement and innovating electrical and electronic devices such as laptops, DVD driver, computers. Partnerships between universities and industry may indirectly lead to the emergence of new industries in order to enrich the competitive advantage of the countries worldwide (Lutchen, 2018; Perkmann, 2012).

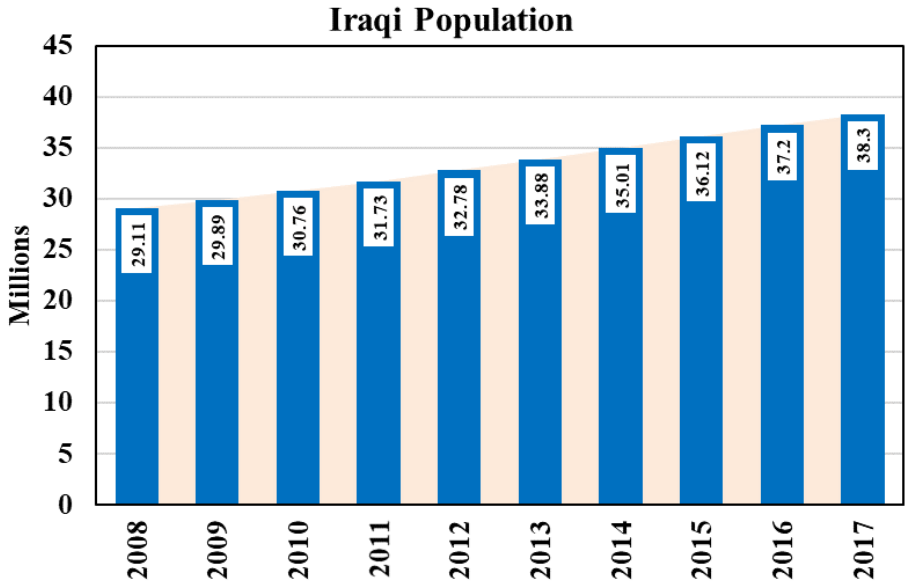

Figure 1. The Iraqi population's incensement (Worldometers.info, 2018)

2. Applying of Partnership

There are many measures that can be taken to achieve a partnership between the industrial sectors and the engineering faculties with their various specialties. For example, the government can support the partnership by organizing the entitlements of each party, as well as organizing working hours for workers under the terms of the agreement. On the other hand, universities can promote research that they can do to attract companies that want to benefit from their services. Promotion can be done in several ways through social media such as Facebook and LinkedIn or through ministries that can benefit from services (Lutchen, 2018).

3. Advantages of Partnerships

3.1 Personnel benefits

One of the benefits of cooperative work between establishments and universities is the complementary ways in which personnel can enrich the relationship. Therefore, if any university collaborated with a company has a strong software development skill, makes high-end computer hardware. Therefore, there will be many benefits from creating products with strong software and hardware components. Non-profit organizations can also advantage from cooperation by an increase in volunteers from the partner company (Daroń M., 2017).

3.2 Companies benefits

Cooperation between universities and industry can stimulate internal R & D (research and development) programs for companies. Where the researchers of University are helping the scientists of industry in order to recognize the existing research, which may be useful for designing and developing the processes of innovative and expected products. The first looking at this advanced research is opening the competitive way for companies to gain an edge for reducing the time required to move the expected productions from the lab to marketing, thus promoting international economic competition. As well as the relationship between universities and sponsoring companies also strengthens the company's reputation. Often, the researchers of both industry and university will write periodical articles explaining the results of research. The sharing publications are presenting a tool for generic relations between companies to improve their position (Dayaker and Bhaskara, 2017).

3.3 Solving local problems

Usually, the local site in all countries around the world facing many problems, or during the work the engineers and the workers found different issues that stopping the works, or could not complete the works without solving these problems. Thus, the partnership between the universities and the companies could provide practical solutions for these issues.

3.4 Solving local problems

In most developing countries, the laboratories of the universities suffering from lack of financial support, and the lack of good and modern equipment, tools and devices. Therefore, in order to continue their work efficiency, there should be a partnership with an external establishment to support these universities finically in order to develop the lab and bought the last technology development in each field. As a result of getting finial support from another sector away from the government such as international and local industries and companies that will reduce the government economic stress, and in the developing countries that will be very useful and effective.

3.5 Provide job opportunities

Most of higher education students (MSc and PhD students), after finishing their practical work at the laboratory they have enough knowledge to explain the experiments and the tests for other students or doing more research in their field of specific study. As well as most of those students cannot get immediately after finish their study, so in some universities that already have a University-industry partnership, those students will have higher opportunity to get a contract for one or two years to do some research that related to their specific field of study. On the other hand, providing jobs will help to increase the male students' enrollment in engineering college, as shown in Table 1, because all of them have previous knowledge that government will never give the engineers any job which leads to decrease the number of male students (Elmi, 2009; Becker, 2010).

Table 1. Enrolments in engineering and technical school by gender in Iran.

Academic year	Total (thousand)	Male (thousand)	Female (thousand)	Ratio (% of total) Male	Ratio (% of total) Female
1976/77	201	162	39	81	*19*
1986/87	207	161	46	78	*22*
1991/92	292	235	57	80	*20*
1996/97	80	60	20	75	*25*
2006/07	509	200	309	39	61

4. Disadvantages of Partnerships

4.1 One-sided effort

In spite of the benefits of research relations between universities and industry, there are a number of obvious flaws as well. Reflect several of these important normative problems related to the academic institution. Professor Norman Bowie, a professor of business and ethics, proposes that the university is "stuck between two of its binding interests" because of its relationship with corporate sponsors. Academic researchers are forced to search for research without considering their commercial benefits; to share results with peers so that they can be examined and verified, and to train future researchers of universities and industries. Universities must balance their relationships with industry to reflect traditional academic standards as well as industry standards.

4.2 The contract issues

The major Key points of the signed voucher between the universities and the third party (the donor) have created fears that the available supervisors are no longer able to choose a specific topic or to implement their own ideas in the research projects they supervise. If the industrial companies (as the major donors for the research projects) or the universities identify the research protocol, many social benefits will be ignored regardless their importance because resources will be restricted only for those activities that increase income.

4.3 Ownership Issues

Many ownership problems can arise between companies and universities that have a research partnership, leading to the development of formal relationships with corporate sponsoring universities through contracts that clearly state ownership of data, as well as interest in any products, developed from university and industry research. For example, some corporate contracts stipulate that university researchers can't share data or research materials with other academic scientists who ask for them. The company assumes that the research created by university researchers contains special information.

5. Conclusion

Research relations between universities and industry have existed in various forms since the 19th century. Existing partnerships are difficult and usually appearing to be threatened by both industrial and academic institutions through conflicting values and objectives. However, the institutions have established formal relations with the industry that mitigate some of the tensions that arise from these relationships. In order to develop the engineering education system, the universities must follow the international fellowship roles and specifications particular in preparing students to successfully work at the forefront of research and must continue to do so. The number of schools from which more and more graduates have graduated in recent years has contributed to meeting the growing need of the nation for advanced expertise in various non-research and research functions, and they may be very suitable for solving corporate problems in various fields.

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