Work Package 1

1.3 Engineering specialization courses and topics for shared learning in EG

1. University-School-Industry pairing models in USA and Egypt:

1.1 Objective

This task of the survey focuses on finding information regarding the different successful and unsuccessful models for university-school pairing.

It originally attempts for finding various industries worldwide to partner with engineering school and vocational school to streamline graduate competencies to align with the industry needs in Egypt & USA.

The outcome of this survey shall spotlight the advantages, disadvantages and the milestones of successful models and unsuccessful ones to avoid.

The focus of ASU and NU is to conduct a comprehensive survey on university-school-industry pairing models in Egypt and USA.

1.2 Results

We have been searching for pairing models between school, university and industry worldwide either in Egypt or in the United States. Unfortunately, we could not find such full pairing models. The search was carried out through regular google search and through communications with colleagues in Egypt and USA either from academia or industry. It seems to us that the pairing model proposed in this project is unique.
A less stringent pairing model exist between:

- vocational schools and industry (Dual education model)
- engineering schools and industry (internships and graduation projects in industry)
- Medical education
- Teachers education

1.3 Dual education

In Egypt, Mubarak Kohl Initiative – now called the Dual Education System is considered as one of the most successful intervention of active labor market programs (ALMPs) in Egypt. The Dual Education Program offers a unique type of education that includes on-the-job training. Students can learn, work and earn in addition to a guaranteed job opportunity upon graduation. The blue collar category is normally the poor people who suffer from a low social standard as well as low income. The Dual Education System mainly targets technical and vocational workers to promote their living standard. Technical and Vocational Education in Egypt occupies the least governmental attention in regards to its improvement and budget allocation. This thesis will give an overview on governmental expenditure on technical and vocational education in Egypt. Also, it will point out the importance of the Dual Education System initiative in promoting the vocational and technical professions in Egypt and providing better job opportunities for its graduates and how far this is actually accomplished in reality and the key behind the project's sustainability. It will also point out the main lessons to be learnt from the Dual Education System, how it can be replicated by other interventions and how the program is evolving in its current scale-up phase. It will also show why preparatory students join the Dual Education System although they do not intend to continue in technical and vocational jobs.

The adaptation of the German dual system to the Egyptian context was supported by German Federal Ministry for Economic Cooperation and Development through German technical cooperation (GTZ) in a partnership between Egypt's Ministry of Education and a newly emerging private sector created by economic reforms. The cooperation extended from 1994 to 2007. This review completed in 2010 uses a non-experimental approach to evaluate the MKI-DS. It examines program outcomes for students, employers, schools, and teachers. Interviews were conducted with a judgment sample of officials from MKI-DS schools, representatives of factories participating in the program, and officials responsible for the program in the Ministry of Education and private investor associations. Focus group discussions were held with employers, students, teachers and school officials.

The dual system required a consensus between schools and enterprises on standards and curriculum before government could approve a program. These principles were built into the MKI-DS along with the introduction of new institutions in the private sector that promoted the public-private partnership underpinning the MKI-DS.

1.4 Internships and graduation projects

Internships and graduation project has an important role in enriching the industry sector, as a lot of the internships offered from factories is regarding a real problem they faced in the

production process, some of these problem need an industrial solution and others need a technical solution.
Also it is not necessary to be a problem it may be an optimization process in used time or material.

In Egypt & USA, many companies offered internships for a specific duration (one week up to six months). A lot of these companies are multinational companies, they cooperate with student activities to construct a booth in the university campus to offer their programs.

On the other hand, engineering schools necessitate that the student spend some time in industry to gain practical experiences.

In USA, most engineering schools necessitate that the students spend an internship in industry. Summer internships are usually part of an engineering course curriculum. Through internships, engineering students gain knowledge from this practical training approach. Students that neglect summer internship are usually lack of training and desired skills that are required in the engineering profession. Most universities curriculum incorporates with summer internship with employers to provide a holistic engineering course. Summer internship usually last between five to ten weeks throughout the summer. Engineering students are able to gain insights about the industry and understand the latest engineering technology during their internship period. Besides that, students that perform well during their internship maybe offered a job placement by their employer once graduate.

Employers usually pay interns salary and provide allowance, when it is applicable. Engineering students will also learn more about their working environment and develop their leadership skills when working in a team. It is certainly true that through summer internships, engineering students are able to learn more from discussions, teamwork and research based work. They will work together with the professionals in the industry and this enhances their career pursuit.

Students gain a global working experience through summer internship with international companies. Besides working in a professional condition, internships will enrich engineering students' ideas and perspectives. They will be able to compete with the professionals and job demand once graduate with internship experience.

As securing a graduate job is difficult, employers prefer to hire students with internship experiences. Summer internship is an opportunity for students to gain valuable working experience. It also enhances their skills and knowledge to have an outstanding academic record. Engineering students with a summer internship experience have a greater chance for career and personal development.

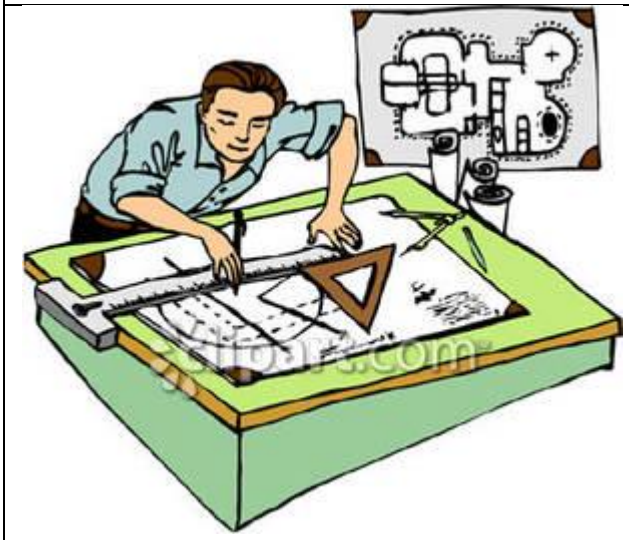
Some organization help to match students with specific qualities to internships with specific requirements. For example:

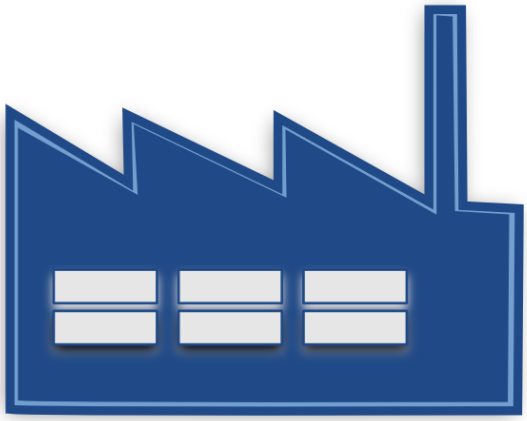
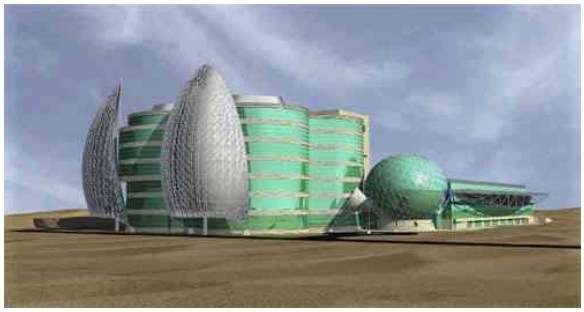
http://www.internships.com/engineering

1.5 Medical education

Since we could not find a full model for engineering-vocational-factory collaboration, we expanded our search to different domains other than that in technology and engineering in order to seek some guidance from other experiences,.

We found that some other domains have some pairing modules which can be considered as analogous to the proposed module. In medical schools for example, students of medical university schools as well as the students of nursing schools in their final years have to spend one academic year in hospitals. The analogy can be represented as in the following figure

Analogy	
 Engineering student	 Medical doctor student
 Vocational student	 Nurse student

	
Factory	Hospital

The medical schools model may be successful or not, but it can be regarded as analogous to the technology one and lessons can be extracted from it.

Some information about how the students spend this year can be found in the following links. Some of the links are in Arabic for the schools in Egypt:

http://yalemedicine.yale.edu/spring2010/features/capsule/50562/

http://www.tandfonline.com/doi/abs/10.1080/0142159X.2016.1270425?journalCode=imte20

http://scc.mans.eun.eg/facnur/arabic/ManagementDepts/honor.htm

http://www.svu.edu.eg/faculties/education/n11/news/36.html

http://www.svu.edu.eg/faculties/education/n11/news/35.html

http://un-uces.org/index.php/2013-05-05-06-55-03

It has to be mentioned here, that the apprenticeship year in medical schools has to be carefully studied because the feedback from students about this year is mostly negative. This can be seen in some of the previous links. The reasons why students find this experience as a negative one should be carefully studied in order to be avoided in this project.

1.6 Teachers education

Another model which can be considered as a pairing model is that of the There is a cooperation system among universities and schools in, this system is related with education, students of faculty of education in the 4th year have to attend training in school of preparatory stage, they

have to simulate the process of education overall, but regarding the level of industry there is no real cooperation among university and schools.

The analogy here is as follows:

Engineering student - Education student.

Vocational student – primary stage student.

Factory – Primary schools.

1.7 Conclusion

From the previous results, the following can be concluded:

- In Egypt and USA there is no university-school-industry pairing models as such.
- The proposed model is unique.
- Pairing exist between vocational schools and industry (dual education).
- Cooperation exists between engineering and industry (graduation projects/internships).
- Other pairing models exist in other domains such as medical and education.
- It is important to consider the negative points in these other models in order to avoid them in our project.

2. Project based learning approach in vocational industrial schools in Egypt

2.1 Objective

The main objective of the survey is focusing on project-based learning approach at different education level.

This shall include STEM schools as a pilot model to implement this approach globally.

In addition this will expand to cover vocational schools in EG.

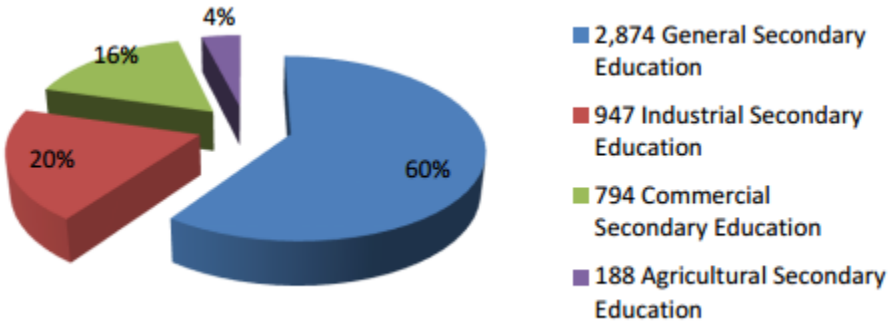
The outcome of this survey is illustrating the means and scope of and the feedback received from staff and students is to fine-tune the proposed model.

So we started a comprehensive survey on project-based learning approach in engineering and vocational schools.

2.2 Results

In Egypt, there are many types of vocational schools, some of them are electrical schools and others are manufacturing schools also regardless the engineering topics there are management and accounting, another discipline there is tourism schools.

A new model for which has recently evolved for vocational schools in Egypt is the STEM vocational schools.



STEM: it's abbreviation for science, Technology, Engineering and Mathematics in learning which reflects the curriculum integrated approach.

Choosing STEM students criteria:

- Students should get 294 of 300 at the end of preparatory stage.
- Student should gain full mark at least in 2 subjects from the following: (Math, English or Science.
- Never failed before during his school years.
- Pass the IQ test with high marks.
- Pass the interview with STEM committee.

The main objective of STEM schools was is looking towards the future, so these schools seek to ensure Egypt will have a fully engaged citizenry of inquisitive and determined young men and women well qualified to respond to the grand challenges facing our nation and our world.

Students' evaluation:

At vocational STEM schools they use the formative assessment for capstone Projects, attendance & class work participation. Also, they use summative assessment by the end of the school year.

Students at the last year of STEM school should pass the universities readiness test (URT) which is equal to ACT/SAT.

Here is a list of the vocational schools in Cairo:

الإدارة	اسم المدرسة	العنوان	التليفون	إجمالي عدد الطلاب
السيدة زينب	السيدة زينب الثانوية المهنية بنين	ش نادى زينهم	---	591
مصر القديمة	القاهرة الثانوية الصناعية بنات	متحف المنيل	3641563	148
حلوان	حلوان ث المهنية صناعة	العزبة البحرية ش 18 رقم 6	---	166
	فصول حلوان الميكانيكية	40ش إسماعيل كامل	5562912	162
	عين حلوان المهنية بنين	مساكن الزلزال	---	96
التبين	مايو الثانوية 15 الصناعية بنين	مجاورة 19- 15 مايو	5522654	95
البساتين ودار السلام	دار السلام الثانوية الصناعية مهني	ش مصر حلوان الزراعي	5241569	134
مدينة السلام	ف. الزخرفية بنات	مساكن الجمهورية بالسلام	2800419	230
	ف ث مهني بالسلام المعمارية	محمد متولي الشعراوي	2800640	89
	ف.الثانوية الصناعية المعدنية	ش العبور مجمع المدارس	---	52
	السلام الكهربية	مدينة السلام- مجمع المدارس	---	144
مصر الجديدة	السلحدار الصناعية (مهني)	80ش عمر بن الخطاب - ألماظة	4158004	65
شرق مدينة نصر	مدينة نصر الثانوية الصناعية الجديدة	1ش مقاتلي رمضان - م.نصر	6703843	99
المرج	المرج ث الصناعية بنين	ش المركز الاجتماعي	4380005	125
النزهة	أحمد عرابي الصناعية (مهني)	ش المدينة السكنية بالهاكستيب	6201534	25

The Suez school for petrochemicals technicians apply the stem methodology. Some information about the school can be found in this link.

2.3 Conclusion

- STEM is a project based learning has different approaches to assessment and it is focusing on high cognitive demand.
- There are a lot of vocational schools in Egypt which has many discipline not only related with engineering.
- The most one of the most important purposes of vocational schools is linking schools to universities, research institutes and IT industry.
- Vocational schools are distributed in all cities of Egypt but it's has many branches in Cairo.

3. Target manufacturing engineering courses:

3.1 Objective

The main objective of this task is focusing on different engineering courses with practical content that are candidate to implement the project-based learning approach to, and those that shall be part of the shared learning environment and interdisciplinary projects for manufacturing.

We planned to design a brief questionnaire about the manufacturing courses that are being taught in engineering faculties in Egypt then to send this template to staff members in different universities in Egypt.

3.2 The questionnaire template

Questionnaire to comprehensive survey on the practical content of the manufacturing engineering courses

Date: …….. University: ……

Person filling the questionnaire: …… Position: ……

Department: ……..
Email: ……..

1- What are the current courses?

2- What are the proposed courses do you prefer?

3- What are your recommendations for tuning the current courses?

4- How could we link the practical content with the theoretical content?

Thank you.

3.3 Filled questionnaires

Questionnaire to comprehensive survey on the practical content of the manufacturing engineering courses

Date: 17/1/2017 University: German university in Cairo

Person filling the questionnaire: Position: Teaching Assistant

Department: Design and production
Email: ahmadmajedashraf@gmail.com

1- What are the current courses?

Engineering Design 1 Engineering Design 2 Solidworks AutoCAD

2- What are the proposed courses do you prefer?

Engineering Design Mechanical Behavior of Materials Inventor

3- What are your recommendations for tuning the current courses?

What current course?!!
They need to be more project based

4- How could we link the practical content with the theoretical content?

By making a project-based course that will make them ask questions ... which will be answered if they've access to an online knowledge center that has videos and modules of the related topics on the internet.

Thank you.

Questionnaire to comprehensive survey on the practical content of the manufacturing engineering courses

Date: 15/01/2017 University: Ain Shams University

Person filling the questionnaire: Ahmed Hesham Abdulaziz Position: Teaching Assistant

Department: Design and Production Engineering
Email: ahesham@eng.asu.edu.eg

5- What are the current courses?

Mainstream program:
The current courses in mainstream program in ASU are:
1 Machine drawing
2 machine construction
3 manufacturing technology
4 Casting & welding
5 Machine Design
6 Theory of machine
7 theory of metal cutting
8 theory of metal forming
9 tool design
10 Die design
11 Measurements
12 machines of forming & machining

13 quality control
14 work study
15 stress analysis

6- What are the proposed courses do you prefer?

- Non Traditional Machining
- Finite Elements method

7- What are your recommendations for tuning the current courses?

- Compare between the current courses and the same courses in American and European universities.
- Preparing seminars in the courses to teach the advances in these courses.

8- How could we link the practical content with the theoretical content?

- Encouraging the industry to give practical training to the students by giving them some advantages such as reduction in taxes or free consultations from the university professors.

Thank you.

Questionnaire to comprehensive survey on the practical content of the manufacturing engineering courses

Date: ……15/1/2017…….. University: …German university in Cairo……

Person filling the questionnaire: Doaa Mohamed…… Position: …teaching assistant ……

Department: ……design & production engineering ……..
Email: ……eng.doaa_mohamed2015@yahoo.com……..

1- What are the current courses?

Facility planning Project management Design of experiments

2- What are the proposed courses do you prefer?

Quality control Operation management

3- What are your recommendations for tuning the current courses?

Using new software

4- How could we link the practical content with the theoretical content?

Visiting modern factories .

Thank you.

Questionnaire to comprehensive survey on the practical content of the manufacturing engineering courses

Date: 18/1/2017….. University: Ain Shams University

Person filling the questionnaire: Mohamed Mahmoud Position: Research Assistant

Department: Design and production engineering.
Email: mohamed.elkammash@eng.asu.edu.eg

1- What are the current courses?

The current courses in credit hour program are: 1 Manufacturing Technology (1). 2 Mechanical behavior and testing materials. 3 Mechanical engineering measurements. 4 Mechanical engineering drawing. 5 Mechanical design. 6 Modeling and numerical solutions. 7 Thermodynamics. 8 Electrical power engineering. 9 Fluid mechanics. 10 Metrology lab. 11 Stress analysis. 12 Mechanical vibrations. 13 Computer aided manufacturing. 14 Metal removal processes. 15 Metal forming processes.

2- What are the proposed courses do you prefer?

1 Mechatronics.
2 Design software.
3 Die Design.

3- What are your recommendations for tuning the current courses?

1 Linking the theory lecture with video explaining the application of the theory.
2 Removing the old theoretical contents that don't have applications.

4- How could we link the practical content with the theoretical content?

1 Increasing the lab sessions that allow for students to apply the theoretical content.
2 Organizing educational visits to the factories of multinational and local companies.

Thank you.

3.4 Conclusion

- There are about 20 course are being taught in engineering faculties,
- Some of them are theoretical contents and the others has practical topics which need a practical class like (Laboratory class, workshop class, etc)
- It was noticed that there are about 5 common courses are being taught in all engineering faculties.
- These common courses are:
  1- Machine design.
  2- Metal forming.
  3- Metal cutting.
  4- Material Engineering.
  5- Stress Analysis.

- The courses that have practical contents are:
  1- Manufacturing technology.
  2- Machine design.
  3- Engineering measurements.
  4- Materials Engineering.

4. Target mechatronics engineering courses:

4.1 Objective

The main objective of this task is focusing on different engineering courses with practical content that are candidate to implement the project-based learning approach to, and those that shall be part of the shared learning environment and interdisciplinary projects for mechatronics student at engineering schools and mechatronics/electrical students at vocational schools.

We planned to design a brief questionnaire about the mechatronics courses that are being taught in engineering faculties in Egypt then to send this template to staff members in different universities in Egypt.

4.2 The questionnaire responses

Responses to Questionnaire to comprehensive survey on the practical content of mechatronics engineering courses

The questionnaire of mechatronics engineering courses targeted students and teacher assistants who are involved in mechatronics studies, here is the courses that are being taught in Ain Shams university as an example of universities offering mechatronics program for undergraduate engineering students:

1- Mainstream System:
   1- Industrial Electronics & applications
   2- Electronic engineering
   3- Logic design
   4- Computer programming
   5- System's modelling & simulation
   6- Management & marketing
   7- Electronic circuits
   8- Computer organization
   9- Automatic control
   10- Mechatronics (1)
   11- Design of applied measurement system
   12- Project management
   13- Microprocessor based system
   14- Pneumatic & hydraulic control
   15- Robotics
   16- Numerical control machines
   17- Digital control

2- Credit System:
   1- Introduction to Nano- mechatronics.

2- Power electronics and drivers.
3- Electrical power engineering.
4- Waves electricity & magnetic fields.
5- Electrical circuit.
6- Electronic instrumentation.
7- Design of mechatronic systems.
8- Introduction to mechatronics.
9- Signals and systems.
10- Microcontrollers.
11- Embedded system design.
12- Engineering computation.
13- Linear Algebra and analytical geometry.
14- Differential equations & partial differential equation.
15- Computer programming.
16- Advanced computer programming.
17- Digital design.
18- Industrial robotics.
19- Digital design.

4.3 Conclusion

- There are about 20 course are being taught in engineering faculties,
- Some of them are theoretical contents and the others has practical topics which need a practical class like (Microprocessor based system, Pneumatic & hydraulic control, Robotics, etc.)

- The courses that have practical contents are:
    1- System's modelling & simulation
    2- Electronic circuits
    3- Mechatronics (1)
    4- Design of applied measurement system
    5- Microprocessor based system
    6- Pneumatic & hydraulic control
    7- Robotics
    8- Digital control