General Knowledge of Engineering Specializations

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Abstract: Iraq suffers from a great confusion between engineering disciplines at several levels among the decision-makers. This resulted from the great development in engineering sciences, which generated many overlaps between the engineering specializations and this problem leads to a bigger problem represented in the quality of the engineering product. This puts us in front of a goal which is the necessity to provide a general knowledge culture in the community that prevents them from mixing between engineering specialties, and to reach such a goal we need a logical analysis of the elements of the problem, as finding general knowledge of engineering specializations will reduce many engineering problems and in all stages of engineering work. Accordingly, this problem can be solved by educating several groups in society, including the citizen, the official and the engineer, in addition to academic disciplines other than engineering. Thus, engineering culture or general engineering knowledge is the basis for obtaining an engineering product of low cost and good quality.

Keywords. Knowledge, Engineering Specializations.

1. Introduction
Engineering sciences are considered one of the most branched sciences, and therefore one of the sciences that touch most human life. It is included in the construction, transportation, communications, and even medical fields, all under the heading of engineering. Therefore, the distinction between these disciplines is a problem most of the time, and therefore many problems occur in developing countries, including Iraq, due to the lack of knowledge in these disciplines, and this requires creating general engineering knowledge that reduces this problem.

2. Research problem
As a result of scientific development, we have overlapped in many engineering specializations, and this overlap has created confusion and problems for many people, especially in countries that do not adopt the exact specialization in the completion of their engineering projects.

3. Research objective
Establish knowledge rules that reduce the overlap in the engineering disciplines of people.

4. Research hypothesis
Having general engineering knowledge leads to reducing different engineering problems that occur during work.

5. Research methodology
The research will rely on the methodology of logical analysis to reach the goal of the research.

6. The basis of the problem
The basis of the problem is the person who rushes to decide to give an entire project or part of an engineering project with a specific specialization to an engineer with another specialization, and the ignorance of this person may cause this problem, or engineer who accepts engineering work with a specialization other than his specialty and in both cases the project will be less efficient or unusable. As the design and implementation of engineering projects cannot be done well without the presence of approved technical specifications at all stages of any project [1]. Therefore, the basis is ignorance and lack of engineering culture; in other words, to obtain a successful engineering project, engineering knowledge is required, see Figure 1.

![Figure 1. Engineering knowledge is the basis of a successful engineering project.](image)

7. Knowledge
There is no doubt that general knowledge is important for a person, expressing his personality and giving him much of what he needs in his various paths to his multiple goals, and he often complains about the weakness of public knowledge awareness. The lack of those interested in culture, and the insufficiency of initiatives in their way, so how did he authorize the engineering culture. In most life aspects, a person needs an engineering culture to understand the other and understand himself in his life with minimal losses. The more complicated the circumstances of life and the changes and the specialization of their requirements, the greater the need for engineering knowledge [2] as a culture today is no longer confined to art, poetry, novel, story, theater, etc., but has become more comprehensive and richer, in which all daily life practices and accumulations that reflect a person’s lifestyle and his outlook on life are included. So, we cannot search for concrete results of culture (knowledge) in our reality apart from absorbing the development and renewal of its concept and then looking at the foundations and rules. The other pivotal aspect contributing to cultural advancement is undoubtedly adopting precise cultural planning, based on a tight cultural policy, which relies on the concerned authorities and bodies to contribute to achieving cultural development as an inevitable outcome [3].

8. Engineering in the arabic language
The word (Engineering) (Hindasa) is derived from the Persian word (Andaz) meaning (measure or estimate), which was used (Ab Andaz) meaning (measure water) within water channels [4].

9. Engineering branches
There are many branches of engineering, which are continually increasing with the development of science. After engineering was limited to construction, it started entering the world of communications, transportation, environment, seas, medicine, and others. This has become everything that goes towards specialization in a future step. The trend towards accurate specialization may be for accuracy in diagnosis and treatment [5], facilitating the development process by reducing cost and increasing production accuracy. Here the overlap between the branches of engineering began in many
people who are far from the field of engineering, and even some who are engineers as a result of the lack of engineering knowledge. Consequently, this distancing and multiplicity in engineering branches generated a kind of overlap among the people between the fields of engineering branches, and it was easier for many people to the word engineering without tracking what follows it (such as water resources engineering or software engineering or others) and depending on a single word (engineering) to determine that (This person is an engineer). Therefore, according to the old perspective - he is “construction competence,” and here begins the problem. The issue comes down to the question: what do engineers share [6]? The answer is that engineering is involved in all life areas, such as agriculture, industry, medicine, etc. In addition to construction, this wide overlap created this confusion in distinguishing between branches of engineering. In general, engineering specializations can be divided according to their appearance and tangible impact on human life (Figure 2):

1- Near-impact engineering: It is engineering with a tangible, direct, close, and continuous relationship to human life. It is represented by the types of engineering specializations related to the physical construction of houses and buildings. Examples include architectural engineering, civil and electricity, etc. Where there may be an overlap between the specialization of architecture and civil engineering.

2- Far-impact engineering: It is engineering with a relationship with human life, but from afar, it may be close, but not continuous, and may be intangible, such as nuclear engineering, communications, agricultural and medical engineering, etc.

**Figure 2.** Engineering specializations according to their appearance and tangible impacts on human life. Source: Researchers

What interests us in this research is the first type of engineering (near-impact engineering) for several reasons:

1- Since this type of engineering work is close to human life in society, it is subject to many problems resulting from the overlap in engineering work by different specializations.

2- The second type of engineering does not have a direct relationship with human life, and therefore it is subject to the specialists - most of the time - and therefore, its problems are less than the first type

**10. General engineering knowledge**

The subject of engineering knowledge can be divided into two parts:

**10.1. The problem of engineering knowledge**

It is possible to know that the problem of engineering knowledge in Iraq is distributed on four main aspects:
10.2. The official principal
Whereas many people in charge of the government have little knowledge of engineering discipline, they also suffer from this problem.

10.3. The citizens
They are the most suffering from this problem as they are far from engineering specializations while they need it in the construction process and other works.

10.3.1. Other academic specializations. They have academic specializations other than engineering, as some of them fall into this problem because of their lack of engineering specialization knowledge.

10.3.2. The engineer. Most of the engineers themselves are not familiar with or have little knowledge of all engineering specialization due to the large number and diversity of these specializations.

10.4. Solving the problem of engineering knowledge
It is well known that engineers should take the initiative to spread engineering knowledge among citizens [7]. However, this problem is more than just defining the engineering specialization for citizens. We understood that this problem consists of four essential aspects, and they are

- The official principal.
- The citizen.
- Other academic specializations.
- The engineer.

A culture (knowledge) is a critical success factor for the success and growth of the business. Great engineering knowledge results in getting things done right [8]. Moreover, suppose we know that culture (knowledge) does not come by force but provides means to facilitate the education process [9]. In that case, we can set several steps that contribute to solving this problem by setting a general structure consisting of four axes to which the solution is directed. Which they are:

10.4.1. First / official principal axis. It is carried out through two methods:

1) Courses: The official principal can enter within simplified courses that show the branches of engineering and clarify the terms of reference for each branch.
2) Interviews with the engineers: Such interviews are essential because the engineer’s direct conversation will clearly show him how each specialty works. This engineer is proficient and has extensive knowledge of the different engineering specializations.
3) The consultant: It is necessary to have at least one consultant with the official principal to explain the difference between the engineering specializations.

10.4.2. Second / Citizen Axis. The citizen is considered the most affected (numerically) in this problem and the most exposed to this problem and therefore, an integrated program must be established to help raise this inconsistency in his engineering competencies, as follows:

1) Cultural centers: The lack of the presence of our cultural centers in Iraq in a substantial way has exacerbated this problem, as the existence of such centers contributes significantly to increasing the knowledge of society and all specializations.
2) The Municipal Council: The Municipal Council has a vital role in increasing awareness of society by holding seminars that concern the development of regions, and through these seminars, there will be direct contact with engineers through which the citizen can teach the difference between the engineering specializations, on the one hand. On the other hand, there are educational media – visual and audio – that the municipal council can spread among society to increase its knowledge in all specializations, including engineering.
3) School Curricula: The school curricula can significantly increase engineering knowledge by introducing students to some engineering branches and the rest of the disciplines to choose the profession they want in the future.

4) The media: The media have the most significant impact on educating the community, and therefore special programs must be developed to educate the community in the engineering departments. Media orientation is at three levels:
   A- Visible: Including television.
   B- Audio: including radio.
   C- Publications: It means billboards, magazines, newspapers, and posters.

10.4.3. Third/Axis of Non-Engineering Academic Specializations. As non-engineering specializations are often far from engineering and because of this, they are far from engineering specializations, and this knowledge of engineering specializations can be increased by:

   1) Joint symposia: seminars that include engineering specialization with non-engineering specializations are held, and therefore engineering specializations will be viewed through these symposia.

   2) Joint exhibitions: If they hold joint exhibitions between the engineering specialization and other specializations also contribute to familiarizing themselves with the engineering specializations and raising awareness in them.

10.4.4. Fourth / Engineer axis. The engineer himself is the problem, as many engineers do not have sufficient knowledge of all engineering specializations and the reason for this is the nature of work between these specializations. For example, a computer software engineer is familiar with the rest of the engineering specializations that have to do with the computer. However, it is far from engineering specializations of a structural nature, that is, dealing with building construction and vice versa and those related to medical devices or infrastructure, and so on. The engineer can be educated about the rest of the engineering specializations through several three methods:

   1) University curricula: Through the academic curricula given to the engineer during his studies, he can introduce the rest of the engineering specializations. Furthermore, the engineers must learn how to work effectively with one another, and from all corners, the call is being made to engineering schools to teach students how to interact in teams [10].

   2) Libraries: It means:
      A- Department’s Library: Usually, there is a library in every engineering department. This library can be provided with publications and literature showing the different engineering specializations.
      B- Central Library: It is also possible to provide the central library in the college or university with publications and literature showing the various engineering specializations. As well as the necessity for the engineering departments to request reports from students with the condition that they work in the department library and the central library; so that the student gets to know the titles of books in the library on the one hand, as well as how to search for books on the other hand.

   3) The increasing rapprochement between state institutions and universities: The rapprochement between state institutions in all of their branches and universities that study engineering contributes significantly to expanding knowledge of employees of these government institutions with engineering specializations on the one hand as well as engineering students ‘knowledge of the rest of the engineering specializations by defining the type of work required of students, which are determined by the governmental institution on the other hand, and thus the societal awareness of these specializations increases.

Convergence can be increased by:
   A- Developing summer training: Usually, students of the Engineering College are required to have a summer training, and that accepting engineering students in all state institutions of an engineering nature will contribute to the knowledge of those institutions with different
engineering specializations on the one hand, as well as students' knowledge of some other engineering branches through interviewing students of other engineering departments. They do summer training in the same government institution, on the other hand. Knowing that Iraqi engineering colleges require students for 60-day summer training as part of the requirements for obtaining a B.Sc. degree.

B- Representation of government institutions in engineering colleges: The opening of a center that represents all state institutions in every engineering university or college will contribute to strengthening the relationship between state institutions on the one hand and engineering specialties on the other hand by increasing interconnection and joint work, exhibitions, conferences and even inquiries by students to some governmental institutions.

10.5. Diagram of engineering knowledge

Based on the above, a diagram can be drawn that shows these branches that lead to solving the problem of engineering knowledge, as shown in Figure 3.

In the case of walking according to the figure above and the points discussed, we can reach general engineering knowledge, avoiding us from falling into many problems.

As an auxiliary component, closing the door to overlapping between engineering specialties and not to make mistakes during implementation is: giving sufficient time to make all the details that engineering projects need, because most of the delay that occurs with implementation is due to not giving sufficient time for the design to work in the required detailed form required [11]. This is because many engineering details will force the executing authority to seek the required engineering specialization and not allow overlapping in the engineering specialties even if there is a lack of knowledge of any party's engineering specialties related to the project.

![Figure 3. How to reach engineering knowledge. Source: Researchers](image)

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**Engineering knowledge**

- **Official principal**
  - Courses
  - Interviews with the engineers
  - Consultant

- **Citizen**
  - Cultural centers
  - Municipal Council
  - School curricula
  - The media

- **Other academic specialties**
  - Common symposia
  - Joint exhibitions
  - Department library
  - Central Library

- **Engineer**
  - University curricula
  - Libraries

- **Increasing rapprochement between state institutions and universities**
  - Developing summer training
  - Representation of government institutions in engineering colleges

- **Visible**
- **Audio**
- **Publications**
11. Conclusions
We conclude from all of the above that:
1- It is possible to increase societal knowledge regarding engineering specializations by setting a clear structure, and therefore the state sponsors this structure, which includes four main axes:
   - Axis / official principal.
   - Axis / citizen.
   - Axis / other academic specializations.
   - Axis/engineer.
2- It is challenging to get acquainted with all engineering specializations, but the issue of superficial knowledge and referring to the people of the specialty remains the best solution to not making mistakes resulting from this lack of knowledge.
3- Knowledge is the operating system for any engineering project.
4- A large number of details in engineering projects reduces the percentage of errors in the implementation.

12. Recommendations
We recommend some recommendations, as presented in the following:
1- Approving the proposed structure (Figure 3) in order to gain general engineering knowledge.
2- Encouraging more research in this area.
3- Examination of damages resulting from a lack of engineering knowledge.
4- Need to research far-impact engineering specializations.

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