

The Models of Engineering Education

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Abstract: The paper defines the position of higher technical education in the structure of higher education system in Poland. Basing on the analysis of the model of engineering assignments, the teaching strategies for future engineers in traditional educational system have been defined. Following the analysis of market demand, new trends involving the education of future engineers have been presented, where great emphasis is placed on the training on the management aspect.

Keywords: education, logical sequence of technical assignments, engineering tasks

Educational system in Poland gives opportunity of study at the following types of schools:

- Universities,
- Universities of Technology,
- Pedagogical High Schools,
- Agricultural High Schools,
- Academies of Economics,
- Academies of Medicine,
- Physical Education High School,
- Universities of Art.

We can presently notice a very distinctive segmentation-taking place in Polish higher education, which is based on “branch of sciences”. We have technical courses at technical universities. That segmentation is determining the activity of higher schools, where the principle distinctive feature involves the introduction of different syllabus.

The development of industry after so – called industrial revolution in 19th century, formed the model of technical university which still exists nowadays, formed its structure and syllabus. It also created a certain vision of a graduate whose basic criteria as far as quality of education is concerned was professionalism which was understood as a thorough knowledge of a certain part of technical field.

The model of engineering tasks could be presented on the basis of a concept of “a process of satisfying the needs” formed by the professor of our University J. Dietrich.

The entire enterprise leading to the possibility of using the product or technical means can be seen as a logical sequence of assignments, which include:

1. recognition of needs
2. designing
3. constructing or working out of technology
4. production
5. exploitation

The task sequences presented above highlight only basic, primary relationships between particular tasks, which combine elementary components of the needs, recognition process. However, during the manufacture of a product or technical means, there must be information feedback, which would ensure that we have influence on particular stages of the enterprise.

We must be aware of the fact that technical means occur in all phases of designing process. Yet at the stage of needs recognition, designing or consulting, the technical means exist as abstract element; in each of the following phases it occurs in more and more detailed form. The last and conclusive stage of the abstract existence of technical means or product exists as the record of the construction or worked out technology. In the forth phase, in the production process, the product assumes real shape, created on the basis of construction record or technological process. Obviously, the first model might not have features that we expect; therefore the feedback with previous phases is necessary to introduce due corrections.

The applicability and usefulness of a ready-made product can be tested in exploitation, where it is subjected to certain processes (wear or ageing). In the exploitation phase the influence exerted on the product or technical means should bring about its possibly longest utilization, which is connected with maintenance, adjustment, technical survey, overhauls and repairs of existing defects. Conclusions drawn from the exploitation process create grounds for innovation of the product or technical means, which establishes a strong connection between the first and fifth phases of the enterprise, and it instigates technical progress, which, in turn, leads to the manufacture of better, more reliable and cheaper products.

Thus engineering tasks could be divided into 3 groups:

- A. design – construction – technology tasks (points 1-3)
- B. production tasks (point 4)
- C. exploitation tasks (point 5)

Increasing complexity of engineering tasks results in considerable narrowing of engineering specialization. Therefore technical universities educate construction engineers (designers), engineers specializing in production and those who specialize in technical means exploitation.

The Silesian University of Technology is one of the biggest technical universities in Poland, where students are taught at 10 faculties and have the choice of 20 courses offering professional knowledge in practically all engineering branches.

Table 1. The register of faculties and disciplines

FACULTY	DISCIPLINES
ARCHITECTURE	ARCHITECTURE AND TOWN PLANNING
AUTOMATIC CONTROL, ELECTRONICS AND COMPUTER SCIENCE	AUTOMATION AND ROBOTICS ELECTRONICS AND TELECOMMUNICATIONS COMPUTER SCIENCE Macrodiscipline in English AUTOMATION AND ROBOTICS, ELECTRONICS AND TELECOMMUNICATIONS, COMPUTER SCIENCE
CIVIL ENGINEERING	CIVIL ENGINEERING
CHEMISTRY	CHEMICAL TECHNOLOGY CHEMICAL ENGINEERING AND APPARATUS MANAGEMENT AND PRODUCTION ENGINEERING
ELECTRICAL ENGINEERING	ELECTRICAL ENGINEERING ELECTRONICS AND TELECOMMUNICATIONS
MINING AND GEOLOGY	MINING AND GEOLOGY
POWER AND ENVIRONMENTAL ENGINEERING	ENVIRONMENTAL ENGINEERING MECHANICS AND MACHINE CONSTRUCTION
MATHEMATICS AND PHYSICS	TECHNICAL PHYSICS MATHEMATICS
MECHANICAL ENGINEERING	AUTOMATION AND ROBOTICS MECHANICS AND MACHINE CONSTRUCTION MANAGEMENT AND PRODUCTION ENGINEERING
MATERIALS SCIENCE, METALLURGY AND TRANSPORT	MATERIAL ENGINEERING METALLURGY TRANSPORTATION MANAGEMENT AND PRODUCTION ENGINEERING
ORGANIZATION AND MANAGEMENT	MANAGEMENT AND MARKETING MANAGEMENT AND PRODUCTION ENGINEERING
ENGINEERING EDUCATION CENTRE	CIVIL ENGINEERING ENVIRONMENTAL ENGINEERING MANAGEMENT AND MARKETING

Another result of the growing complexity of engineering tasks is employing large technical means and groups of people to solve them. Obviously it is necessary to manage and coordinate the tasks. So far the ability of managing in the area of technology has been resulting from individual predispositions, professional experience and intuition. Consequently, the natural selection has been the long lasting process, and achieving a top position has been possible for the elder candidates.

A big demand for specialists, with both engineering skills and managing abilities, has changed the image of an engineer's role in the process of production.

To meet the demand of the market, The Silesian University of Technology established a few years ago the Faculty of Business Administration and Management, the eleventh faculty. The new faculty introduced management problems into engineering studies, which modified typical engineering courses.

That is why at the majority of faculties of our University the course in Managing and Engineering Production has been introduced; where students apart from engineering education studies the most important elements of management:

- defining the strategies understood as a collection of aims which are criteria of decision making
- organizing structures which include managing activities
- realizing the following activities:
 - assignment planning
 - organizing and realizing assignments
 - motivating the employees
 - controlling the completion of assignments

The knowledge in the field of management gives the contemporary engineers additional possibilities as far as their activities are concerned and helps them to adapt the changes taking place in industry.

On the other hand the changes, which take place in the world also affect universities especially technical universities and stimulate and modify the process of engineering education.