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SUSTAINABILITY AND ENGINEERING EDUCATION

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Abstract

People, laics and professionals are taken by several effects in the globalization word. What can the social sciences do for the engineer-education, and how can these sciences help in the using of the skill? Who is the engineer, and what are its exercises? What can they do now, and what will able to do tomorrow, and what kind of social- (organism) background do they live for the sustainable development?
In how many lesson have per semester are the engineers educated in the university? (proxemic, psychology, environment–ergonomic, environment-sociology, technical-sociology,

ethic, technical-pedagogy and law, etc.) The integrated aspect of these sciences can be the basic of a modern engineer-pedagogy. The further goal its in the presentation introduce the result researches in the themas.

1. The Engineer and An Engineer's Work

1.1. The Hungarian word for 'engineer' ('mérnök') derives from 'mérés', i.e. 'measuring'. In the 17th and 18th centuries, people who dealt with measurements, related to military fortifications were called engineers. This was extended **to the regulation of rivers, the building of canals and dams, as well as to the drainage of marshes** in the following decades and century. **These constructions of engineers** still **form** a part of engineering studies. **The domains of activity** of today's engineers evolved actually during the industrial revolution. What constituted the active force of that were the changes in which simple cooperational manufactures were transformed into factories. In this period of industrialisation, **three basic functions of engineers evolved:**

- the planning, design and development of new products and technologies
- the organisation, preparation and supervision of production processes, as well as maintenance, and
- the preparation of decisions and managerial tasks

In what is called the **post-industrial period**, flexible production and the **system of networks** 'incorporated' also **the introduction of communication technologies**, the development and operation of flexible production and service systems (the combination of mass and piece production), as well as the handling of environmental problems among the activities of engineers. We are going to deal with the latter and its social-technical consequences in a separate chapter.

The presentation and teaching of technologies, the training and preparation of professionals and appliers on various levels deserve special attention on this forum. In educative societies, **engineers and engineer-teachers working for schools, firms and educational enterprises have a decisive role in the socialisation process** of technology.

Eventually, however the activities of engineers can also be divided into two groups today:

.a. The activities of the innovation process

- technical-economic planning, analysis, coordination, research, development, experimental work

.b. Operative activities:

- technical control, preparation of production, production management, preparation, technical information service

Who is an engineer or who are engineers and what is their activity? - is the question that we can ask. I think we can quote the following answer also as the summary of the above:

An engineer's work is the novel conceptual combination of the known elements of personal resources and dead work, as well as the novel application of partly scientific-technical, partly economic-organisational knowledge so that the material demands of society would be realised optimally in the given respect.[1]

1.2. The Social Environment of an Engineer

By way of introduction, I would like to remark that during their everyday work, engineers can perform their activity in numerous kinds of organizational **types**, in which they **must** learn **to become acquainted** with the organisation in the first place: the **organisational know-how**, which requies something else than the acquisition of technical sciences, and which forms the **subject of the sociological theory of organisations**.Other fields of study, such as organisational theory, organisation study, decision theory, the psychology of organisations etc. of course also deal with the theory of organisations, that is, engineers and students of engineering generally need the integrated outlook and knowledge of **social sciences**. We can say without a concrete presentation of the empirical data that these subjects/modules have been incorporated into the curriculum of engineering education at very few places. Manifest experience shows that **humane studies and social sciences** are pushed into the background beside **economic sciences**. (2)

Without going thoroughly into the sociology of organisations, we must mention the fact that the social environment of engineers is not restricted to the set of different organisational kinds/types, but, beyond that and within that, it has a bearing on many aspects of human relations, as well as social appreciation

Two basically determining organisational forms are important for engineers. Of course, there are countries where the **training of industrial and administrative (strategic/controlling) engineers** is separated not only in post-graduate, but also in graduate education.

One is the **industrial unit/firm/factory/company etc.** Here, the sociological features are provided by **the corporate hierarchy, the functions, as well as the formal and informal relations.** In the majority of industrial units, bureaucracy and hierarchy are dominant, but

'quality circles' (organisations of the Z type) already present communication and decision-making coming from below. (See the success of Japan.)

With what can we replace hierarchy? - this is the question that we can ask and it has been answered since the 1970s: **With new network models**, which can first be understood as a group of people, 'conversing' with one another, exchanging ideas, information and resources. **Besides the definition** of the sociologically approached concept, we of course **know technological systems with purely technical connections, such as energy supply (gas, electricity) networks.** Information can be acquired and made to stream more easily and the system is linked well in networks.

2. Object Culture, Technical Environment and Attitudes towards life

2.1. Built Environment - Urbanisation and Environment

In this chapter, we would like to demonstrate how the built environment, constituting the artificial world of man 'grew' through urbanisation to be not only the dominant kind of residence, but also one of the main causes of the environmental problems of civil societies. Our approach is centred on technology, however, we cannot separate the role of 'man as a social being', in his capacity as the one who urges development and growth and as the one who enjoys and consumes the achievements.

The birth of cities was a long historical process, at the beginning of which the following factors played a key role: soil of good quality and the development of agricultural production itself. Further key factors were the technical inventions that helped production, transportation and storage, such as the plough, transportation on wheels, irrigation, woodworks etc. The development of agricultural production resulted in surplus production, which lead to transportation (exchange) and it ultimately resulted in the differentiation of the social division of labour. New jobs, trades appeared, which were not linked to the production of foodstuffs any more (clerks, craftsmen, merchants, religious officials). These **pre-industrial cities** were generally smaller than those of the present day, however there were a lot of problems to cope with. City walls had to be built (fortress-like character) against external attacks, contagious diseases swept through and ravaged the population because of the lack of canalisation and the insufficient development of public health. Also the traffic within the city and passenger transport were undeveloped. Without a longer presentation of the historical stages of the development of urbanisation, I would like to illustrate the aspect of what were the obstacles to the growth of cities. On the basis of the work of the American sociologist ***Kingsley Davis***, we can mention the following factors [3]:

Modern urbanism evolved through multifarious stages of development. In the development from the pre-industrial city to the real industrial city centres, the spreading of steam energy, mechanisation, belt-like production lines, the large-scale application of electric power and the spreading of the modern means of transport had an important role. Metropolises emerged, which grew differently in Europe and in America. In the USA, cities with at least half a million inhabitants and whole strings of **megalopolises** evolved on complete large contiguous coastal stretches. At the beginnig, centripetal effects prevailed, because the mass of problems grew (disturbances in traffic and transportation, taxes and ground prices rose etc.), which lead to the deterioration of inner zones. **What is called centrifugal movement**, that is, migration outward took place because of the more favourable means of subsistence, appearing (existing) in these 'swelling' urban zones and the quick connections of transport lines.

According to ***David Harvey***, urbanism was brought along by modern industrial capitalism. (4) In the modern world, the difference and division between rural and urban areas is decreasing, because agriculture has been mechanised and it has become profit-oriented. This is one of the reasons why the area is continually transforming, **the space is becoming restructured**. Developments, investments, constructions, as well as reductions and the closing of workshops and factories are done in the hope of profit.

Manuel Castel holds that the design of cities and their areas constitutes features that express the conflicts between the various groups of societies. (5)Thus, the urban environment can be interpreted as the expression and symbol of wider social forces, and its spatial manifestation. Skyscrapers, for example, symbolise the power of money over the city primarily through **technology and reliability**. However, they can also be built for the simple reason of hoping profit from it.

In ***Edward T. Hall***'s book entitled 'The Hidden Dimension', we can read about the **diversity of attitudes to space, time and matter** among minorities (ethnic groups). If an ethnic enclave cannot expand and maintain a healthy level of population, the **development of a ghetto** is inevitable. Hall thinks that if we are to prevent this 'ghetto' from keeping growing and finally destroying the city, there is only one solution: we must find architectural solutions that reduce the negative symptoms of the 'ghetto' but do not threaten the existence of ethnic enclaves.[6] Thus, sizes are crucial in designing the environment and residential districts in cities. It is therefore very important that **urban sizes should be in accordance with the ethnic scale**. This may give designers no small task, because each ethnic group develops a different scale for itself as a consequence of the diversity of cultural customs and traditions. In this book, we can read about the concepts of **monochronic and polychronic time**, which is

characteristic of people without much influence on one another and its opposite. Monochronic North Europeans find the constant interruptions of South Europeans baffling.

A significant feature of industrial capitalism is the process of **collective consumption**. Home, school, traffic and its services, as well as entertainment facilities are all **classical, typical areas of consumption**. We should notice that today's urban 'development' in this domain is manifested in shopping malls (plazas, shopping centres, shopping cities etc.), where **consumption, entertainment and 'virtual recreation'** is concentrated as gathering places of social contacts.

Urbanisation practically also played a role in the globalisation of environmental problems, and thus, the concept of **sustainable development**, which is well-known by now, also includes the components sustainable city, village, state etc. The decrease of natural space and resources in this concept can be interpreted better **in the concept of ecological footprint**.

2.2. Objects and Interiors

While we were talking about spaces on larger scale, mainly the design and development of cities, in the previous chapter, now we are going to talk about the internal design of the immediately surrounding environment, the home and closed spaces with other functions. Thus, we are going to talk about the rooms for cooking and eating, sleeping, as well as working at home. Perhaps it is not unworthy to make some more introductory remarks and possibly repeat some observations. The exterior and interior design of buildings and the arrangement of objects are **strongly dependent on culture and society**. In the book entitled 'The Hidden Dimension', also referred to earlier, the author (***Edward T. Hall***) is writing about the anthropology of space. (7) He distinguishes basically three 'levels', namely **infraculture, pre-cultural and micro-cultural levels**. He places the lower behavioural levels, underlying our culture, which are rooted in our biological past, in the first category. From our point of view, the third level, the micro-cultural level is relevant. This presents practically the observational aspects of proxemics in a **varied and multilevel** approach to culture. As we know, proxemics is the **science of space management, and therefore the third cultural level distinguishes three aspects in the design of spaces here: namely bound space, partly bound space and unbound space.** What is called **partly bound space**, for example, means that certain spatial elements can be moved occasionally. So this includes mainly furniture. Depending on what kind of situations of human contacts (social, conversational) these render possible, we can talk about **sociopetal and sociofugal** spaces.

2.3. International Outlook about the Teaching of Social-Science Subjects

I conducted my survey in two time sections and with different geographical extensions.

2.3.1. Survey of Forestry Education in Western Europe

I conducted the first comparative survey in 1989 concerning the curricular comparison of the structure of European forest engineer training. I started collecting the empirical data in 1987. (8) The social change in Eastern Central Europe started only later and, therefore, the comparison embraced only the non-socialist countries in Western, Southern and Northern Europe. Based on that, from the comparison of the curricula of the **34** colleges and universities in Western Europe under survey, I found the following:

- The absolute numbers of classes showed great variation (1800 to 6394)
- The time of training ranged from 3 to 6 years, i.e. from 6 to 12 semesters.
- No social-science subjects at all were taught at 6 institutions (15%)
- At 85% of the colleges/universities, some social-science subjects were taught, i.e. they supplied forest engineer trainees with knowledge labelled Sociology, Psychology, Political Science, Forestry Policy, Leadership-Management, History of Forestry, Philosophy, Legal Studies, Ethics etc. That also includes the institutions which embraced knowledge not directly labelled social-philosophical in their curricula.
- The proportion of social-science subjects at these universities ranged from 15 to 25% of all subjects. This is, even in the case of a training with 1800 classes, at least 90 classes, i.e. minimum 2 to 3 subjects' time.

2.3.2. The Situation of Teaching Social-Science Subjects Today

In the course of time, higher education in forestry and, even, the whole higher education has undergone significant changes not only in Hungary but also abroad. Just think of the conversion to multi-cycle training, labelled as the Bologna process. That is one reason why it is interesting to make a narrow outlook, which, however, can be regarded as a representative sample, with respect to the teaching of social-science subjects. Primarily the technical-technological field, i.e. engineering training remained in the focus in my comparative survey, conducted in 2009. As I invariably attach great importance to the role of social-science subjects/modules in preparing for the engineer's role, I analysed these subjects, their labels, inner contents and curricular importance on the basis of Internet access and my own curricular sample.

I sum up the main results of that survey as follows (**9**):

- I examined the curricula of 19 universities altogether in the following countries: England 3, Austria 3, Germany 3, Turkey 1, Romania 2, Taiwan 2, China 2 and Canada 2
- The number of the examined majors: 35
- The names of the examined majors: Mechanical Engineer, Environmental Engineer, Construction Engineer, Electrical Engineer, Informatics, Information-Technology, Audio and Music Technology, Computer and Internet, Building Engineer, Industrial Environmental and Recycling Engineer, Electronics and Computer Science, Sustainable Energy Engineer, **Sustainability Engineer**, International Mining Engineer

These names also indicate that, in response to the challenges of the age, also the environmental and the sustainability engineer majors have appeared besides those in the 'traditional' academic and technological fields. However, it may be surprising that the international mining engineer training is revived in the 'cooperation' of four countries (Austria, USA, Germany and South Africa).

- Which were the most frequent labels for subjects? Innovation Management, Law (general and environmental, or engineering) **sustainability** and environmental management,
- The 'classical' social-science subjects. Sociology, Environmental Sociology, Psychology, Group Management, Economics, Engineering Ethics,
- The specific subjects/modules of the new fields or majors: Social Anthropology, Social Problems and Welfare Policies, Urban Sociology, Stress Analysis, Individual Design and Research Project, Human Ecology, Globalisation and Development, Environmental Enterprise
- Due to the extensive spreading of computerization, also engineers have to take numerous social effects into account and, therefore, I could find also knowledge areas embracing the relationship between learning society, or, information society and digital culture, labelled **'the Information Society and Digital Culture'** at one major of the *University of Kent*.
- I found the most complex, perhaps the most widely embracing subjects at the *Chaoyang University of Technology in Taiwan*. E.g., Planning and design of Civil Works in Urban Area, Field Safety and Environmental Protection, **Government Procurement Law and Act for Promotion Infrastructure Project**, **Human Resources Management**. These subjects are woth 3 credits in the training.

3, Workroom for the environmental and sustainability educated in Hungary

3.1, Workrooms for the enviromental education

The Department of Environmental Protection was formed in Sopron in EFE[1] at first in Hungary, and also here was formed The Department of Technical and Environmental Pedagogy. The enviromental protection engineer and enviromental engineer, as well as wildlife management and agronomy in the parallel could take on teacher of engineering profession(speciality), and in this way they became the teachers of professional subjects in secondary schools.

In base of this department was formed the Hungarian Acadmy of Sciences Regional Committee in Veszprém Work Committee of Environmental Pedagogy with „transregional" style. I was the president of this Work Committee since 1999, and in every year I organized 2-3 conferences, schoolbook presentation area exhibitions, and reader meetings. We organized bigger national and international programs also, jointly with EFE[1] next organisation name (its name is NYME[2]) and with the National Park for Fertő-Hanság and National Park for Fertő-Hanság Neusiedl am See.

In the NYME Faculty of Forest-engineering works the Kitaibel Pál Doctor School of Environmental and within this doctor school works an Environmental Pedagogy Sciences Program.

3.2, The role and planning of stady streat in environmental education

The primary aim of establishing stady street is to develop the environmental consciousness of visitors as well as to promote the education of natural science. Beside ecological – technological – technical respects, pedagogical aspects must also be taken into consideration.

The topic of stady street has so far been rarely researched or studied, apart from some enthisiastic planners, „experts". One of the doctoral researches[3] aims to introduce the place, the role, the sorts of footpath and their methodological aspects in environmental education. To explore the relations of their planning, the general aspects of integrating professional and pedagogical-methodological regards. To illustrate the importance of the dimensions of sustainable development, the enforcement of the compex, holistic approach in the course of designing and practicing stady street (ecological, economical, cultural and social dimension).

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[1] EFE= University of Forestry and Wood sciences

[2] NYME= University of West-Hungarian

[3] Research topic title: The role, methodological aspects and planning of interpretanional trail in environmental education PhD Student: Tímea Kollarics, Lieder of Thema: Dr. habil Lükő István

4. Short Summary

In my lecture, I presented the essence and changes of the engineer's work, as well as the preparation for the engineer's role. I demonstrated with two international outlooks that the role of subjects embracing social-philosophical knowledge has increased in engineering training. Their labels also express the importance of a complex holistic view, besides maintaining the significance and leading role of engineering-professional and natural sciences.

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