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PROFESSION, WORK AND SOCIAL CONTEXT: NON-TECHNICAL SECTIONS OF MECHANICAL ENGINEERING EDUCATION

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ABSTRACT
Recent developmental strategies concerning education of engineers at technical universities across the world have implicated greater accent on cooperative knowledge systems. It has resulted in broadened scope of non-technical subjects and courses at technical universities' curriculums. While the general presumption is aimed to qualify engineers as able to act in unpredictable social environments and not just to "function" as well-educated performers – the implementation of reformed educational programs suggests relative ambiguity in acceptance of content and extent of non-technical topics. Article deals with actual non-technical courses at Faculty of Mechanical Engineering and Naval Architecture at University of Zagreb. Its findings point at persuasive effects of intelectual distorsion that manifests itself in process of dealing with contradictory nature of estblished and achieved educational imperatives.
Keywords: work, education, profession, non-technical courses

1. INTRODUCTION
Contemporary research has shown that relationship between education and profession is mediated rather by transfering dominant culture' core values (for instance - work ethic) than by integration of professional skills and knowledge into the students' developing human potential [2]. While it has been historical trend that lasted through the entire twentieth century, recently it is overshadowed by aggregated emphasis made by so called educational *triple helix* – business, govermnent and university – directed to the imperatives of knowledge society. The outcome of that process seems to be ambiguous: insofar as official objectives of educational system are directed toward development of aplied knowledge and skills, business sector and employers express some sort of disillusionment with academic curriculum's fundamental aspect and inability of newcoming young professionals to succesfuly embrace work tasks emediately. However, dominant values resides within just mentioned matrix as a hidden but important element implicating that the whole process is a reflexion of broader structural consequences of "flexible capitalism" [3, 8, 9]. Its theoreticaly and practicaly challenging aspect within educational context of mechanical engineering is adressing a question of meaning and content of non-technical subjects and courses. They have to balance between, on the one side, hidden ideological consenquences of imperatives toward aplicability and, on the other side, its own imperatives to challenge aplicability as a manifestation of dominant social order. If content of social sciences within curriculum inclines in direction of aplicability - they can provide useful knowledge that is narrowly realistic and temporarily fits into present and predominantly corporate order, but loose its critical charge. If that content is predominantly directed toward developing human potential and if it questions broader social context – it seems to fall short of its aplicability.

2. ENGINEERING PROFESSION - IDENTITY IN TRANSITION

Recent research [5] has confirmed the importance of non-technical skills among engineers' scope of professional activity. However, "there is a wide range of qualifications that an 'engineer' have" in different socio-cultural context [5]. Also, there is an ambiguity in defining engineering as profession with regard to a wide range of qualifications that an engineer might have in a different parts of the world. In general, managerial, negotiation and communication skills – as important and necessary to be improved among engineers – are the most frequently mentioned. "Soft skills" raise in importance within section of professionals concetrated strictly in engineering work. But, due to the fact that significant proportion of technically highly skilled engineers sooner or later are crossing into the management sectors of the companies in which they are employed, technical expertise has to be even more accompanied and supported by, at least, basic knowledge in economy and interpersonal relations.

According to preliminary findings of Lynn and Salzman [5], most frequently mentioned skills and characteristics among "those who excell at their job doing engineering work" can be sumarized as next:

- high technical knowledge and analytical ability;
- ability to solve problems or to find the help in the most efficient way;
- ability to activate people and resources, i.e., to clearly communicate and negotiate assignments;
- effort concerning individual self-development and creativity.

Lynn and Salzman have found non-technical skills to be even more importanat among professionals who move into managerial positions and have "fast track" careers. Their skills and characteristics can be sumarized as next:

- ability to communicate and work with people, i.e., to be proactive with others;
- ability to span boundaries between engineering disciplines, between engineers and non-engineers and with customers;
- sometimes - "external focus", i.e., ability to maintain a "big picture"; in other words - to hold a whole;
- ability to socialy contextualize their own work results, i.e., to raise expectation of socialy and ecologicaly more informed engineering role.

The most of mentioned characteristics are concerned with intra-organizational social context. With regard to educational objectives this can be related to improvment of issues within (business) management courses - mostly themes of motivation, leadership and communication. However, we could say, this is just a part of the story – ability to manage the uncertain and unpredictable aspects of a work situation related strictly to the intra-organizational problem solving could be defined as one-dimensional if social actor – engineers included – is not capable to continually rethink his or her own position in broader social system and critically re-examine his or her own professional activity. Characteristics regarding social contextualization, ecological concern or advansed interdisciplinary imagination seem to be less strictly aplicable and correspond to less visible but long-term educational effect. It assign to engineering profession an humanistic dimension that visualize engineers as personalities able to "purposively connect technical and human elements of production while keeping in mind the fact that the best working place is one that is primarily associated with human needs, and not just with aims of production and profit" [6]. Then it could be possible to say that identity is self-reflexivity – ability that engineers share with other professions and occupations – a fertile synthesis of scientific imagination, professional skillfulness, social responsibility and critically informed social consciousness.

3. NON-TECHNICAL SECTIONS ON FSB, ZAGREB

Some of the key arguments incorporated into the recommendation of the new curriculum at FSB (Faculty of Mechanical Engineering and Naval Architecture), University of Zagreb, reflects the need for more so-called non-technical courses. The new curriculum refers to propositions of ASIIN (Akkredititierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der

Naturwissenschaften und der Mathematik), a German quality assurance agency (Table 1) and follows concern with interdisciplinary improvment of curriculum that is evident in academic technical programs in highly industrialized countries too. With regard to non-technical courses, propositions refers to both, Bachelor and Master curriculum in the same terms - 10% of the study program. Proposed study structure corresponds to the preliminary findings of Lynn and Salzman and suggests that "interdisciplinary and socio-cultural enrichment" is necessary to fit present challenges of engineering profession.

Table 1. Proposed Bachelor study structure at FSB, Zagreb, adapted to recommendations of ASIIN.

Bachelor, mechanical engineering	Minimum	
	%	ECTS
Mathematic-scientific fundamentals (mathematics, chemistry, physics, informatics)	18,0	32
Engineering fundamentals (technical mechanics/mechanical dynamics/theory of vibrations, fluid mechanics, technical thermodynamics, electrical engineering and electronics, materials engineering, measurement engineering and control engineering, etc.)	28,0	50
Engineering applications (construction/product development/manufacture)	12,0	22
Advanced subjects, focal subject (orientated on fundamentals according to choice)	6,0	10
Cross-subject contents Subjects in the fields of economics, non-technical electives, languages (as far as not taught in the afore-mentioned subjects)	10,0	18
Bachelor's Thesis	6,7	12
Practical training (technical laboratory)	3,3	6

Although an non-technical "support" was existing at Faculty of Mechanical Engineering and Naval Architecture for decades, the main educational dilemma points to the old question: in what proportion supposed non-technical skills would be established as a part of educational program without disturbing or limiting the space and time necessary for strictly technical knowledge and expertise More precisely, what supposed non-technical abilities engineers need are consisting of? Altough this non-technical field has recently slightly broadened to the issues of economics, law, management, psychology etc., traditionally it was represented mostly by courses organized at FSB's Department of Sociology. So, sociological subjects can be taken as refferent to non-technical courses at FSB in general (Table 2).

Table 2. Courses of Department of Sociology at FSB, Zagreb, 1990 – 2008.

Time period 1990 – 1994	**Hours per semester**
Sociology 1	60
Sociology 2	60
Industrial Sociology	45
	Σ 145
Time period 1995 - 2003	
Sociology	45
Industrial Sociology	45
	Σ 90
Time period 2004 - 2008	
Sociology	30
Industrial Sociology	30
Science, Technology and Society	45
Social Psychology of Small Groups	45
The Structure of Scientific Knowledge	45
	Σ 195

As a Table 2 suggests, sociological cources were cut in years 1995 - 2003 implicating faculty's key concern with limiting their scope and keeping more concentration directed toward the improvement of students' technical expertise. The new strategy of development at FSB, recognised this concept as a

failure and proposed recomendations that have resulted in more non-technical courses (and their lecture hours) than ever before.
Previously, the main content of sociological courses was pointed to necessary broader intellectualization of students in technical faculties aiming at improvement of their capacities to recognize and understand some of the human and social problems in their future work-context manifestations. Accordingly, the focus was not limited on chosen topics in general sociology but broadened also to correspondent issues in the fields of industrial sociology and psychology – mostly issues of work and its organization [6]. Although interest in human and social aspects of engineers' work condition and profession still exists, those fields are recently even more broadened to other non-technical issues and reflect interest in social context of environment, technology, science, social psychology of small groups etc.
Within that interest sociology and correspondent non-technical issues reffer to the "sphere of 'soft sciences' and 'soft terms' that are unappropriate for exact operationalisation and, even less, for social-darvinist pattern that is dominant in all fields of 'hard' knowledge application" [4]. Consequently, those subjects are not oriented toward "plug'n'play" social solutions and might be seen as weak in terms of immediate applicability. As opposed to pressures of short-term corporate visions that sell even aplicability as such for the sake of profit, content of sociological courses is oriented to "openess, involveness and ideological breadth" [4] that might educate critical sense and spirit within professional human and social potential. This education stems from the knowledge that doesn't exclude aplicability but inhabits fields of sociability beyond it. It informs the consciousness that knowledge itself is grounded in complex social matrix [7]. And it enables social sciences in the context of engineering academic curriculum to express itself and to educate in its own terms and not to stay within the reductionist frame of mere aplicability.

4. CONCLUSION

Individual identity is socially and culturally mediated, but has to be gained through personal commitment and permanent action. Engineers, like other professionals, are creating their careers essentially through accepted technical knowledge. But they are living in society – often occupied by necessities and constraints that have non-technical character. In the world that is dealing wiith "revolution of side-effects" [1], solely technical aspect of someone's intelectual capacity is not enough to confront challenges of global risks. If traditional rule of experts in science is called in question by postmodern deconstruction, then their rule in the area of production is deconstructed by pressures of neo-liberal capitalism. In that sense, engineers face the need to broaden their intelectual scope beyond the limits of tight profession.
Contemporary study of engineers points the problems of narrow specialistic education and claims mostly for broadenings in terms of "cooperative knowledge systems". But, it seems to stay within borders of aplicability and its short-term limitations in the context of present society that comfirms itself as the fertile ground to theories that study it in terms of risk, insecurity and unpredicability of future development. It means that issue of aplicability within engineering education that is broadened by cooperative knowledge system has to be paralleled by unaplicable social sciences and humanities imput.

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