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INTEGRATION OF SOCIAL SCIENCES AND HUMANITIES INTO MECHANICAL ENGINEERING CURRICULUM

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ABSTRACT

Article deals with ways in which social sciences and humanities have been integrated from the 1980s to the present day into curriculum of Faculty of Mechanical Engineering and Naval Architecture at University of Zagreb, Croatia. After a brief review and summary of selected research and theoretical contributions to the subject theme, a specific research setting is indicated and contextualized. Elements of socio-historical approach are established primarily through analysis of corresponding documents: curriculums from the 1980s, 1990s and 2000s and from key documents on strategic development of the Faculty. It is stressed that social sciences and humanities topics are continually represented in mechanical engineering study program as legitimate, but separate unit, poorly integrated in the main engineering courses. Together with more or less expressed orientation toward micro-social and micro-economical issues in industry and business, it points to the main features in continuity of establishing the field of social sciences and humanities. Finally, it is shown that chances to widen and enrich aforementioned field are in close relation to the character of engineering and its social contextualization expressed in a key Faculty's strategic documents.

KEY WORDS

engineering education, engineering profession, non-technical courses

CLASSIFICATION

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INTRODUCTION

In the field of engineering there is a vast discrepancy between the amount of articles on the social aspects of engineering education published in Croatian and in international scientific journals. However, although there are just a few such articles in Croatia, it does not mean that the engineering studies do not include the social sciences and humanities. In fact, it is questionable in what extent such education really exists and what is its character, especially if we wonder what is considered to be complete engineering education. Engineering, as Lynn and Salzman have indicated [1], is anyway relatively undefined in terms of the profession compared to some other disciplines. Therefore, this paper is under limits of the mechanical engineering study, although there are considerable local differences, and so it would be doubtful to estimate the title topic as equivalent at all four faculties of mechanical engineering in Croatia. Also, I will limit myself to the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, because I believe that this issue is the most developed at that faculty (it will be discussed below), in addition to the social context of engineering that is it most represented there. Finally, the context of the Faculty of Mechanical Engineering and Naval Architecture is most familiar to me, since I have been employed there, and my job of a sociologist at the technical faculty provides me with a wide range of insights of ethnographic nature which are ultimately supported by several scientific studies on non-technical content of the engineering education. For the purposes of this paper, the term "non-technical" is used in the same meaning as the term "social sciences and humanities" (SS&H). The first term, though being broader in meaning than the latter, because it affects the natural science and other non-technical fields of science, can be discerned in the recommendations of individual accreditation agencies for the engineering education (such as ASIIN – Akkredititierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik) and affects social sciences and humanities (SS&H), among other things. Both terms hereinafter appear alternately.

SOCIAL SCIENCES & HUMANITIES IN ENGINEERING – A BRIEF OVERVIEW

A handful of thematic concerns and methodological approaches to social issues in the engineering education have already been written so far and it is unlikely to be fairly unified under a common denominator. Social aspects have been indicated since the mid twentieth century and they follow the development of engineering academic curriculum. The basic issues brought out on this point are related to the purpose and character of the non-technical education of engineers on one hand, and the scope and method of integrating the topics in the field of SS&H in engineering academic curriculum on the other. At the same time, the questions about the non-technical nature and scope of engineering education continually reflect ways of deliberating dominant social issues at their certain period. Previously, this reflected primarily in corresponding to the expansion of the capitalist economies in the industrial West [2]. Recently, the challenges in the field of promotion of new goals and values have been indicated, which is, at least at this point, perhaps best reflected in the efforts for greater integration of economic, social and cultural issues, such as social responsibility and social justice, with environmental and technical aspects of sustainable development [3-6]. As Burbules, Lang and Ramsey had well observed, this process often occurs in conflict with traditional ideals and usages of engineering [2], and I would add only that part of the dispute is not entirely and exclusively of recent character.

Namely, in terms of the purpose and character of social and cultural issues in engineering the doubts are visible from the beginning and they are concetrated on question whether SS&H

should be instrumentally-rationally realized as a support to future engineers for their better orientation in business and corporate context in which they would pursue their careers, or these issues should be observed as a part of a broader spectrum of elements necessary to build a complete personality of academically trained engineers. And these elements would be difficult to imagine without strongly established general culture and internalized critical (professional and social) discourse. To put it simply, should engineers predominantly master the "soft skills" in the broadest sense in order to impose themselves as successful employees in the business sector, or should they, moreover, be able to develop critical thinking and attitudes towards the wider society in which they could operate simultaneously considering their role and developing identity that would always place the technical solutions they produce into the matrix of a better and fairer society? The concerns mentioned have already been indicated in a Grinter *Report on Evaluation of Engineering Education* done for the ASEE in 1955 [7], in which it was insisted upon the SS&H attainments not as strictly professional skills, but also as the essential attributes of citizens capable of enriching their own sense of being and make it meaningful. Similarly, the complexity of ethical concerns in engineering has been discussed recently, as indicated by Forum for the Future in 2000: "Ethics and values are something we can have a reasoned debate about. Which draws attention to another commonly held but profoundly mistaken belief about ethics and values - that science is 'hard', objective and factual whilst ethics and values are 'soft', subjective and purely personal, like taste. But issues of right and wrong, or good and bad are not, for example, like the preference for thin as opposed to thick cut marmalade. The difference is that reasons underpin ethics and values, and reasons can be analysed. Ethics and values therefore, unlike tastes and preferences, are accountable in various ways to argument, to reasons, to experience, to strongly held intuitions, and to beliefs. This point is crucial. If we treat ethics and values like tastes, we won't subject them to rational debate. And if we never debate the adequacy of the ethics and values implicit in contemporary society, they will never change. Of course, we already do value the environment and social justice in our society but this is not the case everywhere. However, either we do not value them enough, or we do not value them in practice as well as in theory. If we did, environmental degradation and social inequity would already be a thing of the past. Practical change in our ethics and values is absolutely necessary if sustainability is to be achieved – just as necessary as scientific and technological advance" [8].

Questions about the scope and method of integrating SS&H into the engineering academic curriculum also imply a kind of continuity. Scope does not mean just a range of possible SS&H issues, but also the amount of their representation. It would be ungrateful to grasp the scope of possible issues uniformly, but it could be ascertained that their quantity varies on a global scale depending on the ratio recommended by accreditation agencies and similar organizations, mainly to 20 % of scheduled classes. The integration method is far from any predictable standardization, but can be summarized through the question about whether social and cultural issues should be integrated by establishing the separate courses, more or less adapted to engineering, or should those issues be incorporated into the feasibility plans of very technical courses, i. e. into the so-called engineering scientific core. The possibility of thematic, methodological and pedagogical steps forward that allow teachers to draw the SS&H aspects of engineering using specific and current examples closer to their students is indicated in part of the studies I referred to. Actualization of humanistic and critical pedagogies in the analysing context of liberative interaction patterns already in the classroom [9], contextualization of the engineering "hard core" [10] and alternative modalities in lecturing engineering ethics [11, 12] – are only a few examples.

SETTING AND METHOD

The representation of SS&H courses at the studies of mechanical engineering in Croatia varies depending on the programs of different faculties, as well as on developmental changes in the contents of individual mechanical engineering studies. Presently, there are four academic mechanical engineering studies in Croatia – in Rijeka, in Slavonski Brod, in Split and in Zagreb. From the insight into their curricula considering their current non-technical schedule, it is possible to note only that there are significant differences among these faculties – the similarities are contained only in the representation of foreign language lectures in classes, while the other non-technical courses are grasped by a variety of headlines pointing to learning different soft skills or to basic introduction in selected social issues, mainly in the field of sociology and economics [13-16]. However, in terms of the range in the number of courses referred to the social and cultural aspects of mechanical engineering and engineering in general, Faculty of Mechanical Engineering and Naval Architecture is slightly ahead in relation to the other three engineering faculties in Croatia, because the number of courses offered and the possibility of electivity are significantly higher in Zagreb. This is evident in the very content of courses available: at the study of mechanical engineering in Zagreb it is also possible to identify other subjects that open issues considering the relations of science, technology and society, cultural and social aspects of sustainable development, ethical topics in engineering, etc. Because of this and other reasons mentioned in the introduction, hereafter I will focus on the analysis of SS&H areas as an integral part of the academic program at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb. In doing so, I will, because of the mentioned indentation of issues related to areas of society and culture, keep prevailing attention on the types and character of integration of subjects at mechanical engineering study in Zagreb resulting from the research and teaching activities of the faculty during the past decade at the Chair of Sociology.

Considering the fact that I do not know other scientific papers dealing with non-technical aspects of mechanical engineering education in Croatia, except the ones I quote here [17-22], my analysis of the character of non-technical education in the engineering curriculum at the Faculty of Mechanical Engineering and Naval Architecture is based mainly on the study of available documents from the 1980s to the present day – the study programmes in these past 30 years [13, 23-25], as well as strategic development documents [26, 27]. Therefore, this analysis incorporates elements of the socio-historical approach and enables the identification of certain developmental continuities as well as the occasional development turning points.

RESEARCH FINDINGS – CONTINUITIES

Non-technical aspects of engineering have long been embedded in the organizational structure of the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb. During 1956 the *Seminar for company economics* had been established, which was transformed into an independent *Department for the company organization* in 1967. In the mid 1970s it was transformed into *Department for work organization* representing the area where technical, economic, and socio-psychological aspects of engineering were considered simultaneously. As a part of the Department, in late 1970s, *Operating Unit of Sociology and Economics* was established, which officially changed its name during 1987 into the *Chair of Sociology and Economics*. In the year 1997 the presently existing organization was established: *Department for work organization* changes its name to *Department for Industrial Engineering* so that the whole area could be "adapted to similar institutions in the world" [28], whereby, in the same year within the renamed department, *Chair of Sociology* was established, as its independent and constitutive part [28]. Besides the *Chair of Sociology* (previously also with economics), the non-technical area was parallely covered with the *Chair of Foreign*

Languages as a legitimate humanistic body of knowledge and skills integrated into mechanical engineering academic curriculum. Over the past 30-40 years, the function of these departments has been documented in the respective study programmes and the feasibility plans that not only allow sketching the historical development of non-technical areas at the study of mechanical engineering in Zagreb, but also reflect certain specific national socio-cultural context in which the engineering developed.

First of all, it is evident (Table 1) that the content of social sciences and humanities is continuously represented in the curriculum of the Faculty of Mechanical Engineering and Naval Architecture, whereby it is possible to conclude that, at least formally, i. e. at the level of terminology, the program covers selected areas of a) social theory b) basic economic education and c) foreign languages. Considering ideologization of education at all its levels during the 1970s designed to ensure cultural reproduction of the official political order and the corresponding dominant values, the names of courses which involved selected chapters of social theory had to clearly indicate the official (Marxist) theory and official political project of establishing socialist self-management and it lasted until the very end of the system that collapsed along with the state of which Croatia was an integral part. In the official political project of ideological education during the 1970s, sociology was eliminated from most high schools and replaced with subjects such as *Marxism* and the *Theory and practice of socialist self-management* (TiPSS in Croatian) that appear often as the only non-technical courses at technical faculties. At that time, from the perspective of the ruling structure and single-party system, sociology in Croatia was proscribed as "bourgeois science" [29], a sort of disturbing element on the plan of social analyzes. It is therefore not surprising that, speaking purely formally, *Marxism*, *TiPSS* and *Defence and protection* embodied more than half of the non-technical classes at engineering studies during the 1980s – with courses such as *Organization and Economics of Business Systems*, foreign languages and *Industrial sociology*.

The course *Defence and protection* in the dominant culture of the informal structure of society and power beyond the reach of the single-party system, has been already viewed as a lever of ideological indoctrination in the educational system and it was abolished with the introduction of multi-party political system at the beginning of the 1990s. On the opposite, *Marxism* and *TiPSS* courses were renamed into *Sociology 1 and 2*, to consistently comprehend under that name much of the content that was already predominantly lectured at the courses mentioned. In this sense, it can be concluded that, together with *Industrial sociology*, social issues kept continuity, as well as at least nominally, a framework for introducing basic chapters in the field of social theory to future engineers. Foreign languages also kept the continuity till today, as well as the elements of economic education, which by time, just as the sociological education, changed their names, accents and scope.

Another kind of continuity refers to the way of integration the non-technical courses in engineering academic curriculum. In this section, the non-technical courses are functioning as required and necessary complement to the scientifically-technological education core. It is officially employing teachers of SS&H areas, therefore, non- engineers. Regardless of the fact that it is not possible to estimate how clearly the scope of the representation of SS&H field results from designed strategic analysis, or the adoption of the recommendations of the engineering organizations, and how much is it the product of a spontaneous development, experience or even inertia – strategic documents about the development of mechanical engineering as well as educational programs prior to 2003 year were not available – in the plans for classes from the 1980s and 1990s I had referred to, it is evident that the non-technical content is not directly integrated into main engineering courses, i. e., it is simply not there [23-25]. Although it may leave room for reasonable assumption that the part of teachers had recognized it on an informal level and insisted on direct linking typically

Table 1. Non-technical courses at Faculty of Mechanical Engineering and Naval Architecture, Zagreb (1980s – 2010s). Numbers in cells mean Lectures + Seminar in class hours.

Course	1980s	1990 - 1997	1997 - 2003	2003 -
Marxism	2 + 2	-	-	-
Theory and Practice of Socialist Self-Management	2 + 2	-	-	-
Defence and protection	2 + 0	-	-	-
Sociology 1	-	2 + 2	-	-
Sociology 2	-	2 + 2	-	-
Sociology	-	-	2 + 1	2 + 0
Industrial Sociology	3 + 0	3 + 0	3 + 0	2 + 0
Foreign Language	1 + 1	1 + 1	1 + 1	1 + 1
Organization and Economics of Business Systems	2 + 0	2 + 2	-	-
The Economics of Production	-	2 + 1	2 + 1	2 + 1
Non-technical electives	-	-	-	2 + 1

scientifically-technological contents to the social and cultural ones – such things have not been officially confirmed in the curriculum. On one hand, the continuity mentioned corresponds to the dominant practice in the world but also reflects the more or less formal compliance with the recommendations of some international accreditation agencies (for example, in the part where ASIIN assumes 10% of classes for the so-called cross-subjects) including all deficiencies that are pointed out in the literature [9, 10].

On the other hand, parallel coexistence of the scientifically-technical and the SS&H curriculum, regardless of the nuances in the ratio of representation, is far from indicating that it is being led to their integration at the level of study as a whole. On the contrary, the program for classes organized that way gives much more evidence of the kind of denying at the engineering part of the program to comprehend the social, cultural and, for example, ethical aspects of engineering as underlying scientific and technical, as inherent to scientifically-technical aspects and to future engineering professional practice. In this sense, one can identify an implicit assumption about the SS&H part of the program as indeed necessary, but at the same time as the "work" that will be done by someone else – perhaps by currently available sociologist or economist. The requirements of form and the corresponding percentages are met this way, one could say to oneself and to others, for example, "Here we have ethics," but in the long run it remains within limits that prevent the substantial connection of SS&H, scientific and technical areas into a meaningful whole. Finally, this is a way of confirming the stereotype of the SS&H field which is often indicated as the "area of soft science" and "soft terms" that are not only unsuitable for precise operationalization, but also useless in the socio-Darwinian framework, which is dominant in application areas of "hard" sciences [30].

Finally, the third important continuity is evident in the way of legitimizing SS&H content through topics aimed at teaching future engineers to become better oriented in the world of industry and business world. It is clearly stated in all social, economic and foreign language programs over the past decades, and can be seen today in some of them.

For example, the sociological courses (including *Marxism* and *TiPSS* during 1980s) justified their reason for existence in the mechanical engineering academic study with program that was balanced between the issues of the development planning of a sort of general academic and cultural topics facing the presumed needs of the social contextualization of engineering

in general. The first issues were more often within the general sociological subjects (*Marxism*, *TiPSS*, *Sociology*), and others were in *Industrial sociology*. There were contents matching to it in associated textbooks in which authors had freedom in choosing topics and sometimes lacked strict adherence to textbook form [17, 31]. Knowledge needed for the "understanding of everyday life in all ranges" focuses with assignation on understanding "of human behaviour (group dynamics) in industrial and other organizations" [23]. Program of *Industrial sociology* is much more concentrated on the area of industrial organization and promotes its mission as only "improving students' knowledge about the processes of interaction, cooperation, leadership and conflict in industry" [23]. In doing so, the specified content occasionally leaves the strictly sociological organizational issues engaging in medically-ergonomic aspects of work analysis that is evident in the chapters on fatigue, noise and climate [23].

The noted emphasized introduction of the students of engineering into the typical social intra-organizational issues (such as leadership, motivation, teamwork, microeconomics and management in general) is understandable and necessary, considering that this is the prevailing context in their future careers. However, it can be considered problematic if it is shaped mainly in terms of uncritical adaptation and mere application of organizational skills. This is the way of potential confirming and promoting one of the most common stereotypes about engineers as functional professionals, experts who without questioning the meaning and consequence of their work [32] successfully solve not only technical problems but also other (organizational) ones. Obsession with functional, but not critical potential of "soft skills" is deeply rooted in the dominant culture of the mechanical engineering academic study and corresponds with the expectations of employers instructing students to the action that in the context of real business world and flexible economy Sennett described as "demeaning superficiality" [33]. In this sense it is not surprising that through industrial and intra-organizational orientation the usability of SS&H content not only has been evaluated through past decades, but has also partly affirmed itself.

RESEARCH FINDINGS – TURNING POINTS

Major advancements in the integration of SS&H areas are outlined through reform of the entire mechanical engineering study program from the early 2000s. It is the largest reorganization of studies over the past thirty years, which also anticipated future adjustment of the entire academic education in Croatia in accordance with the Bologna Declaration. The key steps carried out in this direction have been officially confirmed by a series of decisions on the Faculty Councils: especially considering the first working versions of the *Long-term development strategy of the Faculty* 1999, then the establishment of the *Committee for Development Strategy of Faculty* in 2000, and, finally 2002 – after a conducted public hearing – through adoption of the *Strategy development at Faculty of Mechanical Engineering and Naval Architecture up to 2010*, the official document which is used here as a basis for consideration of the changes which have occurred in the area of the character of integration the SS&H field into the engineering academic curriculum.

The implementation of the *Strategy*, and also the Bologna system, started at FSB in the academic year 2003/2004, three years earlier than at other engineering studies in Croatia, as well as at the entire Croatian academic sector. The outcomes of the studies transformation are certainly not unambiguous. On one hand, the general implications can be summarized through a remark concerning the validation still often deeply interiorized, although problematic self-images of engineers by which they declare themselves to be successful "problem solvers" [32]. Bologna system is adopted as the unquestioned norm, without consideration of possible alternatives, and without leaving any room for meaningful

reflection of autonomy in terms of the variety of educational modalities that the system allows. It was carried out quickly, an entire nine-semester study was transformed into two, the first Bachelor's degree (seven semesters) and the Master one (three semesters), thus creating such a hybrid system with its basic structure, even in terms of duration (3,5 years + 1,5 years) which is hardly consistent with most others in the world. Lack of conformity and the basic structure of the duration of study might not have been big problems themselves - much more problematic was the informal internalized assumption which was an attempt to do something new, and that in fact everything remained almost the same. This is perhaps most evident in the fact that the program and related organization and structure of the courses have not adapted to the Bologna qualification propositions or new ECTS credit points system concerning students' load because the qualifying system and ECTS itself often were not considered and understood before a potential threat to individual positions (of a person and of a subject) that should be simply bypassed during the adapting. All these things can serve as a typical example of engineering "problem solving" with unconditional acceptance of the rules without questioning, and without minimal attempts of organized rejection of imposed rules. Initial satisfaction with "the successfully solved problem" soon turns into unforeseen consequences in the form of new problems difficult to solve, which are currently reflected in several years of unsuccessful effort to further reform the already reformed study program. In fact, the problems that arose from unforeseen consequences, should be somewhat expected among engineers because, as Baura observes, "in the course of practicing engineering, an engineer solves problems. But, because there is no perfect solution, any solution implemented inevitably creates a new problem" [34].

On the other hand, the *Strategy* has, even if residual, imposed the need for positioning the college in relation to the immediate and wider socio-cultural context. In this part, from the *Strategy*, it was possible to discern a socially responsible understanding of engineering, and engineers themselves and their role in society. For participants in the field of SS&H part of the study programmes, this provided a solid foundation for the autonomous and creative development of existing and new courses. It could be discerned from those parts of the *Strategy* that were clearly in coordination with engineering studies which emphasized the need for stronger socio-cultural contextualizations of engineering curriculum, which is appropriate to summarize here with remark by Beder on the importance of "providing young engineers with an understanding of the social context within they will work together with skills in critical analysis and ethical judgment and an ability to assess the long term consequences of their work" [32]. Moreover, the *Strategy* have reflected the recommendations by international engineering organizations such as IGIP (International Society for Engineering Education) or SEFI (Société, Européenne pour la Formation des Ingénieurs) as well as the educational accreditation agencies like ABET (Accreditation Board for Engineering and Technology) and ASIIN (Akkredititierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik) which proclaimed a need for widening a diversity in engineering education arrangements with regard to humanities, social issues, responsibility, and environmental awareness. Both, the European and US reports on engineering education also call for further incorporation of humanistic subjects into engineering education. It is stated that what is required is an engineering education system that is highly adaptable to the demands of the future, producing well-rounded professional engineers able to work together efficiently in teams, to *identify* and solve complex problems in industry, academy, *government* and *society*. Among supposed competencies beyond technical expertise of both, educators and engineers, communication skills, intellectual breadth, a habit of lifelong learning, teamwork, *ethics*, *intercultural sensitivity* and *social* and *environmental responsibility* are most often mentioned. It is anticipated that these qualities would enable engineering graduates to manage through their

professional life as well as through careers in other professions. For instance, ASIIN request for "cross-subject" as an integral part of curriculum providing academy institutions to arrange this space according to their social, cultural and economic specificities and needs.

In the text of the aforementioned *Strategy* the real recommendations are reflected in the following items:

- it is necessary to provide students with more active status that would enable them to raise freedom of creativity, entrepreneurship and gaining more knowledge and skills in fields such as management, team-work, culture, citizenship, communication, languages, ethics, philosophy, social sciences and broader spectrum of elective courses,
- it is necessary to specify the reasons why non-technical spectrum at the moment is limited if flexible, mobile and educated experts have to be skilled to manage in the most different actions at a "battle field" of everyday life, and not just to slip through specialists corridors,
- it is necessary to know history and philosophy of technology, and to raise consciousness of influence and social consequences of technical processes – safety, health, quality of environment, personal development, character of society and ethics [26].

Regardless of occasional military overtone, such officially emphasized sensibility towards stronger integration of the SS&H fields in engineering study program soon resulted in the broad electivity spectrum. From 2003 till today, students are able to enrol non-technical elective courses throughout the University of Zagreb, and at the Faculty, besides the existing mandatory non-technical contents, the new non-technical courses are gradually established (Table 2).

Regardless of the variations in semesters, non-technical courses at undergraduate level comprehend approximately 10 % of the program for classes. At the graduate level, the variations among the directions are much higher and range from 4 % (marine engineering, mechatronics and robotics) to 29 % of classes (industrial engineering) which are dedicated to non-technical courses. The non-technical subjects continue to be treated as separate entities, separate from the so-called "technical core" with only a couple of truly interdisciplinary courses such as *Product development* (mandatory course for some courses) or *Ethics in metrology* (elective course for all students). The electivity somewhat functions at the Faculty, but it is

Table 2. Non-technical courses at Faculty of Mechanical Engineering and Naval Architecture, Zagreb, since 2003. L + S stands for the numbers of lectures and seminars, respectivelly, in class hours.

Non-technical Electives since 2003.	L + S
Social Psychology of Small Groups	2 + 1
Science, Technology, Society	2 + 1
Industrial Sociology	2 + 1
Ethics in Metrology	2 + 1
Introduction to Technology	2 + 1
Interdisciplinary Modelling of Systems	2 + 1
Functionality of Biological Systems	2 + 1
Statistics in Metrology	2 + 1
Accounting and Finance for Managers	2 + 1
Production Economics	2 + 1
Innovation Management in Product Development	2 + 1
Change and Knowledge Management	2 + 1
Business and Work Law	2 + 1
Entrepreneurship	2 + 1
Strategic Management	2 + 1
Business Foreign Language (English, German)	2 + 1

much more difficult at the university level because of complicated administrative procedures and unequal academic schedule components. As shown in a previous studies [21, 22], only the part of the students accepted elective courses as an opportunity to improve engineering knowledge with various social and cultural aspects, or as an opportunity for personal intellectual development; the courses are often (especially when it comes to micro-economic and managerial courses) considered as strictly utilitarian, and occasionally as a mere obligation that must be fulfilled. What is particularly important, it often turns out that some of the "core study" teachers themselves consider the non-technical courses similarly [21]. In a way, this somehow obstructs the spirit of the 2003 *Strategy* in practice. Its validity as an official document expired in 2010 and a new strategy is currently coming to an end. On the web site of the Faculty is currently available version that is still being completing [27] and it is possible to discern a new long-term turning point that would make the engineering much more open as the service for the economy and the business world with the tacit renunciation of – as declared in the previous strategy – value of engineering ethics, social responsibility and the commitment to sustainable development and the welfare of the social community. It is already clearly indicated in the its *Vision* where the faculty pretentiously gets "a key role in initiating the development and securing the prosperity of innovative Croatian economy" and the *Mission* where the research work is put to welfare function of the economy again. Orientation to the economy is also visible in part of the general objectives (specific objectives 1.8., 1.9., 2.1. - 2.7., 4.1. and 7.1.), and the predominant discourse in the whole document has the corporate character. There are no indications of possibilities to see the scientific research acquirements of the Faculty in terms of public good, and there is neither an indication of the social responsibility of the Faculty. Even at points where society is mentioned (2.2., 4.1. and 4.5.) hints are at economics, geopolitics and the economy. Also, the relationship with the stakeholders is focused on promoting the Faculty and its interests, and it is poorly indicated what faculty could offer the community in addition to the economy. The things mentioned can be best seen in 8.6. within the overall objective 8. (Strengthen cooperation with other stakeholders) in which only the defensive security systems of Croatia are mentioned [27]. One simply can not read the other needs of the community to which the Faculty could be attached, and the sustainable development is not even mentioned.

Considering the fact that the process of finalizing the Strategy is still in progress, it is possible to take reservedly some of the mentioned arguments on its character, though I suppose that no significant changes in that part would happen.

CONCLUDING REMARKS

Overview and analysis of the available scientific literature, the study programmes and the policy documents on SS&H part of academic engineering at the Faculty of Mechanical Engineering and Naval Architecture provides several generalizations usable for other engineering studies in Croatia and abroad. They are not imperative in character due to legitimate differences in the contents of the studies and the differences arising from their scope and the local socio-cultural and economic specificities.

First of all, it is obvious in Croatia that the scientific dialogue that would be based on published research of the non-technical part of the engineering academic curriculum has not yet been sufficiently developed. Studies are not numerous, even in terms of comprehending issues in engineering in general, outside of mechanical engineering. The study of diverse experiences, the underlying concerns and pedagogical practices and their publication primarily in engineering, Croatian and foreign magazines might enable creative thinking and possible improvements. In this section, the actual activities and cooperation are just about to occur.

Elements of the historical approach to mechanical engineering study in Zagreb demonstrate long-term viability of the non-technical area, which proved to be resistant to changes in dominant societal ideologies. Already in the period of socialist socio-economic order that resistance has been evident in the content of very study programmes and related textbooks, and was reflected in the intellectual questioning the ideological premise of the official order in its own terms. Some of the subjects (*Marxism* and *TiPSS*), whose function was designed as a propaganda of official values, were almost entirely devoted to a critical assessment of these values along with, often intellectually complex, expressing marxism as authors' and teachers' sociological, humanistic and theoretical position whereby it was openly declared as an "incentive on their own freewill – getting humanistic meaning and facilitate their efforts to let others who would come to make a step forward in attaining our own human identity" [31]. This approach has promoted the ideas that are, in part of the engineering today, seen as the prerequisites of independently and critically oriented professional discourse.

It turns out that here analyzed non-technical aspects of engineering education in Croatia continuously share similar problems with related aspects of engineering education in the world. Maybe regardless of the extent, these problems are reflected in the character of the integration of social and humanistic issues in the engineering study. These issues are poorly involved in the main engineering courses and still predominantly function as an addition – as a legitimate, but separated unit. In addition, their legitimacy is often reduced and assessed in terms of the adaptation to the needs of the business world. As much as it was a real enrichment of professional competence, quite rich and developed literature of engineering provenance points to the need to critically question the things and overcome in terms of humanistic worldview and knowledge to consider science and technology as a way to achieve a better and fairer society [35].

Finally, it is obvious that the strategic orientations of the institutions that implement engineering education are of great importance in defining the range of related SS&H issues. To the extent to which such strategic documents clearly show the importance of engineers in society as actors dedicated to independent deliberation and participation in creating a better and fairer world – a space for creative development of non-technical fields of academic engineering programs is enriched and expanded. Conversely, strategically defined image of engineers as generally effective servers for business and corporate world, despite the seductive images, narrows that space and reduces it thematically.

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INTEGRIRANJE DRUŠTVENO-HUMANISTIČKIH ZNANOSTI U NASTAVNI PROGRAM STUDIJA STROJARSTVA

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SAŽETAK

Članak se bavi načinima na koje su, u razdoblju od 1980-ih do danas, društveno-humanističke znanosti integrirane u nastavni program Fakulteta strojarstva i brodogradnje Sveučilišta u Zagrebu. Nakon pregleda odabranih istraživanja i teoretskih doprinosa temi, u radu se naznačuje i kontekstualizira mjesto istraživanja. Elementi socio-historijskog istraživanja utvrđeni su analizom pripadajućih dokumenata: nastavnih programa iz 1980-ih, 1990-ih i 2000-ih te strateških dokumenata fakulteta. Analiza pokazuje da su društveno-humanističke znanosti u programima studija strojarstva kontinuirano zastupljene kao legitimna, ali ipak odvojena cjelina, slabo integrirana u glavne inženjerske sadržaje. Zajedno s manje-više izraženom orijentacijom prema mikro-društvenim i mikro-ekonomskim temama upotrebljivim u svijetu industrije i biznisa, to upućuje na glavna obilježja u kontinuitetu etabliranja društveno-humanističkog područja u studij strojarstva. Napokon, pokazuje se kako su mogućnosti za sadržajno bogatije proširenje spomenutog područja u neposrednoj vezi s načinom na koji se inženjerstvo osmišljava i društveno kontekstualizira u fakultetskim strateškim dokumentima.

KLJUČNE RIJEČI

inženjersko obrazovanje, inženjerska profesija, netehnički kolegiji