MATERIALS SCIENCE MA(S)TERS

developing a new master's degree

REPORT ON INTELLECTUAL OUTPUT 1

THE MARKET AND SCIENCE ENVIRONMENT NEEDS ANALYSIS

Final report on IO1 with recommendations for IO2

MATERIALS SCIENCE MASTERS

Co-funded by the European Union

UNIVERSITY OF SILESIA IN KATOWICE

Co-funded by the European Union

Contents

Introduction 3

The aim of IO1 5

Sub-task, technical approach and 6

Conclusions and recommendations 9

Part 1: Student survey 9

Section 1: Quality of the study program 9

Section 2: Teaching quality 12

Section 3: Learning resources/student's support 13

Part 2: Company/Industry survey 14

Section 1: Knowledge and engineering skills 14

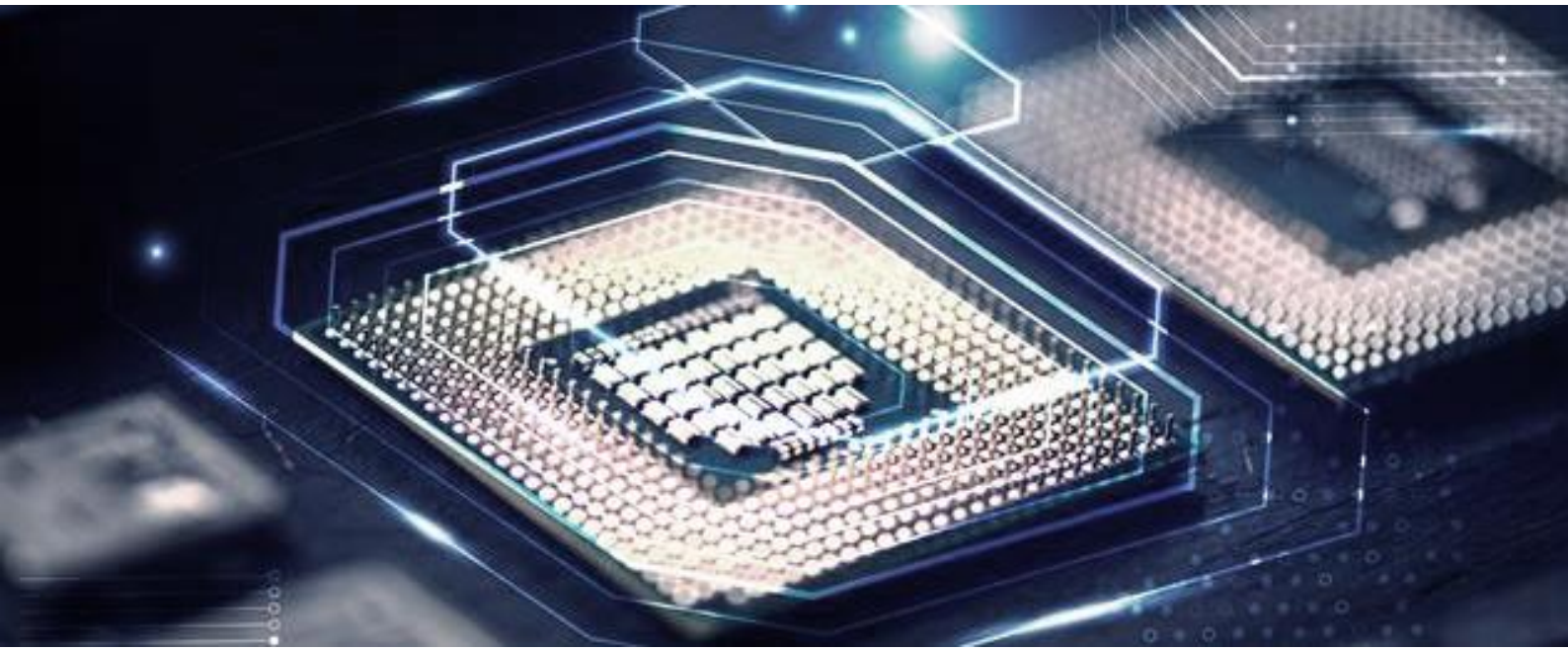
Section 2: Competences gap in organizational skills and others 14

Section 3: Lectures suggestions 14

Section 4: Comments regarding materials science education 15

Section 5: Collaborations with Industry and University 15

Part 3: Seminar 16



Introduction

The need to develop Science and Engineering is a long-term struggle for humanity to improve life and conditions, i.e., well-being, for a better future for all living subjects. It is almost an obligatory duty for all to fulfill the desire and curiosity to learn and apply for the matter of technology which is a collective title for the result of advancing science and its application put into the use of humanity.

Technology was and is the only means of advancement in carving through science and climbing up the ladders of perfection to a complete knowledge-driven community. Applied sciences base themselves in the heart of student or scholars who has the affinity for knowledge; where there is no desire for such, there will be no advancement in the driving force in the related scientific community. In the meantime, science evolves and adapts itself to the necessity interacting subjects, i.e., humans, particularly those applying science to industry practice.

One of the most technologically advanced subjects is materials science, and its applied branch, Materials Engineering, in addition to Metallurgy, is the oldest technical profession on earth, which changed the destitute of living beings. However, being a driving force and engulfing the variety of basics and applied sciences together, Materials Science and Engineering is in decline in preference to newly spiked professions which also utilize its products. This is not the indication

of contempt in those branches of science and technology but it is the finding a new role in Materials Science and Engineering in newly reforming or reshuffling scientific medium. As previously said, where there is no desire, there will be no well-paced advancement, but rather ill-paced and slow growth tends to be observed.

To maintain the interest and further research in Materials Science and Engineering field and to reveal its potential in the developing scientific world, a step forward is a must in this field, by either sustain existing interesting features of materials science and engineering or speak of its broadness in the development of almost all technological branches.

"Materials Science Ma(s)ters - developing a new master's degree program" is a project co-funded by the European Union within the scope of Erasmus + program KA220 HED and is a collaboration between the University of Silesia in Katowice (Poland), the University of Zilina in Zilina (Slovakia), Afyon Kocatepe University in Afyonkarahisar (Turkey) and the Ivan Franko National University of Lviv in Lviv (Ukraine). The goal of this initiative is to develop an industrial-oriented materials engineering master's program. As a requirement of this project, ideas are taken from businesses and institutions of different sizes about the lessons to be offered and the topics to be covered.

Co-funded by
the European Union

The aim of IO1

The result aimed to identify knowledge and skills desired by employers, and students' expectations as to the methods and results of studying, analyze the needs and barriers of contemporary teaching in materials engineering and identify possible solutions.

Sub-task, technical approach and

To develop recommendations for the IO2 task, the following sub-tasks were carried out:

1

Creation of a common enterprise database of companies representatives related to materials engineering, all partners provided links for labor market enterprises ready to participate in studies in their own respective countries.

Participants: US, AKU, UNIZA, IFNUL

Implementation period: 02 - 03.2022

Indicator for implementation: at least 50

Realized indicator: 50

2

Development of research tools for the analysis of students and labor market - surveys separately for students and representative of the industry.

Participants: US, AKU, UNIZA, IFNUL

Implementation period: 03 - 04.2022

Indicator for implementation: one survey for each: students and labor market

Realized indicator: one survey for each: students and labor market

3

Polling labor market needs and expectations of employers regarding necessary competencies of potential job candidates by each partner (study, in total, at least 50 companies participating).

Participants: US, AKU, UNIZA, IFNUL

Implementation period: 04 - 06.2022

Indicator for implementation: 50 companies

Realized indicator: 50 companies

4

Polling students - market needs by each partner

Participants: US, AKU, UNIZA, IFNUL

Implementation period: 04 - 06.2022

Indicator for implementation: 80 students

Realized indicator: 160 students

5

The seminar "Needs and barriers in didactics of materials engineering", dedicated to the academic teachers, was organized in Chorzów (Poland) on 12th May 2022 in hybrid form with the use of the ZOOM platform.

Participants: stationary 62 participants from Poland, Slovakia, Turkey, and Ukraine and 65 participants connected online from Algeria, the Czech Republic, Pakistan, Poland, Finland, Canada, and Great Britain

Implementation period: 05.2022

Result: Report on the current state of barriers and needs in the teaching of material engineering,

6

Compilation of data from the students and labor market surveys. Completion of analysis report on current needs in the labor market and expectations of employers regarding necessary competences of potential job candidates and current state of education in material engineering according to students and their needs.

Participants: US, AKU, UNIZA, IFNUL

Implementation period: 06 - 08.2022

Realized indicator: Report The Market And Science Environment Needs Analysis. Analysis on current needs in the labor market and expectations of employers regarding necessary competences of potential job candidates and current state of education in material engineering according to students and their needs.

7

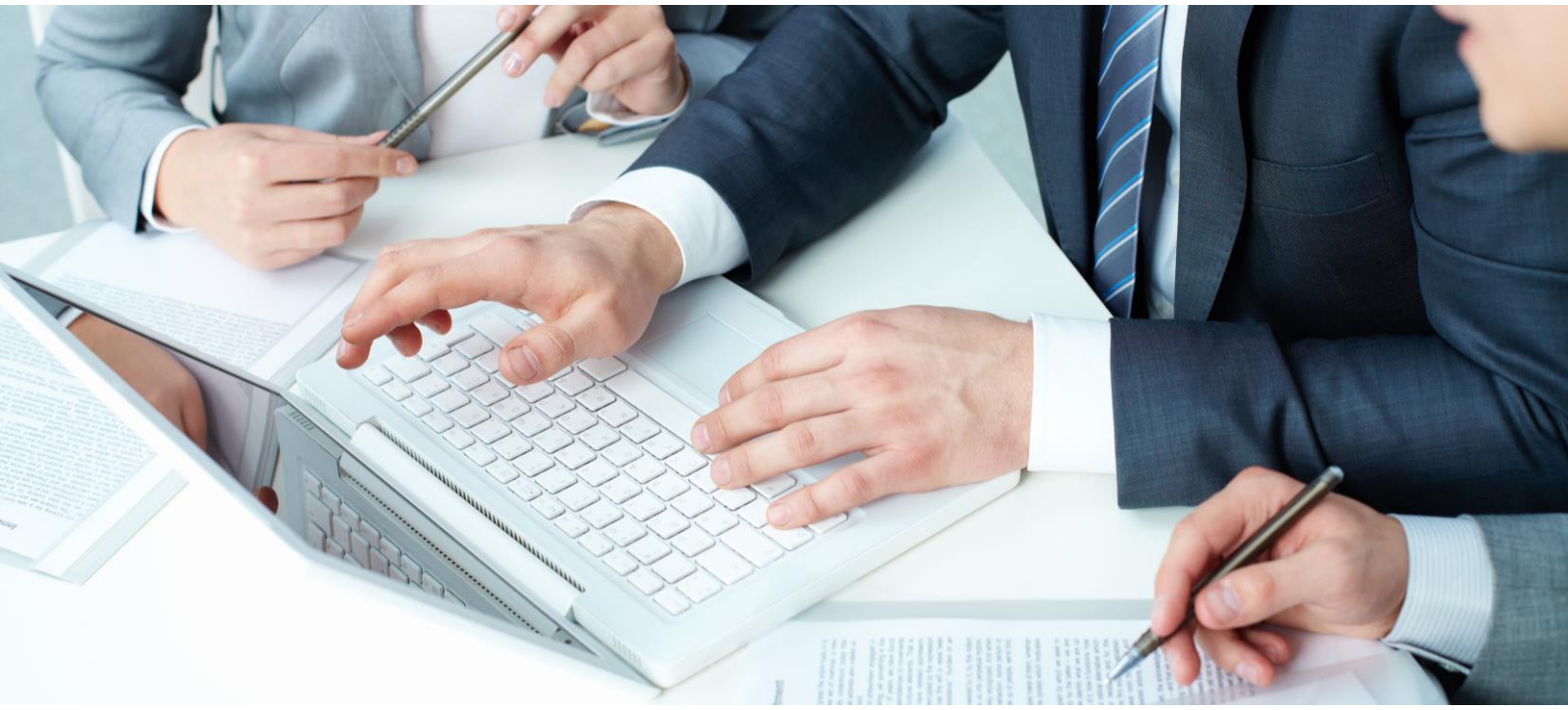
Recommendations from the conducted analyses and seminar - proposal for changes and conclusions in the form of good practices, and suggestions for the best teaching methods and resources for materials engineering didactics.

Implementation period: 06 - 07.2022

Participants: US, AKU, UNIZA, IFNUL

Realized indicator: Final report on IO1 with recommendations for IO2.

Co-funded by
the European Union



Conclusions and recommendations

Part 1: Student survey

Section 1: Quality of the study program

1

In the opinion of students, the developed study programs were of good quality. However, this opinion does not coincide with the later answers to the questions. Most students get to know the curricula, modules, and topics and generally say their choice was right - a good one. However, going into the details of the program evaluation, it appears that there are too few practical classes. They are generally satisfied with the level of specialists/lecturers. The excellent quality of the programs may be proved by the fact that approximately 70% of respondents would undertake these studies again and/or recommend them to others, and the knowledge gained during their study affects finding employment. However, the number of answers for "slightly" and "not at all" increases threefold when the

application for a job abroad is concerned. One of the reasons is the insufficient quality of English language teaching, in particular technical.

Conclusion:

The research and the collected results show that the developed programs are at a reasonable level. However, they require improvement and modernization following the modern labor market in materials engineering.

Recommendation:

To maintain the overall outline of the program with an increase in the number of practical classes and specialized English.

2

It was varied on to the specific thematic blocks of the curricula that were most useful in the opinions of students and alumni. Similar differentiation occurred in the assessment of unhelpful blocks. However, among the respondents' responses, it could be seen that the modules related to Materials characterization, Materials Science Engineering, Quality control, Structure of Materials / Crystallography, and testing labs are a strong point of the currently functioning programs. Basic subjects such as Crystal chemistry, colloid chemistry, and physical chemistry were not selected from the proposal. On the other hand, the blocks of modules related to management/economics, philosophy/sociology, mathematics/statistics, Physics, mechanics / Engineering/technology / electrical, according to the respondents, did not contribute anything necessary to obtain knowledge, skills, and competencies helpful in obtaining a job.

Conclusion: Summing up this part, it can be concluded that the humanities and basic sciences modules are not crucial in receiving a job in the field of materials science.

Recommendation: These modules should be reduced to a minimum or their parts should be incorporated into engineering modules where a given issue is discussed with the addition of basic knowledge.

3

According to about 12% of respondents, it is unnecessary to introduce IT tools/skills tools. The respondents claim that they have general knowledge and can use them. However, almost 20% believe that the MS Office suite is needed and used practically, as well as: Online resources, engineering drawings or atom/molecule modeling. Programming is of less interest as well as distant learning tools, robot control software, and data processing.

Conclusion: Education at the earlier stages provides students with a small part of tools used in second-cycle studies and is useful in further work. Generally, software packages are needed for processing and editing data (application for laboratories), and specialized software is required depending on the specialization and completed diploma and final theses.

Recommendation: Increasing work using tools such as editing packages, calculation, and simulation packages.

4

Conclusion: In the case of results related to basic needs that could help in the work carried out or continuing education, the respondents emphasize the importance of skillful solving practical problems and working in laboratories. In addition, they note the importance of research tools.

Recommendations: Introduce the form of seminar classes or replace the form of lectures with examples in conjunction with the theory focusing on the so-called "case study". The analyzed cases should come from actual incidents that have occurred/encountered in the industry. The analysis of the questionnaires shows the need to maintain an increase in classes covering research methods and techniques. The application of the of acquired knowledge in practice is at an average or poor level (most answers), hence there is a need to reduce the inflow of theoretical knowledge and increase the practical knowledge.

5

Conclusion: The results regarding the form of conducting classes show that the contact form is preferred during lectures, while the seminars should be remote. The same is valid for exams. However, conducting remote examinations shows a decrease in knowledge and the level of knowledge.

Recommendations: introducing seminars in a remote form, maintaining the contact form in the case of lectures and exams.

Section 2: Teaching quality

The respondents' answers regarding the quality of education indicate that it is generally conducted at a reasonable level. Approach to students and their stimulation, student-teacher communication, and the availability of teachers are usually good or excellent (about 64%). However, this analysis should not be generalized but should approach the results of individual project partners. Some lecturers do not meet academic standards. Thus university or faculty authorities, knowing these facts, should take preventive steps.

6

Conclusion: The quality of teaching, as assessed by students, is at a reasonable level, and this is not a reason for students from leaving the university or not taking up studies.

Recommendation: Appropriate selection of academic teachers meeting the highest academic standards is required.

Co-funded by the European Union

Section 3: Learning resources/student's support

Most often, for reasons related to student support and university facilities, the respondents indicated boredom/disinterest, no prospect of a career, and lack of support from lecturers and administration. The latter factor is in contradiction with the results obtained in section 2.

7

Conclusion: The factors mentioned above are not a common reason for leaving the studies, or they are not in the first place when it comes to not choosing the field of material engineering.

Recommendation: Increasing the attractiveness of the education program, e.g., by organizing scientific visits, educational trips, internships, or study visits to industrial centers or inviting industry representatives or specialists from other universities to attend activities.

Part 2: Company/Industry survey

Section 1: Knowledge and engineering skills

The questions have been arranged according to the principle of closed questions with an appropriate assigned scale. First, the industry's expectations and the employed graduate's quality were concerned.

1

Conclusion: The comparison of the obtained results shows that the level of knowledge and engineering skills expected by the employers is high, while the employed candidate has features on the rating scale lower than expected.

Recommendation: Increase the candidate's level of knowledge and skills

Section 2: Competences gap in organizational skills and others

2

Conclusion: The situation is similar in the case of organizational competencies as above: the comparison shows that the expected level is high, and the candidate is characterized by organizational skills one step lower.

Recommendation: Raising the level of competencies and organizational skills of the student.

Section 3: Lectures suggestions

3

Conclusion: The industry is generally open to collaboration with universities in materials science. The shortcomings revealed in sections 1 and 2 mobilized industry representatives to propose modules that could increase the employed materials engineering graduate's knowledge, skills, and competencies. These were in particular: Microstructural Characterization and Analysis, numerical modeling in

heat treatment, Image processing in Material science and engineering, Microstructure and property interactions, Testing standards in Quality control procedures, Surface science/tribology/mechanism.

Recommendations: Maintain these modules in the curriculum or, if there is none then introduce them.

Section 4: Comments regarding materials science education

4

Conclusion: Among the three significant problems/gaps in materials science education at universities mentioned by employers, the respondents primarily indicated: lack of practical and theoretical knowledge in the field of materials and manufacturing/processing methods, problems with personal development of the student, or Wide range of Industry Branches/R&D. On the other hand, the responses from industry respondents show that students are well supplied with Basic Sciences and Basic Vocational/Technical knowledge.

Recommendation: Increasing the level of practical knowledge.

Section 5: Collaborations with Industry and University

5

Conclusion: The industry is open to cooperation with universities and will welcome it.

Recommendation: Focusing the subject of diploma theses on the problems faced by the industry. Joint implementation of such works. Increasing practical classes, but with the use of industrial facilities.

Part 3: Seminar

Conclusion: The industry is open to cooperation with universities and will gladly take it. More and more foreigners choose to study Materials Engineering in English. It seems interesting for students to propose dividing study topics into Bio and Nano and to include the 3D printing methods path in the education program. The division into industry-related "practical studies" and science-related "theoretical" studies. Studies in the Bologna system (3 + 2 model) do not work well concerning technical and scientific subjects requiring not only theoretical knowledge, but also practical experience acquired in research and teaching laboratories. The number of candidates for studies in material engineering at the partner's universities is decreasing. One of the reasons is the demographic decline and not necessarily the lack of attractiveness of the curricula.

Recommendations:

Focusing diploma theses and the problems faced by the industry. Joint conduction of such works. Increasing practical classes, but with the use of industrial facilities. Due to the growing number of foreign-originated candidates for material engineering studies, developing a competitive educational program concerning other international units makes sense.

MATERIALS
SCIENCE
MASTERS

Co-funded by
the European Union

UNIVERSITY OF SILESIA
IN KATOWICE