Strategic programme of scientific research

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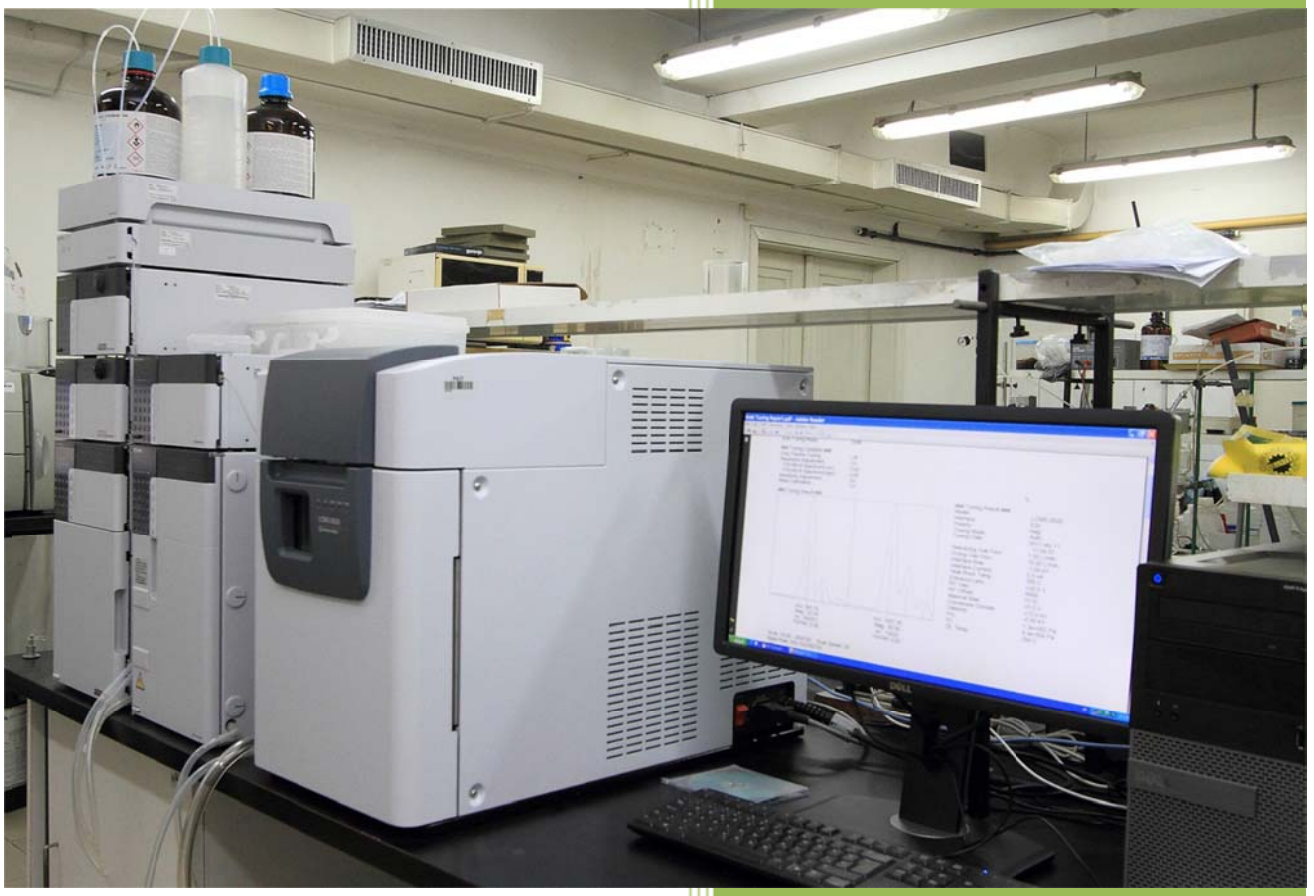

University of Zagreb
Faculty of Chemical
Engineering and Technology

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Strategic Programme of Scientific Research of the Faculty of Chemical Engineering and Technology of the University of Zagreb for Period 2015 – 2020

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1. Introduction

The Faculty of Chemical Engineering and Technology of the University of Zagreb (the Faculty), as a public institution financed to a large extent by the state budget money, wants to use public resources responsibly and return the best possible value for money to the community. This means that – even in the current state of limited resources – the Faculty aims at increasing its quality level by responsible actions in all the fields of its activity. In the very focus of the Faculty activity there is the scientific research, for at least two reasons. At first, an excellent science is the only warrant of an excellent instruction. The results coming from the research are to be transferred into the teaching process; the students are to be included in the research where they can breathe a sense of innovativeness – to be transferred to others later in their career. If not so, the Faculty ceases to be the university institution and turns into the polytechnics or vocational school. Secondly, the results of the scientific work are to be transferred to the business sector as well, because this is exactly what the community in a desire to advance expects from us. Mature technologies and well-established knowledge are for sale on a free market and therefore they cannot bring any comparative advantage to a society – novel things have to be developed. If not so, the society becomes merely a service, a step or two behind the best ones. In the light of the culture of quality the Faculty adopts this strategic document in order to plan the directions of its scientific activity in the next five-year period. We base our research on knowledge at disposition, in areas where we feel excellent and competitive; otherwise we would be building the house without a firm foundation. We look into the future far behind the encompassed five years, but – that is the very nature of the science – in five years time the world might look entirely different, and it is well-known fact that the all-world knowledge base is doubled every two years.

The Faculty bases this Strategic Programme of Scientific Research on the recent self-evaluation report[1], on the adopted general strategy of development of the Faculty[2], on the rendered decision on the Faculty restructuring[3], on the European trends in higher education[4-12], on the Science and Higher Education Act (NN 123/03, 198/03, 105/04, 174/04, 2/07–OUSRH, 46/07, 45/09, 63/11, 94/13, 139/13 and 101/14–O and RUSRH)[13], the national Strategy of Education, Science and Technology [14], the Self-Evaluation Report of the University of Zagreb[15], the corresponding Evaluation Report [16], strategic documents of the University of Zagreb [17], in particular the Strategy of Investigations, Technology Transfer and Innovations, other acts and ordinances of the University and the Faculty, Dean's Programme etc.

2. Historical Framework

The University of Zagreb (the University) was officially founded on September 23rd, 1669 by Emperor and King Leopold I Habsburg who issued a decree granting the status and privileges of a university to the Jesuit Academy of the Royal Free City of Zagreb. Therefore, the University celebrates 1669 as the year of its foundation. The gradual development of science and ever changing social circumstances forced the University to change its organisational framework superposed onto its continuous growth.

In year 1919 the Technical Institute was founded in Zagreb; one of its departments was the Chemical Engineering Department, the first Dean of which, Prof. Vladimir Njegovan, Ph.D., from the very beginning strove to ensure the teaching and scientific activity modelled upon European and American higher-education institutions. He very soon gathered the first group of distinguished teachers, such as Ivan Marek, a well-known inventor of the furnace for elemental analysis of organic chemicals Ivan Plotnikov, a world renowned photochemist, Franjo Hanaman, an inventor of a Tungsten filament for electric bulbs and later on, Vladimir Prelog, a future Nobel laureate. The Technical Institute very soon became the part of the University of Zagreb, from 1926 holding the name of the Technical Faculty of the University of Zagreb. Following the restructuring of the Technical Faculty in 1956, the Chemical Technology programme of study was taught at the Faculty of Chemical, Food and Mining Technology, and from 1957 within the newly-founded Faculty of Technology. In 1978 the Faculty of Metallurgy and

in 1980 the Faculty of Food Science and Biotechnology became separate faculties. Finally, on 16 November 1991 the Faculty of Technology split into the Faculty of Chemical Engineering and Technology and the Faculty of Textile Technology, and the long lasting wish of the Faculty to become independent came true. From the very beginning of the higher education at the Faculty (and its predecessors) more than 6000 students graduated and over 1100 M.Sc. theses as well as around 650 doctoral dissertations were defended. All of this points to the long-lasting tradition of the Faculty and on its potential in educating well-trained engineers as well as on its capability of dealing with the most demanding research and professional topics.

3. The Faculty Today

Today, the Faculty gathers 16 Departments and one Chair as well as the Library and Information Centre (BIC, Bibliotečno-informacijski centar) of the Faculty. The Faculty has premises in four buildings situated at the three main locations; none of the buildings is owned by the Faculty. The Faculty has 11 lecture rooms and two IT classrooms, the Faculty Council hall, 56 laboratories with associated minor facilities, a number of teacher offices, as well as auxiliary premises. The quality of the premises is below the standard and it is planned to migrate the Faculty to the Borongaj Research and Education Centre. At the same time, the Faculty rendered a decision on its restructuring which intends to reduce the number of Departments from present 16 to future four.

The basic activities of the Faculty are teaching, scientific and research activity, professional activity as well as well as socially responsible activity in the areas of chemical engineering, other fundamental technical sciences, interdisciplinary technical sciences and chemistry.

The Faculty carries out four undergraduate and graduate programmes of study, respectively, one postgraduate doctoral programme of study as well as one postgraduate specialist programme of study. In the two postgraduate interdisciplinary programmes of study the Faculty acts as the coordinator institution. The Faculty is able to meet the entire enrolment quota for undergraduate programmes of study (220) and graduate programmes of study (125) on regular basis. The number of students per year who complete graduate programmes of study of the Faculty varies from 60 to 100. The overall count of students exceeds 1000 if doctoral students are included. The Faculty employs 57 teachers holding academic ranks, three teachers holding teaching ranks and 15 teaching assistants. 37 junior researchers are engaged in the teaching process as well. In addition, there are two professional associates, technical staff amounts to 18, administrative staff to 20 and auxiliary staff to 21.

The scientific activity is commonly organised via national scientific projects financed by the Croatian Science Foundation (five projects), and to a much lesser extent via programme contracts financed by the Ministry of Science, Education and Sports (and distributed by the University in a form of so-called short-term financial support of investigations). However, the scientific potential of the Faculty is much better illustrated by the number of 34 so-called Z-projects by the Ministry of Science, Education and Sports that expired recently; those projects formed a basis for high scientific output of the Faculty for many years. The Faculty regularly applies to the international calls and occasionally some top-class projects (FP6, FP7, Horizon 2020) are selected for funding. According to the Web of Science (tertiary database), from the beginning of 2009 to the end October 2014 the scientific output of the Faculty amounts to 517 publications. The figures for Current Contents (tertiary database) and Scopus (secondary database) are 501 and 586, respectively. Those numbers (normalised by the number of staff) position the Faculty to the very top of scientific productivity in the Republic of Croatia. The Faculty itself is a publisher; its editions include university textbooks and handbooks, a number of popular science items as well as a journal cited in Current Contents and Web of Science tertiary databases. The Faculty is involved in four CEEPUS projects, two COST projects and one NEWFELPRO project.

The professional activity is best illustrated by 61 projects started in the last five years as well as a number of other activities, such as organisation of professional meetings and excursions, coordination and involvement in many professional societies, execution of summer schools and professional courses, occasional laboratory analyses, providing of professional opinions and expertises etc. In December 2014, the first spin-off company owned by the Faculty and University was founded. In addition, the

Faculty hosts its alumni organisation for the last 25 years – the Association of Graduate Engineers and Friends of Chemical and Technological Studies, *Almae matris alumni chemicae ingeniariae Zagrabiensis* (AMACIZ).

4. The Proposal for Restructuring

The Faculty Council has on October 27th, 2014 in its 182nd regular session, adopted the proposal for restructuring that is closely related to this strategic programme. Namely, one of the main objectives of the restructuring was to define more precisely the research capacity of the Faculty and consequently to optimise it.

According to the newly proposed organisation scheme, which is yet to be implemented following the adopted Development Strategy, 16 present Departments and one Chair shall be replaced by four Departments: the Department of Applied Chemistry (*Zavod za primijenjenu kemiju*, ZPK), the Department of Chemical Process Engineering (*Zavod za kemijsko procesno inženjerstvo*, ZKPI), the Department of Materials Engineering (*Zavod za inženjerstvo materijala*, ZIM) and the Department of Environmental Engineering (*Zavod za ekoinženjerstvo*, ZE) which clearly define the fundamental directions of research at the Faculty and correspond at the same time to the structure of the programmes of study and – at least partially – to the structure of professional activities at the Faculty (although those activities are by nature the more successful the more interdisciplinary they are). The four proposed Chairs: the Chair of Social Sciences and Humanities (*Kabinet za društvene i humanističke znanosti*, KDHZ), the Chair of Physics (*Kabinet za fiziku*, KF), the Chair of Mathematics (*Kabinet za matematiku*, KM) and the Chair of Electrical and Mechanical Engineering (*Kabinet za elektrotehniku i strojarstvo*, KE) cover the areas that are not fundamental for the Faculty. This does not mean that the Faculty is against the research of his employees in the corresponding areas. On the contrary –scientific research is their duty as well and the Faculty shall support the inclusion of the employees coming from those Chairs in any interdisciplinary project, either initiated by the Faculty or by any other institution, which requires their area of expertise.

According to the accepted proposal, the Department of Applied Chemistry (ZPK) would include 13 academic staff members and one senior lecturer operating in 12 existing research laboratories and four student's laboratories. The Department of Chemical Process Engineering (ZKPI) would include 13 academic staff members, 12 research laboratories and five student's laboratories. The Department of Materials Engineering (ZIM) would include 15 academic staff members, 12 research laboratories and five student's laboratories. The Department of Environmental Engineering would include 11 academic staff members, 12 research laboratories and three student's laboratories. The number of teaching assistants, junior researchers, technicians and professional associates would be approximately equal in all the Departments of the Faculty. The true rationalisation of the premises, i.e. merging of some research and student's laboratories would be possible only after migration to the migration of the Faculty to the Borongaj Research and Education Campus, which is an objective forcefully supported by the Faculty – the Faculty shall do its best to migrate to the Campus as soon as possible.

Such an organisation scheme would largely facilitate the effort in achieving the Faculty mission:
The mission of the Faculty is to promote chemical engineering, applied chemistry, materials engineering and environmental protection engineering as scientific disciplines by establishing links between science and technology and economy, industry and public activities, with the aim of achieving sustainable development, increasing the general level of innovation in the society, accelerating knowledge transfer, that is creating and promoting new entrepreneurship.
as well as to accelerate the realisation of its vision:
The vision of the Faculty is to become recognised in the Central European region as a venue of "good vibrations", a focal point of partnership- and cooperation-based gathering at the international, national and local level, in the projects developing innovative and improving current chemical processes, products, that is materials and in the environmental protection projects. The students who complete their undergraduate, graduate and postgraduate programmes at the Faculty will be sought as excellent and broadly educated human resources competent in finding efficient problem solutions within their

scope of activity. The public at large will recognise the Faculty as an institution showing corporate social responsibility within the scope of its scientific, educational and professional activity.

5. SWOT Analysis

Within the area of scientific research, the Faculty recognises the following strengths, weaknesses, opportunities and threats.

Strengths

- Scientific activities are traditionally well transferred into teaching practice and professional activities
- The present academic staff is elected into their positions in compliance with criteria that are far above the national ones in the field of technical sciences, which means that the teachers are adept to publishing in prestigious international journals
- The above mentioned high criteria as well as the large number of junior researchers and teaching assistant in recent years have made them very competitive; part of those junior researchers remained employed at the Faculty, the other part left to the business sector or other scientific institutions, yet keeping strong liaisons with the *Alma Mater* thus creating the powerful formation of alumni with a huge collaborative potential

Weaknesses

- Poor working conditions of the Faculty (premises, including the research laboratories)
- A lack of financing of material assets by line ministries as a result of a poor economic situation
- A lack of financing of human component – the decreased number of projects is accompanied with the decreased number of junior researcher which in turn increases the teaching load of the academic (research) staff
- A small number of applications for the national and international calls for funding the scientific research

Opportunities

- Foreseen migration to the new building at the Borongaj Research and Education Campus
- Pioneer attempts of the Faculty in the establishment of spin-off companies that might take over a large part of the professional activities, thus liberating a part o human resources for more involvement in research
- The incipient success in the application for new cycles of calls of the Croatian Science Foundation and Horizon 2020 serve as an impulse for others on the Faculty to put more effort project applications
- A relatively large number of approved so-called short-term financial supports of investigation (financed by the Ministry of Science, Education and Sports via programme contracts and distributed by the University) creates positive environment for the future applications that would support the valuable research
- A favourable moment sensed in the Croatian pharmaceutical industry as a traditional partner of the Faculty opens many possibilities for intensification of cooperation and joint research projects
- The increasingly bold social consciousness on the necessity of solving environmental “skeletons in the closet” in conjunction with the knowledge gathered on the Faculty brings many new topics into the scientific focus of the Faculty
- A recently reformed and therefore modern doctoral programme of study is capable to attract more students, indigenous, coming from the neighbouring countries as well as those from the third world

Threats

- A difficult moment in the basic chemical industry in Croatia threatens to cut off the whole range of scientific topics oriented toward the collaboration with that industrial branch.

6. A Strategic Objective, Measures and Activities in the Area of Scientific Research

In the adopted general Development Strategy of the Faculty, only one – yet comprehensive and extremely demanding – strategic objective is defined in the area of scientific research, that is:

- To confirm and raise the indicators of scientific and professional productivity.

The objective is comprehensive since those indicators are usually the first, the most important and – unfortunately – often the only indicators used to judge our value. It is heard commonly: How often do you publish? How many European projects do you have? What's your citation count? The objective is extremely demanding as well, because the self-evaluation report clearly shows that our scientific project indicators are at the very top on the national level. On the other hand, in comparison with the similar European institutions a demand and plenty of room for advance is apparent. Hence, it is important to resist the sense of satisfaction and to prevent losing a desire for betterment. We should take successful foreign institutions as our examples-to-follow.

Here we shall transfer the measures and actions plans from the general Development Strategy that are **directly** related to the scientific research activities. These are:

Measure A. To involve more intensively in international scientific projects.

Action plan A. The Faculty is at the very top of scientific productivity on the national level, but there is a rather large gap when comparing to relevant international institutions. A step forward can be achieved only by the more intensive involvement in international scientific projects. The activities done in this area will be sensed in the Strategic Objective 6 as well. The activity carriers are the Vice-Dean for Science and International Cooperation and the Commission for International Cooperation, as supporting and consulting bodies. The awareness of the need for such projects is immanent, and there are individual and persistent efforts. The expected amount of work is not as large as to justify establishing the Office for International Cooperation of the Faculty at this moment, but the situation has to be carefully monitored and – if changed – the reaction has to be immediate. The experience of the International Office of the University, MZOS, AZVO and the Agency for Mobility and EU Programmes (AMPEU – *Agencija za mobilnost i programe Europske unije*) has to be thoroughly exploited. The potential applicants for project proposals have to be encouraged to take part in national and international workshops and conferences, available web portals for gathering project consortia have to be used, etc. In addition, members of the Office for Material Transactions and Financial Management of the Faculty have to be trained in order to be able to provide financial services in the international environment more efficiently.

Measure B. To involve more intensively in national competitive scientific projects.

Action plan B. The repealed so-called Z-projects have been replaced by projects of the Croatian Science Foundation (HRZZ – *Hrvatska zaklada za znanost*) and – to a lesser extent – programme contracts financed by MZOS (and distributed by the University in a form of so-called short-term financial support of investigations). The overall level of financing decreased nevertheless in comparison to the previous period. The Faculty has to push more effort into HRZZ calls, but one cannot expect a significant increase because there are many applicants for a relatively small amount of money. The activity carriers are the Vice-Dean for Science and International Cooperation and all the academic staff as potential applicants. Members of the Office for Material Transactions and Financial Management of the Faculty have to be permanently trained in order to be able to provide financial services more efficiently.

Measure C. To persist in the scientific excellence of doctoral programmes of study.

Action plan C. In the past period the Faculty has accepted completely the provisions of the Ordinance on Doctoral Programmes of Study at the University of Zagreb in all details of the procedure. The procedure is aimed at shortening the period of study and it should be insisted upon. At the same time, the Faculty has for the sake of rationalisation merged its two doctoral programmes of study into a single one entitled Chemical Engineering and Applied Chemistry. In addition, the Faculty has adopted the criterion on publishing articles within the doctoral programme of study that is more stringent in comparison to the one of the University. The Faculty should continue to insist upon it to retain the scientific rigor. The incoming mobility on the doctoral programme level is to be supported. In the sessions of the Council of the Doctoral Programme of Study (up to ten sessions annually) topics such as the introduction of new content in the doctoral programmes, introduction of new teachers in the entitlement of courses list, etc. are to be discussed. The activity holders are the Vice-Dean for Science and International Cooperation and all the academic staff as potential applicants. The activity carriers are the Vice-Dean for Science and International Cooperation, the counsellor(s) of the programme of study, the Council(s) of the Doctoral Programme of Study and the Faculty Council within range of its competence.

Measure D. To introduce the system of awarding the most successful scientists.

Action plan D. The Faculty believes that it is a sort of redundancy to award the academic staff for the scientific merit. Namely, the scientific merit is the criterion for promotion and is therefore awarded in that way. Nevertheless, junior researchers/teaching assistants/doctoral students/post-docs form the category of employees to be stimulated by awarding procedure. They are all fixed-term employees and every award or certificate of merit positively affects their *curriculum vitae*. It is proposed to award the most productive/successful scientific author from the category. The Dean of the Faculty in cooperation with the Vice-Dean for Science and International Cooperation and other Vice-Deans shall invent the criteria and prepare the decision. The Head of the Library and Information Centre shall collect and elaborate the scientific output data within a calendar year. Based on the data, the Vice-Dean for Science and International Cooperation shall prepare the awarding proposal to be adopted by the Faculty Council; the award is to be given on occasion of the Day of the Faculty.

Measure E. To intensify the collaboration with the business sector.

Action plan E. By the summer of 2015 the Business Council of the Faculty is to be constituted to gather active and interested members of the academic staff as well as recognised professionals – friends of the Faculty coming from the business sector. The Business Council shall hold regular sessions twice a year and discuss the possibilities for promoting collaboration in the promising areas. Moreover, the Business Council shall support and coordinate actions of the Faculty in direction of regulating the profession of chemical engineers in Croatia. The members of the Business Council would contribute in defining the competences of their future employees, within setting up the standards of profession and qualification framework. Another way of cooperation is establishment and initial support of spin-off companies in areas of mutual interest. Collaboration with the business sector has to be exploited for the two-way transfer of knowledge. The most valuable results are to be published in scientific or professional journals and collected intellectual property is to be protected by patent applications or corresponding confidentiality and non-disclosure agreements.

Measure F. To refresh and modify the content of university postgraduate specialist programmes of study.

Action plan F. The activity carriers are the Vice-Dean for Science and International Cooperation, the Counsellors and Councils of specialist programmes of study, the future Business Council as an advisory body and –within range of their competence – the Faculty Council and the Dean. The regular sessions of the Council of the Specialist Programme(s) of Study (up to ten sessions annually) should be used to discuss the topics such as the introduction of new courses in the programme(s) curriculum, introduction of new teachers in the entitlement of courses list, inventing new specialist programmes of study, renewal of the programmes of out-of-date specialist programmes of study, etc.

The measures shall be extracted that appear in the general Development Strategy in other strategic areas, nevertheless they are expected to affect significantly approaching the desired strategic objective. In the first place this is the measure (and the objective at the same time) of migrating the Faculty to the new location of Borongaj Research and Education Campus, and in addition:

Measure G. To bring into full operation the adopted organisational scheme of the Faculty.

Action plan G. The process begins with adjustment of the legal framework. The Dean, Secretary, Vice-Deans, the Commission for the Faculty Development Strategy and the Faculty Council are all involved in preparing, harmonising and adopting the new Statute of the Faculty. Based on the new Statute, the decisions are rendered on the abolition of existing and institution of new Departments, as well as on electing their steering bodies. (Please consult Chapter 4 of this document for more details.)

Measure H. To distribute evenly the teaching load.

Action plan H. Sessions of the Dean and the Commission for the Faculty Development Strategy and partially sessions of the Electoral Commission are the points where human resource policy of the Faculty is discussed… (It is expected that this measure might release a large part of blocked scientific potential.)

Measure I. To magnify the mobility figures of academic staff and students by involvement in exchange networks.

Action plan I. The Faculty has to institutionalise the support for all activities in the field of mobility and international cooperation… … the exchange of students, academic staff and non-teaching staff is to be supported within the programmes Erasmus+, COST, CEEPUS, bilateral and multilateral projects, bilateral and multilateral agreements, etc. The activity carriers are the Vice-Dean for Science and International Cooperation, the ECTS Coordinator and the Commission for International Cooperation. In case of large increase of the amount of work establishing the Office for International Cooperation of the Faculty is to be considered as the possibility. The services, knowledge and contacts of the International Office of the University, AMPEU, European offices and others are to be extensively used. A compulsory reporting on the results of outgoing mobility is to be introduced, preferably in form of oral reports, for example within the scientific colloquia series organised by AMACIZ. Outgoing student mobility is to be supported, for example by granting the travelling costs. (This measure aims at increasing the collaborative potential of the Faculty as a basis for more successful applications for international project calls, see Measure A.)

Measure J. To improve the material assets for studying and research.

Action plan J. …The increase of financial autonomy of the Faculty shall facilitate planning of renewal and maintenance of the existing and acquiring new capital research equipment. The responsible bodies for this area are the Dean and the Faculty Council. (Purchasing and maintenance of the capital research equipment exceed the potential of the individual research projects and constitutes a part of the integral policy of the Faculty.)

The responsible persons and bodies for performing particular measures and monitoring their execution, the corresponding indicators and time frames will not be discussed here, since the measures are actually taken from the Development Strategy of the Faculty of Chemical Engineering and Technology of the University of Zagreb for Period 2015 – 2020.[2] Within that document the same measures are numerated differently, and Table 1 shows the corresponding conversion key.

Table 1. Parallel measures from the Strategic Programme of Scientific Research of the Faculty of Chemical Engineering and Technology of the University of Zagreb for Period 2015 – 2020 and Development Strategy of the Faculty of Chemical Engineering and Technology of the University of Zagreb for Period 2015 – 2020.

Strategic Programme	Development Strategy
Measure A.	Measure 5.1.
Measure B.	Measure 5.2.
Measure C.	Measure 5.3.
Measure D.	Measure 5.4.
Measure E.	Measure 5.5.
Measure F.	Measure 5.6.
Measure G.	Measure 1.1.
Measure H.	Measure 4.2.
Measure I.	Measure 6.1.
Measure J.	Measure 7.3.

7. Strategic Directions of Scientific Research

The main purpose of this document is to recognise the directions of scientific research of the Faculty where a clear perspective is expected, i.e. there is high-quality academic staff, necessary experience, past results and the recognisability of research groups on the national and international level.

The capability of transferring the results of scientific research to the business sector is important as well. The results of IPA project *Technology Mapping at the University of Zagreb* in 2013[18] illustrate the difficulty of the very estimation. The project was aimed at mapping the technology potential and the fields of expertise of the Faculty. The general objective was to strengthen the technology transfer of components of the University of Zagreb, in order to contribute to the sustainable regional development and the competitiveness of the business within the sectors possessing high added value as well as within the sector of small and medium knowledge-based enterprises. The Recommendations as an output deliverable of the project recognised the technology potential and the professional knowledge spectrum of the research groups of the Faculty to be offered to the industry, primarily via available

services for the chemical industry, and later on by the transfer and exploiting of new technologies, methods, products and processes. In particular, moderate and/or high potential was recognised in the research areas of catalysis, organic chemistry and chemical process engineering and process control. The last statement was deeply questionable in the present difficult moment in the basic chemical industry in Croatia.

The transfer of results of scientific research into the process of instruction is equally important. According to the statement accepted from the self-evaluation report[1], the Faculty has retained, in the last five-year period, the status of leading academic institution in the fields of chemical engineering, materials engineering and science, applied chemistry and environmental engineering. The academic staff of the Faculty has in the observed period achieved high scientific productivity. The mentioned fields correspond roughly to the scheme of undergraduate and graduate programmes of study of the Faculty and they are reflected in the adopted scheme of restructuring of the Faculty as well. The new scheme shall include the following organisational units: the Department of Applied Chemistry (ZPK), the Department of Chemical Process Engineering (ZKPI), the Department of Materials Engineering (ZIM) and the Department of Environmental Engineering (ZE)

Strategic directions of the scientific research shall be arranged according to the names of future Departments, although the interdisciplinary feature of research and cooperation between the Departments and Chairs as well as with other institutions is implicitly assumed.

Investigations in the (future) Department of Applied Chemistry (ZPK)

- Analytics of the environment oriented toward the development of advanced analytical methods for monitoring priority and emerging pollutants in the environment
- Chemometrics in the analytical chemistry
- Organic synthesis oriented toward medical and pharmaceutical applications
- Organic photochemistry oriented toward monitoring of mechanisms of reactions in excited state as well as toward identification of photoproducts in laboratory and in environment
- Development of advanced chemical and biochemical sensors

Investigations in the (future) Department of Chemical Process Engineering (ZKPI)

- Methods of intensifications of modern separation – distillation, absorption, adsorption, extraction and electrocoagulation – processes
- Desulphurisation, denitrification and dearomatisation of oil and oil fractions
- Catalysts and catalytic processes – methods of intensification and applications in petroleum, petrochemical and pharmaceutical industry as well as in purification of water and air
- Development of advanced methods of industrial process control
- Comminution and agglomeration processes with applications in pharmaceutical and other industries
- Development of polymeric additives for advanced applications

Investigations in the (future) Department of Materials Engineering (ZIM)

- Surface phenomena in multiphase polymeric materials
- Bioactive and biodegradable polymeric materials
- Nanostructured organic / inorganic composite materials with potential medical applications
- Nanostructured advanced ceramic materials

- Advanced materials for applications in storage of energy
- Advanced methods of corrosion protection

Investigations in the (future) Department of Environmental Engineering (ZE)

- Advanced oxidation processes in water treatment
- Processes for treatment of waste effluents and bioremediation of the environment
- Removal of inorganic and organic pollutants from potable water
- Membrane separation processes
- Industrial biotechnology
- Application of micro- and macroreactors in biochemical engineering

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