

Faculty of Forestry, University of Zagreb and Department of Forest Engineering in the Bologna Process

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Abstract – Nacrtak

The paper presents the past course and achievements of the reform of the higher educational system at the Faculty of Forestry of the University of Zagreb. The reform is part of the effort undertaken in order to include the Faculty in the European Area of Higher Education (EHEA) and the European Research Area (ERA). A three-cycle educational system has been adopted and the curricula for undergraduate, graduate and postgraduate studies have been devised on a 3 +2 +3 (2) or 180 + 120 + 180 (120) ECTS points basis. Three undergraduate studies have been established: Forestry, Urban Forestry and Wood Technology, whose programmes are already followed by two generations of students. The following graduate study programmes have been developed: Forestry and Urban Forestry, Nature and Environment Protection and Wood Technology Processes and Design of Wood Products. Graduate studies in the Forestry department contain two programmes: Silviculture and Forest Management with Wildlife Management and Techniques, Technologies and Management in Forestry.

An improved proposal for doctoral study has been developed in the Forestry Department consisting of three programmes (Silviculture and Wildlife Management, Techniques, Technologies and Management in Forestry, and Urban Forestry, Nature Protection, Forest Management and Protection), as well as a doctoral study programme Wood Technology. Specialist postgraduate studies have been devised in ten programmes.

Keywords: Faculty of Forestry Zagreb, reform of higher educational system

1. Introduction – Uvod

The reform of the higher educational system was initiated at the Ministerial Conference in Bologna in 1999 with the issue of the famous Bologna Declaration and has been further developed at subsequent biannual conferences of the European Union Ministers. The Bologna Declaration is the core document for the reform of the higher educational system in the European Area of Higher Education (EHEA). Its signatories are ministers of education of 29 European countries gathered at a Ministerial Conference in Bologna on 19 June 1999. Croatia accepted and signed the document at a Ministerial Conference in Prague in 2001. By signing the Declaration, Croatia adopted the European higher educational system of undergraduate and graduate studies, while by agreeing to the proposals of doctoral studies put forth at the Berlin Ministerial Conference in 2003, it completed a

three-tier cycle of the higher education – undergraduate, graduate and doctoral. The higher educational system has been reformed with the goal of providing more purposeful education and enabling competent and skilled young experts to join global economic trends and create their own careers. The criteria of excellence, competence and mobility rank high in this reform.

Guidelines for the development of higher educational and research processes in the European area are contained in a number of political and professional decisions and documents of the European Union. The European Council convened in Lisbon in March 2000, where the representatives of the governments of the European Union passed knowledge-based strategic goals intended to increase employment and strengthen economic reforms and social cohesion in the decade to come (»to become the most competitive

and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion«). The strategy has been elaborated in a number of recommendations, communications and action plans, which served as a basis for the issue of key guidelines at the highest political level: Towards a European Research Area, The European Research Charter, The Code of Conduct for the Recruitment of Researchers, Action Mobility Plan, Science and Society Action Plan, and Action Plan 3%.

The reform of the higher educational system on the Bologna principles in Croatia was regulated at the national level by the 2003 Act on Scientific Activity and Higher Education and by subsequent amendments and other University documents. The National Institute of Science, Higher Education and Technological Development of the Republic of Croatia took part in the reform of doctoral studies by issuing ten core principles for the organisation of doctoral studies. The National Council for Higher Education of the Republic of Croatia passed the Principles for the Organisation of Postgraduate Doctoral Studies on July 14, 2006, consisting of General Principles, Principles of Study, and Organisational and Financial Principles.

The Faculty of Forestry in Zagreb is the oldest institution of higher specialist education in south-eastern Europe. It dates back to 1860, when the High School of Agriculture and Forestry was established in Križevci and to 1898, when the Forestry Academy was founded in Zagreb. From 1920 to 1960 it was part of the Faculty of Agriculture and Forestry of Zagreb University and later became an independent faculty within the University of Zagreb. Overall, 4,580 students of forestry and 1,647 students of wood technology have graduated from the Faculty to date. The academic titles of Master of Science and Master Specialist have been acquired by 343 students, of which 246 titles account for the scientific field of forestry and 97 for the scientific field of wood technology. A total of 190 doctoral theses have been defended, with 139 titles in the scientific field of forestry and 51 titles in the scientific field of wood technology. According to the Faculty's historical documents, all the changes in teaching plans have been undertaken with the view of coordinating the educational profile and the necessary knowledge with the increasing demands of the profession and growing specialist and scientific insights. Immediately prior to the Bologna Declaration (2000) and in response to growing demands for differentiated knowledge within the profession, the Faculty conducted a reform by introducing a module educational system. All the teachers at the Faculty of Forestry contributed to the

latest reform of the educational system with debates and proposals at the department level. In order to achieve compatibility as a basic prerequisite for free subject mobility in the European educational system, the commissions preparing the proposals drew upon the previously mentioned principles and upon their own and other experience, in particular the experience of forestry faculties in Germany, Austria, the Czech Republic, Slovakia, Hungary, Slovenia and other EU member countries.

Apart from experts at the Faculty of Forestry, the reform has also attracted the participation of experts in the Ministry of Agriculture, Forestry and Water Management of the Republic of Croatia, the Academy of Forest Sciences and the Forestry Institute of Jastrebarsko, who have organized a number of workshops. The forestry operative has taken part via the Croatian Forestry Society, as well as via the management and specialist services of the company Hrvatske Šume Zagreb. Members of the Department of Forest Engineering have also taken an active interest in the reform. The higher educational system at the Faculty of Forestry of the University of Zagreb has been reformed according to the system of three educational cycles based on a 3 + 2 + 3 (2) scheme, or 180 + 120 + 180 (120) ECTS points.

2. The reformed study structure at the Faculty of Forestry – *Struktura reformiranoga studija na Šumarskom fakultetu*

Up to the Bologna reform, the four-year study programme at the Faculty of Forestry put forth two profiles of experts with Bachelor degrees in forestry and in wood technology. The postgraduate study system led to the degrees of Master of Science, Master Specialist and Doctor of Science.

A three-tier system of higher education was adopted with the Bologna reform: undergraduate, graduate and postgraduate. The scheme is given in Figure 1.

2.1 Undergraduate study – *Preddiplomski studiji*

According to Figure 1, three undergraduate study programmes have been devised at the Faculty of Forestry and adopted by the University of Zagreb: a) Forestry, b) Urban Forestry, Nature Conservation and Environmental Protection and c) Wood Technology.

Educational undergraduate study programmes last for three years (6 semesters). Students are required to collect 30 ECTS points or 180 ECTS points

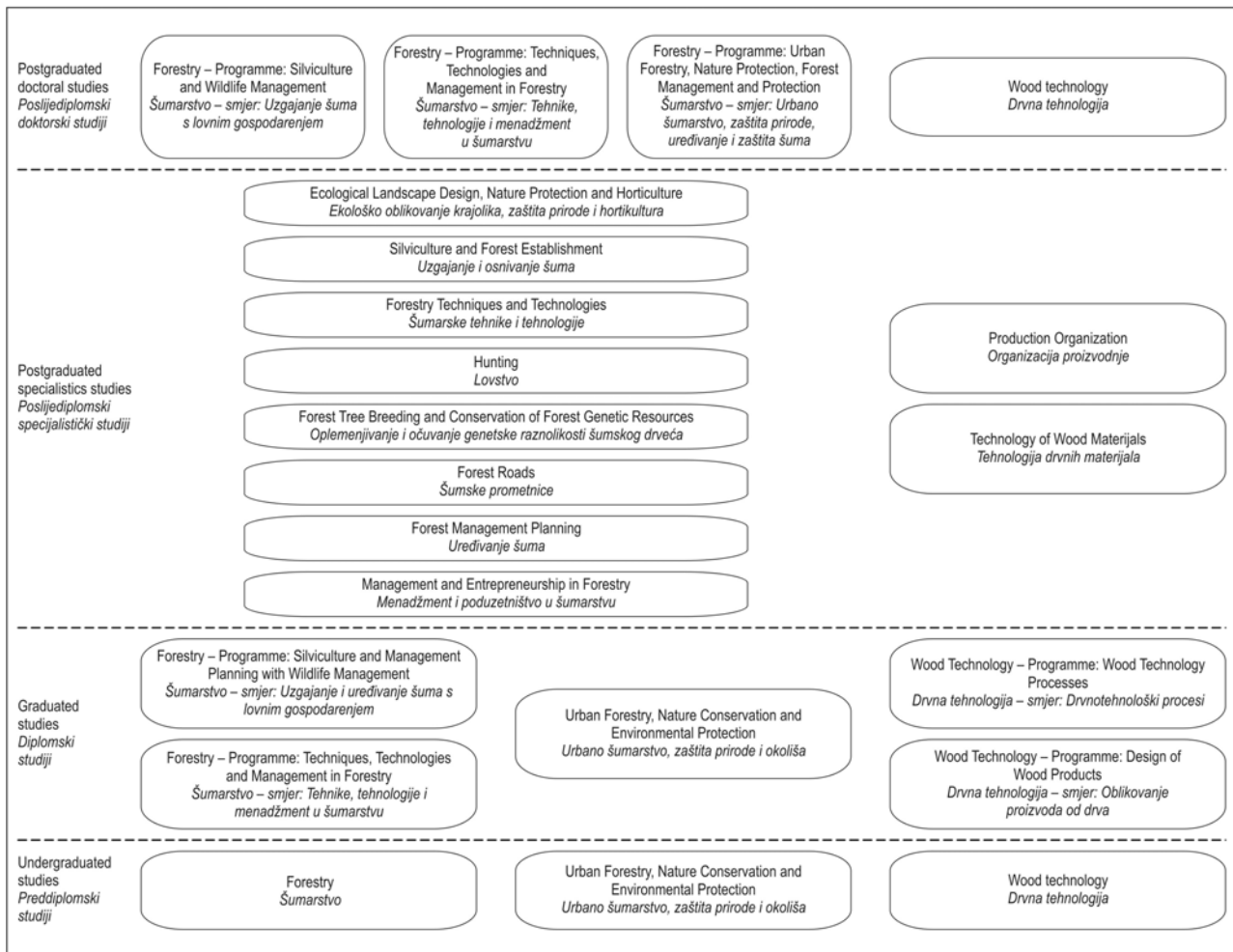


Fig. 1 Structure of the higher educational system at the Faculty of Forestry, University of Zagreb
Slika 1. Struktura visokoobrazovnog sustava na Šumarskom fakultetu Sveučilišta u Zagrebu

throughout the duration of the study. The courses are compulsory and optional, lasting for one semester with additional values of ECTS points. By completing the undergraduate study students obtain the title of baccalaureate (BSc.), acquire competences for individual and team work in private entrepreneurship and specialist jobs in forestry, urban forestry, nature conservation and environment protection, wood processing and manufacture, as well as competences for the enrolment into graduate studies. Enrolment into the programme and programme course is defined by the Faculty Statute and by other acts. Student mobility in the undergraduate programme is expressed by their ability to choose optional courses at three levels: from other undergraduate programmes at the Faculty of Forestry in Zagreb, from biotechnology studies in Croatia and from studies at other faculties and polytechnics in the country and abroad.

2.2. Graduate study – *Diplomski studiji*

The Faculty offers graduate study programmes for the educational profile in *Forestry, Urban Forestry, Nature Conservation and Environmental Protection*, as well as programmes for the study of *Wood Technology Processes* and *Design of Wood Products*. The graduate *Forestry* study has two programmes: *Silviculture and Management Planning with Wildlife Management* and *Techniques, Technologies and Management in Forestry*. The study lasts for two years or four semesters and requires 120 ECTS points in all. By completing the study, students acquire the academic title of Master according to the completed study (e.g. master of forestry – technique, technology and management). The number of optional courses per semester is significantly greater compared to the undergraduate study and offers wider possibilities for forming an individual educational profile. The study also provi-

des better possibilities for horizontal and vertical student mobility across domicile and foreign educational institutions.

Candidates in the study programmes develop managing competences and the ability to make independent and team business decisions, take part in developmental professional courses, as well as continue education in doctoral studies. By completing graduate studies, students obtain the necessary knowledge and skills for complex forestry tasks, ranging from the lowest forest structural units such as forest offices and districts to the highest ones on a vertical scale, such as county and republican institutions with jurisdiction over forestry. The scope of employment also includes inspection services, businesses and tasks in forest entrepreneurship, jobs and tasks in developmental, scientific and educational institutions, trade with forest products at home and foreign markets, trade with equipment, tasks in professional publishing and forestry-related media; complex jobs in urban forestry and forest and nature protection, as well as sawmilling and wood processing.

2.3 Postgraduate study – *Poslijediplomski studiji*

The Faculty of Forestry of the University of Zagreb has a long tradition of postgraduate education, first through the writing and defence of doctoral theses, and in later periods through the establishment of master's scientific and specialist study programmes. The first doctorate at the Faculty (Agricultural-Forestry Faculty) was defended on 4 June 1923. Before that, doctoral theses had been submitted to and defended at foreign faculties or at the Faculty of Philosophy of Zagreb University, whose constituent part was the Forestry Academy from 1898 to 1918. So far a total of 190 doctoral theses have been defended at the Faculty of Forestry, University of Zagreb.

Postgraduate study of forestry and wood technology (leading to a master's and master specialist degrees, as well as doctoral studies) in several scientific fields were established in 1960 after the Faculty of Forestry became an independent institution. The first master's degree was defended on 31 August 1964. A total of 343 masters of sciences and master specialists theses have since been submitted at both Faculty departments, of which 246 in the Forestry department.

Postgraduate study programmes are regarded as a component of lifelong learning, especially in the sense of new knowledge transfer during high-quality research and professional training and during its application in practice.

According to past experience, the following partners have expressed interest in postgraduate studies: the public economic sector, in the first place the state company for the management with state-owned forests (79% of all forests in Croatia) whose 9,500 and more employees work in over 170 regionally distributed organisational units; state administration (management and inspection services of the Ministry of Agriculture, Forestry and Water Management and state administration offices in counties); the private sector represented by a broad scope of forestry entrepreneurs employed in forestry services (operational work, trade, promotion, etc.); interest associations of private forest owners; the scientific-research sector and all those who seek to benefit from such training by achieving increased competitiveness and improving their company businesses.

2.3.1 Doctoral study – *Doktorski studiji*

Although doctoral studies were discussed at earlier ministerial conferences (Bologna 1999, Prague 2001), ministers of 33 European countries met in Berlin in 2003 to determine the priorities needed to accelerate the establishment of stronger links between the *European Higher Education Area* (EHEA) and the *European Research Area* (EHA), as well as introduce the third cycle of higher education (doctoral study) within the Bologna Process. The most important criteria that were highlighted included interdisciplinarity, a systematic approach to quality assurance in higher education, student and research mobility and excellence networking.

»Doctoral studies are third-cycle studies which require original research for the acquisition of the academic degree of doctor of science (PhD.). Doctoral programmes are essential for the development of EHEA and ERA and represent a link between these two processes. The main responsibility for the training of researchers at different stages of their career is borne by universities. They must respond to the challenges of training young researchers not only to meet the needs of the academic market but also the needs of other sectors and labour markets such as industry, entrepreneurship, trade, public institutions and organisations, research organisations, etc.«

The Rectors of European universities met in Graz in 2003 and issued a declaration on the Europe of Knowledge and the central role of universities in research and research-based higher education. They emphasised that competitiveness and excellence should be balanced with social cohesion and inclusion of growing numbers of people into higher education. The basic principles were set down stating that European universities will build their research

and innovative strategies in the spirit of the Europe of Knowledge.

In June 2003 the European Commission passed, and the European Council and the European Parliament adopted a Communication addressing the need to develop research professions and research criteria. Care for the creation of a research career is a constituent part of a doctoral programme. The Communication provides basic guidelines to be realized by a doctoral programme: *increase researcher employability through the development of general competences and skills needed for employment; restructure and reorganize doctoral programmes and include them in the Bologna Process; provide better organized training through a doctoral programme; systematically develop supervision and mentorship; fully integrate doctoral students in research, but also open the path to additional profiling of their careers outside the research area; ensure financing and adequate social rights for doctoral students, as well as organized approach to mobility.*

In 2004 the European University Association (EUA) initiated a project of doctoral programmes and attracted the participation of 49 European universities from 22 countries – EU members. The 2004 EUA conference in Maastricht devised a framework of institutional policy in the field of doctoral training. The 2005 Conference in Salzburg elaborated the EUA Doctoral Project recommendations and the Maastricht conclusions by putting forth a set of ten basic principles for the organisation of doctoral studies: *doctoral study should be based on the advancement of knowledge through original research; doctoral study and the development of research careers should be imbedded in institutional strategies and policies; the rich diversity of doctoral programmes in Europe should be preserved; doctorate candidates should be recognized as early stage researchers or professionals with commensurate rights; supervision and assessment of candidates should be based on a transparent contractual framework of shared responsibilities that clearly define rights and obligations; doctoral programmes should seek to achieve critical mass of expertise through the creation of doctoral schools or excellence network; as a rule, doctoral training should last for 3 – 4 years full-time; the innovative programme structure and the development of general competences should be realized through interdisciplinarity; mobility should be increased, a number of obstacles removed and adequate financial instruments for its implementation ensured; appropriate funding and a system of developing quality doctoral programmes should be ensured.*

The conference held in Vienna in 2006 discussed the Charter and the Code and developed instruments for supporting doctoral candidates; *clearly defined goals and projects of doctoral research; training plans and supervision plans for each individual doctoral*

candidate; a compulsory part of the programme through courses and modules; research-based colloquia and workshops; training for the acquisition of general skills; institutionalized monitoring and guidance through a candidate's career; participation in the organisation of scientific events and taking responsibility for a part of the work (poster sections); participation in decision-making bodies.

Programmes of postgraduate doctoral studies and postgraduate specialist studies have been set down at the Faculty of Forestry within the postgraduate study reform: doctoral Forestry study (two programmes) and doctoral Wood Technology study, as well as eight programmes of specialist forestry studies and two programmes of specialist wood technology studies (Figure 1). A temporary license was issued for the above programmes, which currently serve as the basis for the third higher educational cycle.

Taking into consideration the reviewers' and reporters' comments related to the doctoral study programme of Forestry and the Principles for the Establishment of Postgraduate Doctoral Studies issued by the National Higher Education Council of the Republic of Croatia on 14 July 2006, as well as other domicile and European guidelines, we undertook to make an in-depth revision of the doctoral study programme with a view to meeting the European requirements and principles of doctoral training. The revision envisages one doctoral study of Forestry with three programmes:

- ⇒ *Silviculture and Wildlife Management,*
- ⇒ *Techniques, Technologies and Management in Forestry,*
- ⇒ *Urban Forestry, Nature Protection, Forest Management and Protection.*

Doctoral studies last for three years. Students acquire ECTS points from three point groups. The first two point groups relate to teaching, from which a doctoral candidate collects 60 ECTS points or 20 points per semester, while the third group relates to extra-curricular activities, from which the candidate is required to collect 120 ECTS points. The first point group is made up of compulsory courses for all doctoral students. The second point group consists of optional courses in dependence of a study programme.

The first semester in the field of doctoral study consists of courses that are compulsory for all study programmes. In the second and third semester all the courses are optional. Students are required to collect 20 ECTS points/semester or 60 ECTS points in all from the teaching part of the study. Instruction is held in the form of lectures (contributing to a maximum of 25% of the timetable), field/laboratory work and seminars. Focus is on the candidate's inde-

pendent work based on seminar papers. In the fourth, fifth and sixth semester students are required to collect 40 ECTS points/semester or a total of 120 ECTS points in extracurricular activities from the Third point group. Immediately upon enrolment, the candidate takes part in scientific-research work on projects and is required to publish his/her research results in leading professional and scientific journals. In the fourth, fifth and sixth semester a doctoral candidate spends some time abroad, publishes papers, prepares and defends a dissertation. A mentor is selected after the first semester.

A candidate is obliged to enrol a minimum of 51% of optional courses from the programme of doctoral study, while the remaining 49% may be elected from other programmes or doctoral studies at domicile and other faculties and universities with bilateral contracts (after consultations with their mentors).

The proposal of the doctoral study programme outlined above is currently being evaluated at the University of Zagreb. The high quality of doctoral study programmes will be ensured by the employment of competent mentors and teachers, the inclusion of candidates in scientific-research activities in home and international projects, suitable facilities and equipment, maximal profiling according to the candidate's individual desires reflected in the choice of optional courses, as well as by mobility within postgraduate studies at domicile and foreign educational institutions. The doctoral study reform will allow doctoral candidates to become an organic component in educational and research processes and will enable accelerated acquisition and quality of their individual competences. Foreign institutions with which the Faculty of Forestry in Zagreb or the University of Zagreb have signed contracts on cooperation include BOKU, Vienna, Austria; University of Silesia in Katowice, Poland; Mendel University of Agriculture and Forestry, Brno; Biotechnological Faculty of the University of Ljubljana, Slovenia, and the Faculty of Forestry of the University of Sarajevo, Bosnia and Herzegovina.

By obtaining the academic title of doctor of science, doctoral candidates acquire competences for independent and original scientific-research work, as well as develop the ability to objectively and critically evaluate other scientific projects, make scientific and academic advancements and promote their careers. The purposefulness of doctoral studies at the Faculty of Forestry of Zagreb University is reflected in the need of the Croatian forestry for doctors of science, particularly for purposes of sustaining and promoting scientific-research and educational components in the educational and scientific-research framework (Faculty of Forestry Zagreb, Forestry Ins-

titute Jastrebarsko, polytechnics and secondary forestry schools), and their activities in productive and developmental services of forestry companies and affiliated activities. The researchers of the Faculty of Forestry in Zagreb and the Forestry Institute have for the past 35 years been firmly integrated in the technological development of forestry in Croatia (seven mid-term research programmes), thus ensuring high-educational and scientific basis for forest management and integration in global developmental trends.

Full-time study organisation is based on an 8-hour working day of students at the Faculty of Forestry, within which they attend lectures, participate in scientific-research work on scientific projects and teach in undergraduate and graduate study courses. Part-time study organisation entails attending lectures within doctoral study and participating in scientific projects at the Faculty of Forestry or the related faculties and scientific institutions in the country and abroad in the status of cooperator-researcher.

2.3.2. Specialist study – *Specijalistički studiji*

Specialist studies are intended for further training of operative experts. The purposefulness of postgraduate specialist study is reflected in the needs of Croatian forestry for such an educational profile, and particularly for their work in production and developmental services of forestry companies and affiliated activities, as well as in the increasingly developing private sector. The study, based on scientific developments, promotes basic skills and the ability to solve complex production and developmental tasks individually or in a team.

According to Figure 1, ten specialist study programmes in all have been proposed for evaluation, of which eight are from the field of forestry and two from the field of wood technology. Specialist studies last for two years or four semesters. A study candidate is required to collect a total of 120 ECTS points or 30 ECTS points per semester during the length of study. The weekly load may be maximally 12 hours (180 hours/semester). The first semester consists of compulsory courses of general importance for the study. In the second semester and the first half of the third semester all the courses are optional. Candidates are required to enrol 51% of the optional courses from the study programme, whereas the remaining 49% are elected from other studies at domicile and other faculties and universities (in consultation with mentors). A mentor is selected after the first semester. In the middle of the third and in the fourth semester the candidate writes and publishes papers, writes and defends his specialist work. During the

Table 1 Graduate study of Forestry, programme: Technique, Technology and Management in Forestry**Tablica 1.** Program diplomskoga studija Šumarstvo, smjer: Tehnike, tehnologije i menadžment u šumarstvu

Compulsory courses <i>Obvezni predmeti</i>	Lectures <i>Predavanja</i>	Laboratory <i>Vježbe</i>	Field work <i>Teren</i>	ECTS	Obligatory optional courses <i>Obvezni izborni predmeti</i>
	classes – sati		days – dana		
1st semester <i>I. semestar</i>					
Logging II <i>Pridobivanje drva II</i>	3	2	3	7	Torrent Control <i>Uređivanje bujica</i>
Mechanisation of Timber Logging <i>Mehanizacija pridobivanja drva</i>	3	2	3	7	Sociology of Organization in Forestry <i>Sociologija organizacije u šumarstvu</i>
Management and Entrepreneurship in Forestry <i>Menadžment i poduzetništvo u šumarstvu</i>	2	2	2	6	Physical and Mechanical Properties of Wood <i>Osnove tehnologije drva</i>
Forestry Policy and Legislation <i>Šumarska politika i zakonodavstvo</i>	2	-	-	4	Humanisation of Work in Forestry <i>Humanizacija rada u šumarstvu</i>
Optional course 1 <i>Izborni predmet 1</i>	1	-	-	2	
Optional course 2 <i>Izborni predmet 2</i>	1	-	-	2	
Optional course 3 <i>Izborni predmet 3</i>	1	-	-	2	
Total <i>Ukupno</i>	13	6	8	30	
2nd semester <i>II. semestar</i>					
Planning of Forest Road Network <i>Otvaranje šuma</i>	2	2	2	6	Forest Product Trade <i>Trgovina šumskim proizvodima</i>
Forest Products <i>Šumski proizvodi</i>	2	1	2	4	Ergonomics of Forest Machines <i>Ergonomija šumskih strojeva</i>
Integrated Forest Protection <i>Integrirana zaštita šuma</i>	2	1	2	4	Mechanical Technologies of Wood <i>Osnove mehaničke preradbe drva</i>
Silviculture <i>Silvikultura</i>	2	2	3	5	Forest Fires <i>Šumski požari</i>
Graduate paper <i>Diplomski rad</i>	-	-	-	5	Forest Fire-Prevention Infrastructure <i>Šumska protupožarna infrastruktura</i>
Optional course 1 <i>Izborni predmet 1</i>	1	-	-	2	
Optional course 2 <i>Izborni predmet 2</i>	1	-	-	2	
Optional course 3 <i>Izborni predmet 3</i>	1	-	-	2	
Total <i>Ukupno</i>	11	6	9	30	
3rd semester <i>III. semestar</i>					
Design of Forest Roads <i>Projektiranje šumskih prometnica</i>	2	2	4	6	Technology of Forest Road Construction <i>Tehnologije gradnje šumskih prometnica</i>
Forestry Firm Economics <i>Ekonomika šumarske tvrtke</i>	2	1	1	5	Evaluation of Forest Resources <i>Vrednovanje šumskih resursa</i>
Marketing in Forestry <i>Marketing u šumarstvu</i>	2	1	-	3	Forest Biomass for Energy <i>Šumska biomasa za energiju</i>
Digital Cartography in Forestry <i>Digitalna kartografija u šumarstvu</i>	2	1	-	3	Planning of Technological Operations <i>Planiranje tehnoloških operacija</i>

Compulsory courses <i>Obvezni predmeti</i>	Lectures <i>Predavanja</i>	Laboratory <i>Vježbe</i>	Field work <i>Teran</i>	ECTS	Obligatory optional courses <i>Obvezni izborni predmeti</i>
	classes – <i>sati</i>		days – <i>dana</i>		
4 th semester <i>IV. semestar</i>					
Environmental sound Technologies <i>Okolišno prihvatljive tehnologije</i>	2	2	3	4	
Organization of Production in Forestry <i>Organizacija proizvodnje u šumarstvu</i>	2	2	3	5	
Forest Regulation and Planning <i>Uređivanje šuma</i>	2	1	2	3	
Graduate paper <i>Diplomski rad</i>	-	-	-	18	
Total <i>Ukupno</i>	6	5	8	30	

Table 2 Doctoral study in Forestry, programme: Techniques, Technologies and Management in Forestry – the first point group – Methodological (compulsory) courses

Tablica 2. Doktorski studij Šumarstvo, smjer: Tehnike, tehnologije i menadžment u šumarstvu – Prva bodovna skupina – Metodološki (obvezni) kolegiji

Courses <i>Predmeti</i>	Load, hours – <i>Opterećenje, sati</i>				ECTS
	Total <i>Ukupno</i>	Lectures <i>Predavanja</i>	Laboratory <i>Vježbe</i>	Seminars <i>Seminar</i>	
Methods and Techniques of Scientific-Research Work <i>Metode i tehnike znanstvenoistraživačkog rada</i>	20	5	10	5	4
Design of Experiments and Statistical Modelling <i>Planiranje pokusa i statističko modeliranje</i>	20	5	10	5	4
Remote Sensing and GIS in Forestry <i>Daljinska istraživanja i GIS u šumarstvu</i>	24	10	10	4	5

study candidates are involved in scientific-research work (projects).

The study is organized in such a way as to ensure horizontal and vertical student mobility. Horizontal mobility refers to studies within biotechnology and other studies at Croatian universities and abroad. Vertical mobility refers to the transition to doctoral studies. By completing the studies the candidate acquires competences for providing independent and team solutions to complex and very complex production and developmental professional tasks on scientific principles.

3. The position of the Department of Forest Engineering in the Bologna Process – *Položaj Zavoda za šumarske tehnike i tehnologije u bolonjskom procesu*

As mentioned before, members of the Department were actively involved in the Bologna reform

and contributed greatly to a successful presentation of programme proposals for undergraduate, graduate and postgraduate studies at the Faculty.

The Department teachers hold courses on all educational programmes of the reformed study. They teach a large number of compulsory and optional courses in undergraduate studies.

Of particular importance is the fact that forestry engineering has been highlighted through the creation of special educational programmes led by the Department members. Thus a special educational programme in the graduate study of *Forestry*, entitled *Forestry – programme: Technique, Technology and Management in Forestry*, whose programme is given in Table 1.

Within the doctoral study in *Forestry* the Department also proposed and developed a programme of doctoral study entitled *Techniques, Technologies and Management in Forestry*. The programme consists of lectures (Tables 2 and 3) and extra-curricular activities (Table 4). The focus is placed on extracurricular

Table 3 Doctoral study in Forestry, programme: Techniques, Technologies and Management in Forestry – the second point group – Optional courses
Tablica 3. Doktorski studij Šumarstvo, smjer: Tehnike, tehnologije i menadžment u šumarstvu – Druga bodovna skupina – Izborni predmeti

Courses Predmeti	Load, hours – Opterećenje, sati				ECTS
	Total Ukupno	Lectures Predavanja	Laboratory Vježbe	Seminars Seminar	
Work and Time Study <i>Studij rada i vremena</i>	24	6	8	10	5
Rationalisation of Wood Harvesting Operations <i>Racionalizacija radova pridobivanja drva</i>	24	6	6	12	5
Forest Operations Management <i>Upravljanje šumskim operacijama</i>	24	6	4	14	5
Cost Calculations of Harvesting Operations <i>Kalkulacije troškova pridobivanja drva</i>	24	6	6	12	5
High-tech in Forest Harvesting <i>Vrhunske tehnologije pridobivanja drva</i>	24	6	6	12	5
Marketing and Forest Products Trade <i>Marketing i trgovina šumskih proizvoda</i>	12	2	4	6	3
Commercial Law <i>Trgovačko pravo</i>	12	4	-	8	3
Forest Harvesting and Environment <i>Pridobivanje drva i šumski okoliš</i>	12	4	2	6	3
Optimisation of Forest Road Infrastructure <i>Optimizacija šumske prometne infrastrukture</i>	24	8	6	10	5
Primary and Secondary Forest Opening <i>Primarno i sekundarno otvaranje šuma</i>	24	6	8	10	5
Computer Forest Road Design <i>Računalno projektiranje šumskih cesta</i>	24	8	8	8	5
Techniques and Technologies of Forest Road Building <i>Tehnike i tehnologije izgradnje šumskih prometnica</i>	24	8	6	10	5
Prominent Properties of Wood <i>Prominentne značajke drva</i>	12	4	6	2	3
Management in Forestry <i>Menadžment u šumarstvu</i>	24	8	6	10	5
Corporation Management <i>Korporacijsko upravljanje</i>	12	4	-	8	3
Business Ethics <i>Poslovna etika</i>	12	4	-	8	3
Measurement Techniques on Forest Machines <i>Tehnike mjerenja na šumskim strojevima</i>	24	6	8	10	5
Technical and Environmental Suitability of Forest Machines <i>Tehnička i okolišna pogodnost strojeva</i>	24	6	6	12	5
Ergonomics in Forestry <i>Ergonomija u šumarstvu</i>	24	6	8	10	5

activities from which a doctoral candidate must collect 120 of a total of 180 ECTS points.

Three proposals for a specialist study programme have been devised at the Department, of which two have passed the evaluation criteria while the third is currently being evaluated. The study programmes *Forest Techniques and Technologies* and *Forest Roads*

have been approved. The third study programme is *Management and Entrepreneurship in Forestry*.

Tables 5 and 6 present educational programmes of two specialist studies developed within the Department. As the evaluation of the specialist study programme *Management and Entrepreneurship in Forestry* is still under way, it is not given here.

Table 4 Doctoral study in Forestry, programme: Techniques, Technologies and Management in Forestry – the third point group – Extracurricular activities (120 ECTS)**Tablica 4.** Doktorski studij Šumarstvo, smjer: Tehnike, tehnologije i menadžment u šumarstvu – Treća bodovna skupina – izvannastavne aktivnosti (120 ECTS)

Scientific Activity and Scientific Articles <i>Znanstvena aktivnost i znanstveni radovi</i>	No. of ECTS points <i>Broj ECTS bodova</i>
Conducting a scientific project (for young scientists) <i>Vođenje znanstvenog projekta (za mlade znanstvenike)</i>	15
Participation in a domicile scientific project <i>Sudjelovanje na domaćem znanstvenom projektu</i>	5
Participation in an international scientific project <i>Sudjelovanje na međunarodnom znanstvenom projektu</i>	5
Scientific work published in a journal cited in 1 st group databases (CC, SCI,...) <i>Objavljen znanstveni rad u časopisu a1 skupine</i>	30 (A*), 15 (K*)
Scientific work published in a journal cited in 2 nd group databases (CAB, Agricola,...) <i>Objavljen znanstveni rad u časopisu a2 skupine</i>	20 (A), 10 (K)
Presentation at an international scientific meeting <i>Prezentacija na međunarodnom znanstvenom skupu (a3 skupina)</i>	15 (A), 5 (K)
Poster at an international scientific meeting <i>Poster na međunarodnom znanstvenom skupu</i>	10(A), 4 (K)
Presentation at a domicile scientific meeting <i>Izlaganje na domaćem znanstvenom skupu</i>	8 (A), 3 (K)
Poster at a domicile scientific meeting <i>Poster na domaćem znanstvenom skupu</i>	6 (A), 2 (K)
Other articles (evaluated by the study's organizer) <i>Ostali članci (prema ocjeni voditelja studija)</i>	0–10
Defending doctoral thesis <i>Obrana teme doktorske disertacije</i>	10
Patents, books and parts of books (evaluated by the study's organizer) <i>Patenti, knjige i dijelovi knjiga (prema ocjeni voditelja studija)</i>	0–15
Awards, certificates and similar (evaluated by the study's organizer) <i>Nagrade, priznanja i sl. (prema ocjeni voditelja studija)</i>	0–10
Scientific training abroad (up to 1 month) <i>Znanstveno usavršavanje u inozemstvu (do 1 mj.)</i>	10
Scientific training abroad (from 1 to 3 months) <i>Znanstveno usavršavanje u inozemstvu (od 1 do 3 mj.)</i>	20
Scientific training abroad (more than 3 months) <i>Znanstveno usavršavanje u inozemstvu (više od 3 mj.)</i>	30

* A - first author - prvi autor, K - co-author - suautor

Table 5 of Specialist study programme in Forestry Techniques and Technologies**Tablica 5.** Program specijalističkoga studija Šumarske tehnike i tehnologije

Courses <i>Predmeti</i>	Load, hours - <i>Opterećenje, sati</i>				ECTS
	Total <i>Ukupno</i>	Lectures <i>Predavanja</i>	Laboratory <i>Vježbe</i>	Seminars <i>Seminar</i>	
1 st semester – Compulsory courses <i>I. semestar – Obvezni predmeti</i>					
Methods and Tech. of Scientific-Research Work with Experiment Planning <i>Metode i tehnike znanstvenoistraživačkog rada s planiranjem pokusa</i>	30	20	10	-	6
Statistical Methods and Models in Forestry <i>Statističke metode i modeli u šumarstvu</i>	30	20	10	-	6
Remote Sensing and GIS in Forestry <i>Daljinska istraživanja s GIS-om</i>	40	16	12	12	6
Work and Time Study <i>Studij rada i vremena</i>	40	16	14	10	6
Measurement Techniques on Forest Machines <i>Tehnike mjerenja na šumskim strojevima</i>	40	20	20	-	6
Total <i>Ukupno</i>	180	-	-	-	30

Courses Predmeti	Load, hours - Opterećenje, sati				ECTS
	Total Ukupno	Lectures Predavanja	Laboratory Vježbe	Seminars Seminar	
2 nd semester - Optional courses II. semestar - Izborni predmeti					
Forest Wood Products Šumski drvni proizvodi	18	7	6	5	3
Forest Non-Wood Products Šumski nedrvni proizvodi	18	7	6	5	3
Felling and Processing of Trees Sječa i izradba drva	18	10	8	-	3
Ground-based Timber Extraction Privlačenje drva po tlu	36	16	10	10	6
Marketing of Forest Products Marketing šumskih proizvoda	18	8	5	5	3
Cable Yarding and Aerial Logging Žičare i zračni transport drva	36	16	10	10	6
Further Timber Transport Daljinski transport drva	36	20	10	6	6
Technical Suitability of Forest Machines Tehnička pogodnost šumskih strojeva	36	18	18	-	6
Abnormalities and Defects of Wood Nepravilnosti drva	18	10	8	-	3
Total Ukupno	180	-	-	-	30
½ 3 rd semester - Optional courses ½ III. semestar - Izborni predmeti					
High-tech in Forest Harvesting Vrhunske tehnologije pridobivanja drva	18	10	6	2	3
Logistics in Forest Operations Logistika šumskih operacija	18	10	6	2	3
Cost Calculations of Harvesting Operations Kalkulacije troškova šumskih operacija	18	8	10	-	3
Anisotropy of Physical and Mechanical Properties of Wood Anizotropnost fizikalnih i mehaničkih značajki drva	18	8	10	-	3
Water in Trees and Wood Voda u drvetu i drvu	18	8	10	-	3
Environmental suitability of Forest Machines Okolišna pogodnost šumskih strojeva	18	10	8	-	3
Entrepreneurship and Innovation in Forestry Poduzetništvo i inovacije	18	12	-	6	3
Ergonomic in Forestry Ergonomija u šumarstvu	18	6	12	-	3
Total Ukupno	90	-	-	-	15
½ 3 rd and 4 th semester ½ III. semestar i IV. semestar					
Writing articles and preparation of thesis Pisanje članaka, izrada specijalističkog rada	270	-	-	-	45
Total Ukupno	270	-	-	-	45
Overall Sveukupno	-	-	-	-	120

* In 2nd and 3rd semester students choose a minimum of 51 % of the listed subjects, and the rest from other programmes.

* u 2. i 3. semestru studenti biraju najmanje 51% od navedenih predmeta, a ostatak iz drugih programa.

4. Conclusion – Zaključak

The Faculty of Forestry of the University of Zagreb is successfully addressing the compulsory postu-

lates of the higher educational reform stemming from the Bologna principles. The majority of the designed educational programmes for undergraduate, graduate and postgraduate (doctoral and specialist) studies

Table 6 Specialist study programme in Forest Roads**Tablica 6.** Program specijalističkoga studija Šumske prometnice

Courses Predmeti	Load, hours - Opterećenje, sati				ECTS
	Total Ukupno	Lectures Predavanja	Laboratory Vježbe	Seminars Seminar	
1 st semester - Compulsory courses I. semestar - Obvezni predmeti					
Methods and Tech. of Scientific-Research Work with Experiment Planning <i>Metode i tehnike znanstvenoistraživačkog rada s planiranjem pokusa</i>	30	20	10	-	6
Statistical Methods and Models in Forestry <i>Statističke metode i modeli u šumarstvu</i>	30	20	10	-	6
Remote Sensing and GIS in Forestry <i>Daljinska istraživanja s GIS-om</i>	40	16	12	12	6
Work and Time Study <i>Studij rada i vremena</i>	40	16	14	10	6
Measurement Techniques on Forest Machines <i>Tehnike mjerenja na šumskim strojevima</i>	40	20	20	-	6
Total Ukupno	180	-	-	-	30
2 nd semester - Optional courses II. semestar - Izborni predmeti					
Primary Forest Opening <i>Primarno otvaranje šuma</i>	36	18	18	-	6
Secondary Forest Opening <i>Sekundarno otvaranje šuma</i>	36	18	18	-	6
Methodologies of Forest Road Measurement <i>Metodologije izmjere šumskih cesta</i>	18	8	10	-	3
Computer Design of Forest Roads <i>Računalno projektiranje šumskih cesta</i>	36	14	22	-	6
Technology of Forest Road Building <i>Tehnologije izgradnje šumskih prometnica</i>	36	26	10	-	6
High-tech in Forest Harvesting <i>Vrhunske tehnologije pridobivanja drva</i>	18	10	6	2	3
Bases of Forestry Business <i>Osnove poslovanja u šumarstvu</i>	18	12	6	-	3
Total Ukupno	180	-	-	-	30
½ 3 rd semester - Optional courses ½ III. semestar - Izborni predmeti					
Legal Foundations of Planning, Design and Building Forest Roads <i>Zakonske osnove planiranja, projektiranja i izgradnje šumskih cesta</i>	36	30	6	-	6
Making a Forest Opening Study <i>Izrada studije otvaranja šuma</i>	36	14	22	-	6
Cable Yarding and Aerial Logging <i>Žičare i zračni transport</i>	18	9	9	-	3
Machines for Building Forest Roads <i>Strojevi za izgradnju šumskih prometnica</i>	36	18	18	-	6
Management in Forestry <i>Menadžment poduzeća u šumarstvu</i>	18	10	8	-	3
Total Ukupno	90	-	-	-	15
½ 3 rd and 4 th semester ½ III. semestar i IV. semestar					
Writing papers and preparation of thesis <i>Pisanje članaka, izrada specijalističkog rada</i>	270	-	-	-	45
Total Ukupno	270	-	-	-	45
Overall Sveukupno	-	-	-	-	120

*In 2nd and 3rd semester students choose a minimum of 51 % of the listed subjects, and the rest from other programmes.

* u 2. i 3. semestru studenti biraju najmanje 51% od navedenih predmeta, a ostatak iz drugih programa.

have passed the process of evaluation and are currently being implemented. However, we must constantly bear in mind that every educational system is in continuous transition. Although during the preparation of the programme we adhered to the principles of responsibility and conscience, it is more than certain that the programmes of all educational degrees at the Faculty of Forestry will have to be permanently polished and improved in order to meet the reform objectives; provide young experts, competent promoters of the development of the profession and economy in the European framework, with rapid and successful training of the highest quality.

The Department of Forest Engineering of the Faculty of Forestry in Zagreb has been entrusted with the honourable and responsible duty to develop and design special educational programmes related to forest engineering in the second and third educational cycle.

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Sažetak

Šumarski fakultet Sveučilišta u Zagrebu i Zavod za šumarske tehnike i tehnologije u bolonjskom procesu

Reforma visokoškolskoga obrazovnoga sustava potaknuta je na Ministarskoj konferenciji u Bolonji 1999. godine donošenjem tzv. Bolonjske deklaracije, koja je razrađivana na kasnijim konferencijama ministara Europske unije, koje se održavaju svake dvije godine. Bolonjska je deklaracija temeljni dokument za reformu visokoobrazovnoga sustava u Europskom prostoru visokoga obrazovanja (EHEA). Potpisali su je ministri obrazovanja 29 europskih zemalja na Ministarskoj konferenciji u Bolonji 19. lipnja 1999. Hrvatska je prihvatila i potpisala dokument 2001. na Ministarskoj konferenciji u Pragu. Time se Hrvatska opredijelila za europski visokoškolski obrazovni sustav preddiplomskoga i diplomskoga studija, a prihvaćanjem preporuka Berlinske ministarske konferencije iz 2003. godine o doktorskom studiju zaokružen je trostupanjski ciklus visokoga obrazovanja – preddiplomski,

diplomski i doktorski. Visokoškolski se obrazovni sustav reformira radi svrhovitijega obrazovanja i bržega uključivanja kompetentnih i vještih mladih stručnjaka u gospodarske tokove i stvaranje vlastite karijere. Pri tome se u prvi plan stavljaju kriteriji izvrsnosti, kompetentnosti i pokretljivosti. Ministri iz 33 europske zemlje 2003. godine u Berlinu utvrđuju prioritete za ubrzano stvaranje jačih veza između Europskoga prostora visokoga obrazovanja (EHEA) i Europskoga istraživačkoga prostora (ERA) te nužnost uspostave trećega ciklusa visokoga obrazovanja (doktorskoga studija) u okviru Bolonjskoga procesa. Pri tome su kao najvažniji prioriteti istaknuti: interdisciplinarnost, sustavan pristup osiguranju i unapređivanju kakvoće visokoga obrazovanja, mobilnost studenata i istraživača te povezivanje u mreže izvrsnosti.

Bolonjska reforma visokoobrazovnoga sustava u Hrvatskoj na državnoj je razini određena Zakonom o znanstvenoj djelatnosti i visokom obrazovanju iz 2003. godine te usmjerena podzakonskim aktima i drugim dokumentima Sveučilišta. U reformu doktorskih studija uključuje se Nacionalna zaklada za znanost, visoko školstvo i tehnološki razvoj Republike Hrvatske, koja donosi deset temeljnih načela za organizaciju doktorskih studija. Nacionalno vijeće za visoko obrazovanje Republike Hrvatske 14. srpnja 2006. donosi Načela za uspostavu poslijediplomskih doktorskih studija koja sadrže Opća načela, Načela studiranja i Organizacijska i financijska načela.

Šumarski fakultet u Zagrebu najstarija je visokoobrazovna strukovna ustanova jugoistočne Europe, koja korijene vuče iz Visokoga gospodarsko-šumarskoga učilišta osnovanoga 1860. godine u Križevcima i Šumarske akademije utemeljene 1898. u Zagrebu. Od 1920. do 1960. godine djeluje u sklopu Poljoprivredno-šumarskoga fakulteta Sveučilišta u Zagrebu, a potom kao samostalni fakultet u okviru Zagrebačkoga sveučilišta. Do danas je na Fakultetu diplomiralo 4580 studenata šumarstva i 1647 studenata drvene tehnologije. Akademске titule magistra znanosti i magistra specijalista stekla su 343 studenta, od kojih 246 u znanstvenom polju šumarstvo, a 97 u znanstvenom polju drvena tehnologija. Obranjeno je ukupno 190 doktorata, 139 u znanstvenom polju šumarstvo i 51 u znanstvenom polju drvena tehnologija.

Slijedeći platforme, upute i zacrtane ciljeve te vlastita i strana iskustva, na Šumarskom je fakultetu uspješno provedena prva faza reforme obrazovnoga sustava. Prihvaćen je trostupanjski obrazovni sustav te su izrađeni obrazovni programi za preddiplomske, diplomske i poslijediplomske studije po shemi 3 + 2 + 3 (2) odnosno 180 + 120 + 180 (120) ECTS bodova. Uspostavljena su tri preddiplomska studija: Šumarstvo, Urbano šumarstvo i Drona tehnologija, po kojim se programima obrazuju već dvije generacije studenata. Razvijeni su programi diplomskih studija Šumarstvo i Urbano šumarstvo, zaštita prirode i okoliša te programi Dronotehnološki procesi i Oblikovanje proizvoda od drva. Diplomski studij Šumarstvo ima dva smjera: Uzgajanje i uređivanje šuma s lovnim gospodarenjem i Tehnike, tehnologije i menadžment u šumarstvu. Nadalje, razvijen je poboljšani prijedlog doktorskoga studija Šumarstvo s tri smjera (Uzgajanje šuma i lovno gospodarenje, Tehnike, tehnologije i menadžment u šumarstvu te Urbano šumarstvo, zaštita prirode, uređivanje i zaštita šuma) te program doktorskoga studija Drona tehnologija. Specijalistički poslijediplomski studiji razrađeni su u deset programa i zamišljeni su kao sastavnica cjelovitnoga obrazovanja stručnjaka iz prakse. Šumarskomu je inženjerstvu poklonjena značajna pažnja kreiranjem obrazovnih programa, čiji su nositelji članovi Zavoda za šumarske tehnike i tehnologije. Tako je ostvaren poseban obrazovni program u diplomskom studiju Šumarstvo, koji nosi naslov Šumarstvo – smjer: tehnike, tehnologije i menadžment u šumarstvu. U okviru doktorskoga studija Šumarstvo Zavod je razvio program smjera doktorskoga studija pod nazivom Tehnike, tehnologije i menadžment u šumarstvu. Na Zavodu su razvijena tri prijedloga programa specijalističkih studija, od kojih su programi Šumarske tehnike i tehnologije i Šumske prometnice prošli evaluaciju, a treći, Menadžment i poduzetništvo u šumarstvu, nalazi se u postupku predlaganja. Programi svih stupnjeva obrazovanja na Šumarskom fakultetu u vremenu sadašnjem i budućem moraju se stalno poboljšavati i na taj način približavati zadanim ciljevima reforme, tj. da visokoobrazovne institucije brzo, uspješno i kvalitetno obrazuju mlade stručnjake, kompetentne nositelje razvoja struke i ekonomije na domaćim i europskim prostorima.

Ključne riječi: Šumarski fakultet u Zagrebu, reforma visokoobrazovnoga sustava

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