

AKADEMIJA TEHNIČKIH ZNANOSTI HRVATSKE

„GODIŠNJAK AKADEMIJE TEHNIČKIH ZNANOSTI HRVATSKE –
JUBILEE ANNUAL 2022-2023 OF THE CROATIAN ACADEMY OF
ENGINEERING“

**„Godišnjak Akademije tehničkih znanosti Hrvatske –
Jubilee Annual 2022-2023 of the Croatian Academy of Engineering“**

Published on the Occasion of the 30th Anniversary of the Academy

Publisher:

Croatian Academy of Engineering – HATZ
Kačićeva ulica 28, PO Box 14, HR-10105
Zagreb, Republic of Croatia

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ISSN 2975-657X (Print)

ISSN 2991-1532 (Online)

Godišnjak Akademije tehničkih znanosti
Hrvatske – Jubilee Annual 2022-2023 of the
Croatian Academy of Engineering
God. Akad. teh. znan. Hrvat.

Editorial Board address: **Croatian Academy
of Engineering – HATZ, „Godišnjak
Akademije tehničkih znanosti Hrvatske –
Jubilee Annual 2022-2023 of the Croatian
Academy of Engineering“**, Editorial Board,
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Pre-press:

Tiskara Zelina, Inc., Zelina

Press:

Tiskara Zelina, Inc., Zelina

Circulation:

300

Usage Permission Statement:

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Zagreb, 2023

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Editorial



Engineers play an important role in shaping the future of our society, driving innovation and solving complex problems that impact our daily lives. Today, engineers face a variety of challenges while navigating a rapidly evolving technological landscape. Engineers are tasked with developing innovative solutions, while the increasing complexity of projects requires them to tackle multidisciplinary problems and collaborate with professionals from diverse backgrounds. This requires effective communication, teamwork, and adaptability to work seamlessly across different domains. The digital revolution brings a number of challenges, including cybersecurity threats and the need

to leverage various new technologies. Engineers need to keep abreast of the latest developments and have the skills to leverage these technologies while addressing related ethical and privacy concerns. In essence, today's engineers must be equipped with a broad set of skills, a strong ethical compass, and a willingness to take on these complex challenges.

Climate change is a pressing global issue, and engineers play a critical role in fighting its effects. They can focus on developing renewable energy technologies such as solar, wind, and hydroelectric power that reduce dependence on fossil fuels and cut greenhouse gas emissions. They can also work to improve the energy efficiency of buildings, transportation systems, and industrial processes to help reduce carbon footprints. In addition, engineers can design sustainable infrastructure, including green buildings, smart cities, and efficient transportation networks that minimize environmental impacts. They can also help adapt to climate change by developing a resilient infrastructure that can withstand extreme weather events. In addition, engineers can contribute to environmental monitoring and modeling, providing data-driven insights that help policymakers make informed decisions about climate change mitigation and adaptation strategies. Overall, engineers have the expertise and creativity to develop

innovative solutions that can mitigate the impacts of climate change and promote a more sustainable future.

Academies of Engineering are prestigious organizations that bring together leading experts from academia, industry, and government. These academies are typically composed of distinguished engineers and scientists who have made significant contributions to their respective fields and serve as influential bodies that provide guidance, expertise, and recommendations on critical engineering-related issues.

The Croatian Academy of Engineering (HATZ) is a prestigious institution that plays a vital role in advancing engineering education and research in Croatia. Founded in 1993, the academy is dedicated to promoting excellence in engineering and enhancing the country's technological development. HATZ comprises esteemed engineers, scientists, and experts from various engineering disciplines, who bring their extensive knowledge and experience to the forefront. As an independent organization, HATZ serves as a think tank and advisory body, providing valuable insights and recommendations on engineering-related issues to government agencies, industry leaders, and the public. The academy actively engages in fostering collaboration between academia, industry, and the government, ensuring that engineering solutions address the societal and economic challenges of the country. HATZ also focuses on promoting lifelong learning and professional development. Through its continuous efforts, the Croatian Academy of Engineering plays a pivotal role in driving innovation, facilitating knowledge exchange, and shaping the engineering landscape in Croatia.

This Annual is dedicated to its 30 years of existence.

Editor-in-Chief
Prof. *Vedran Mornar*, Ph.D.

Part I - About the Academy

Organization of the Croatian Academy of Engineering¹

Prof. **Dubravko Rogale**, Ph.D.
 Prof. **Bruno Zelić**, Ph.D.

The Croatian Academy of Engineering has a complex internal organization, which has been changed and improved during the existence of the Academy. In this way, its efficiency has been ensured and increased. The organization has a very clear organizational scheme and hierarchical structure, its bodies and holders of the tasks. The organizational structure in the mandate of the Governing Board of the Academy 2022-2026 has changed to a small extent in the new mandate 2022-2026 and is shown in Figure 1.

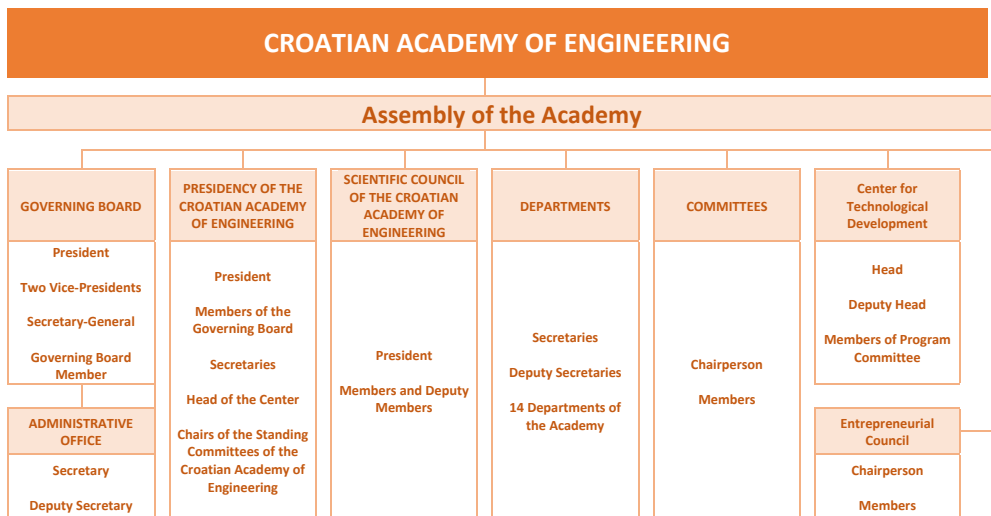


Fig. 1. Basic organizational structure of the Croatian Academy of Engineering

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

The above figure also shows the newly established Center for Technological Development, which was established to unify the activities of the Academy’s existing centers and increase the efficiency of the Academy’s cooperation with the business community. Former centers were merged into the Center for Technology Transfer, where the Program Committee was formed as a body that participates in project implementation and assists the head of the Center in managing project activities.

Assembly of the Academy

The Statute of the Academy stipulates that the Assembly is the highest body of the Academy, Fig. 2, constituted of all categories of members and chaired by the President of the Academy.

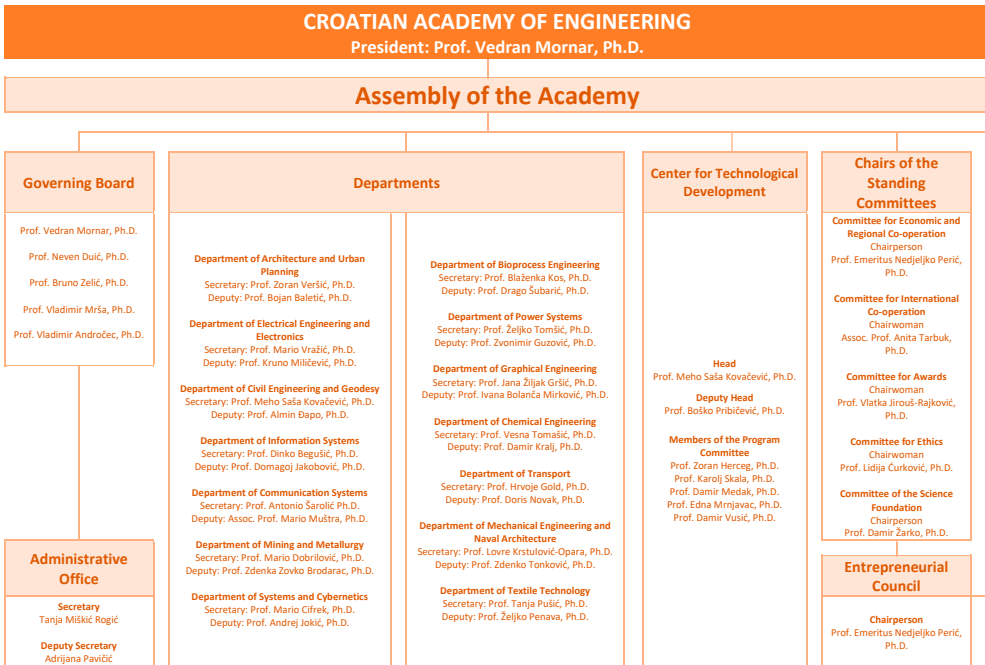


Fig. 2. Organizational structure of the Academy with all constituent elements and the leadership elected for 2022-2026 mandate

The above figure lists the names of the members of the Governing Board elected for the 2022-2026 mandate, the names of all 14 Academy Departments and their Secretaries and Deputy Secretaries, the members of the Center for Technological Develop-

ment, the names of the Committees and their Chairpersons, and the Entrepreneurial Council with its Chairperson.

Governing Board

The Governing Board of the Academy consists of the President, two Vice-Presidents, the Secretary-General of the Academy and Governing Board Member. The mandate of the elected members of the Governing Board lasts 4 years, Fig. 3.

The President of the Academy presides over the Governing Board.

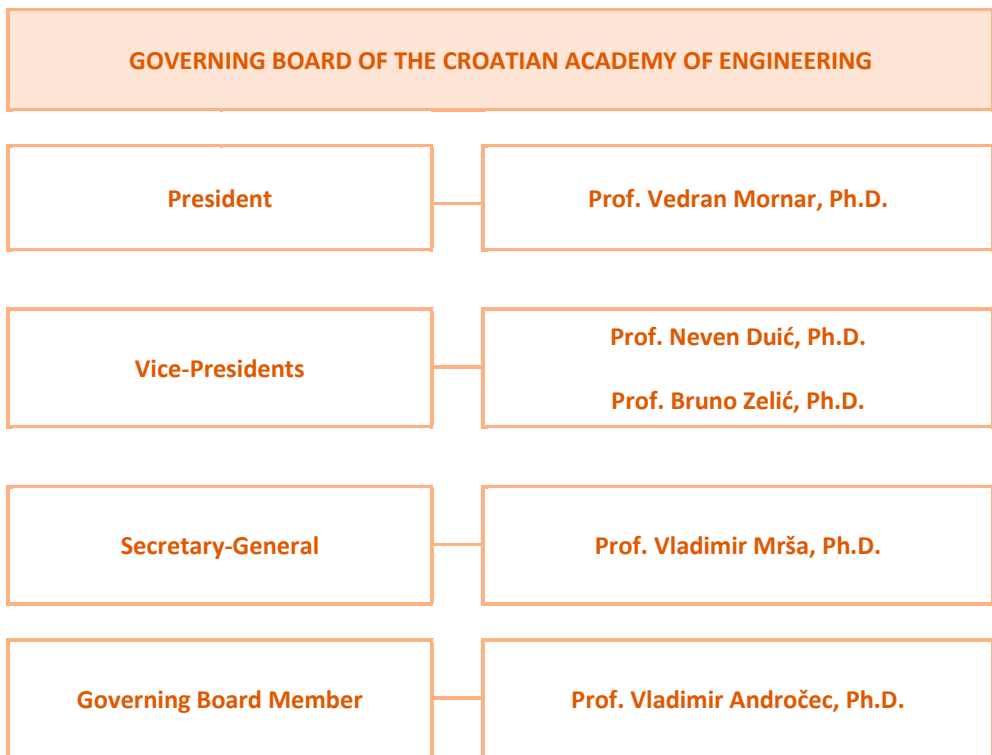


Fig. 3. Organization of the Governing Board of the Croatian Academy of Engineering 2022-2026

President of the Academy represents the Academy, presides over the Assembly, convenes the meetings of the Assembly, Presidency and Governing Board, chairs them and supervises decision making and execution of decisions. President of the Acad-

emy acts on behalf of the Academy and manages its financial affairs. President of the Academy may assign particular areas of his/her authority to the Vice-Presidents and Secretary-General. President of the Academy promotes activities of the Academy in administrative structures and in collaboration with industry in Croatia, and according to the program of the Academy in cooperation with foreign countries. President of the Academy is elected for a term of four years with the possibility of reelection for another consecutive mandate.

Vice-Presidents of the Academy carry out tasks under the authority entrusted to them by the President of the Academy. One Vice-President of the Academy is responsible for monitoring and coordinating the work with the Departments of the Academy, and the second Vice-President of the Academy is responsible for the execution of the program, i.e. projects of the Academy, activities of the Standing Committees and monitoring the work of the Science Fund of the Academy. Vice-Presidents are elected for a term of four years with the possibility of reelection for another consecutive mandate.

Secretary-General of the Academy organizes the work of the Professional Services of the Academy, prepares and organizes meetings of bodies, drafts decisions and documents of the Academy, coordinates the work of the bodies of the Academy, supervises the execution of the decisions made by the Academy, performs all tasks entrusted to him/her by the Assembly, the Presidency, the Governing Board and the President of the Academy. Secretary-General of the Academy is elected for a term of four years with the possibility of reelection for another consecutive mandate.

Presidency of the Academy

The Presidency of the Academy is executive body of the Assembly.

The Presidency of the Academy consists of the President of the Academy, two Vice-Presidents of the Academy, the Secretary-General of the Academy, one member of the Governing Board, Secretaries of Departments of the Academy, the head of the Center for Technological Development and the Chairpersons of Committees of the Academy (Fig. 4). The mandate of the Presidency lasts 4 years.

Meetings of the Presidency are held as required, six times a year as a rule. Fig. 4 shows the structure of the Presidency and the members elected for the 2022-2026 mandate.

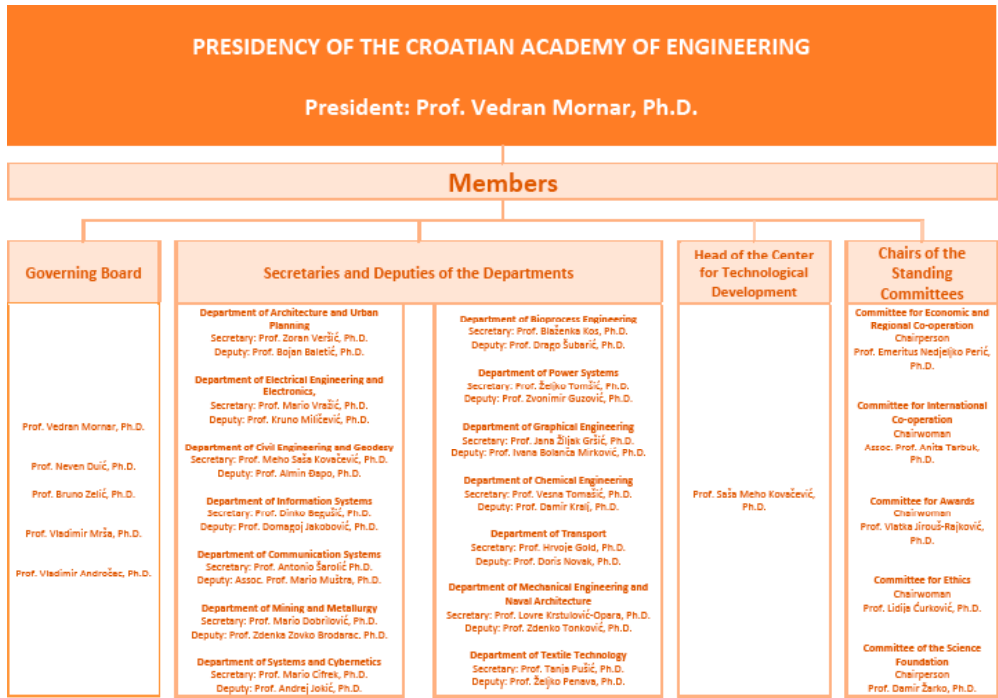


Fig. 4. Presidency of the Croatian Academy of Engineering 2022-2026

Scientific Council of the Academy

Scientific Council of the Academy is a scientific body of the Academy. Scientific Council of the Academy consists of the representatives of each Department (one per Department) and Chairperson of the Scientific Council, Fig. 5. Members of the Scientific Council of the Academy shall be elected from among members of the Academy and Members Emeriti of the Academy by Departments for a period of four years with the possibility of reelection. Fig. 5 lists the names of the members of the Scientific Council and their Deputies for the 2022-2026 mandate.

President of the Academy is the function of a member and Chairperson of the Scientific Council, but it is stipulated that he may transfer his powers to the Vice-President. Each Department shall nominate one representative of the Department as a candidate for member of the Scientific Council. Secretary and Deputy Secretary of the Department cannot be candidates for membership of the Scientific Council. Decision on election of members of the Scientific Council (one per Department) is made by the Presidency on the proposal of each Department.

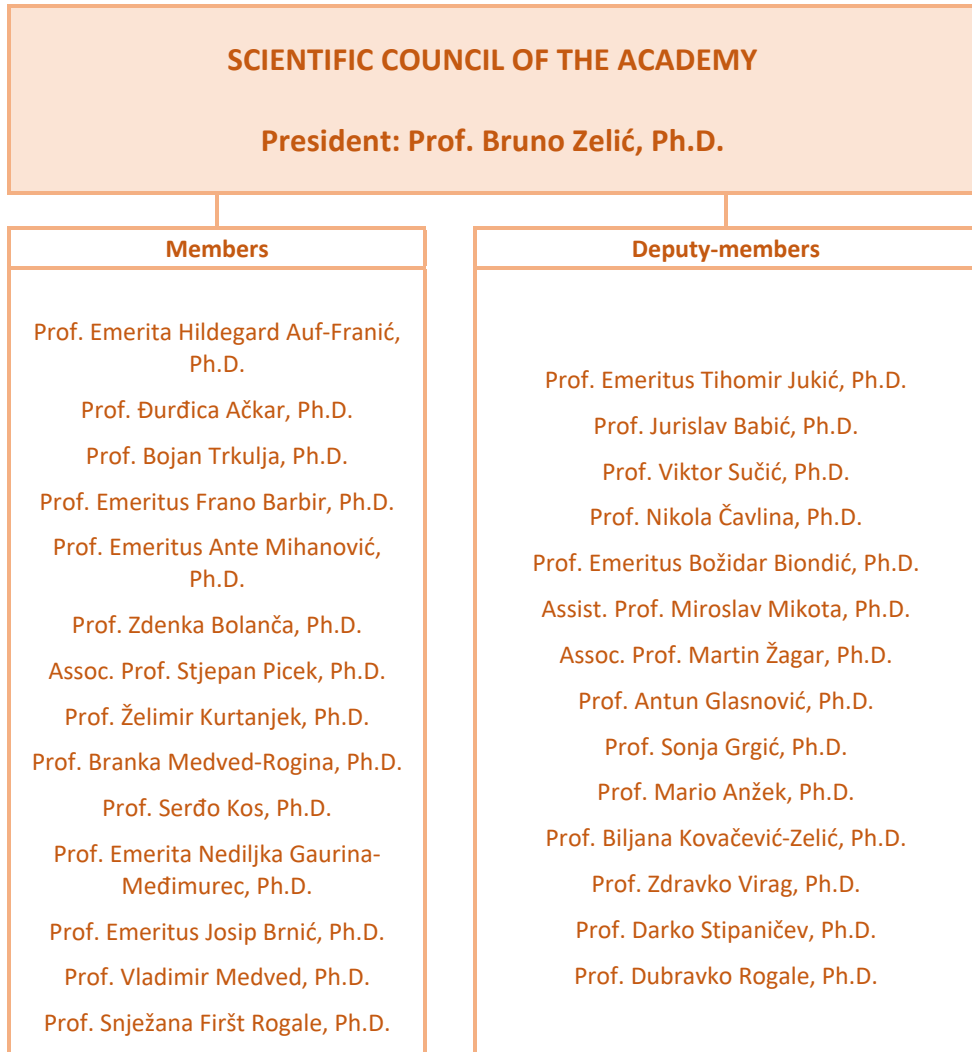


Fig. 5. Scientific Council of the Croatian Academy of Engineering 2022-2026

Organization of the Activities of the Academy

According to the provisions of the Statute the Academy organizes its activities in Departments, Center, Committees and other organizational forms. The activities and organization of work of the Departments, Center, Committees and other organizational forms are regulated by the Statute and bylaws and rules of procedure.

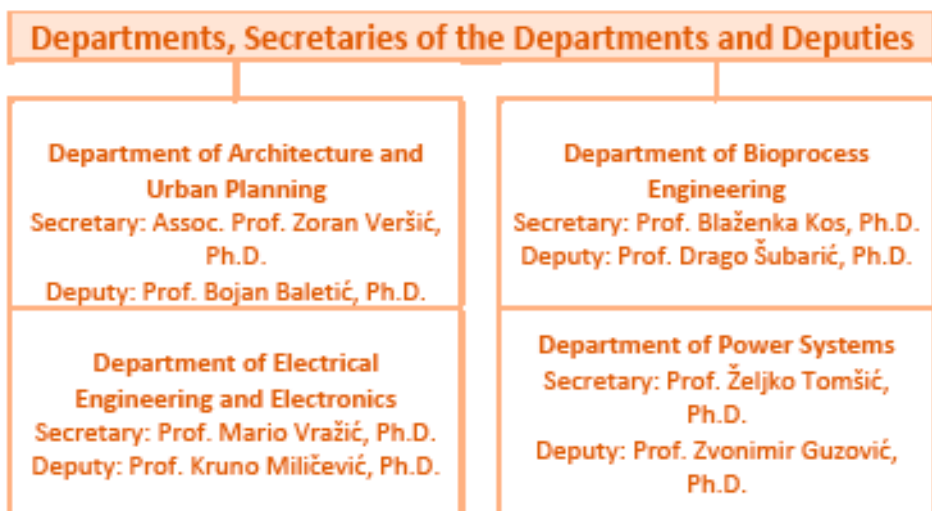
Task management of the Academy is carried out by the Departments, Center and Committees that have no legal personality.

At the head of a Department there is Secretary of the Department of the Academy, Head of the Center of the Academy presides over Center and at the head of a Committee there is Chairperson of the Committee of the Academy. In the bodies of the Academy a Department of the Academy is represented by Secretary of the Department, the Center of the Academy is represented by the Heads of the Center, and each Committee is represented by Chairperson of the Committee. Secretaries of Departments of the Academy and Chairpersons of Committees of the Academy and Head of the of the Center and their deputies shall be elected for a term of four years with the possibility of reelection for a successive mandate.

Departments of the Academy

Departments of the Academy are:

Department of Architecture and Urban Planning, Department of Bioprocess Engineering, Department of Electrical Engineering and Electronics, Department of Power Systems, Department of Civil Engineering and Geodesy, Department of Graphical Engineering, Department of Information Systems, Department of Chemical Engineering, Department of Communication Systems, Department of Trans-port, Department of Mining and Metallurgy, Department of Mechanical Engineering and Naval Architecture, Department of Systems and Cybernetics and Department of Textile Technology, Fig. 6.



<p>Department of Civil Engineering and Geodesy Secretary: Prof. Meho Saša Kovačević, Ph.D. Deputy: Prof. Almin Đapo, Ph.D.</p>	<p>Department of Graphical Engineering Secretary: Prof. Jana Žiljak Gršić, Ph.D. Deputy: Prof. Ivana Bolanča Mirković, Ph.D.</p>
<p>Department of Information Systems Secretary: Prof. Dinko Begušić, Ph.D. Deputy: Prof. Domagoj Jakobović, Ph.D.</p>	<p>Department of Chemical Engineering Secretary: Prof. Vesna Tomašić, Ph.D. Deputy: Prof. Damir Kralj, Ph.D.</p>
<p>Department of Communication Systems Secretary: Prof. Antonio Šarolić Ph.D. Deputy: Assoc. Prof. Mario Muštra, Ph.D.</p>	<p>Department of Transport Secretary: Prof. Hrvoje Gold, Ph.D. Deputy: Prof. Doris Novak, Ph.D.</p>
<p>Department of Mining and Metallurgy Secretary: Prof. Mario Dobrilović, Ph.D. Deputy: Prof. Zdenka Zovko Brodarac, Ph.D.</p>	<p>Department of Mechanical Engineering and Naval Architecture Secretary: Prof. Lovre Krstulović-Opara, Ph.D. Deputy: Prof. Zdenko Tonković, Ph.D.</p>
<p>Department of Systems and Cybernetics Secretary: Prof. Mario Cifrek, Ph.D. Deputy: Prof. Andrej Jokić, Ph.D.</p>	<p>Department of Textile Technology Secretary: Prof. Tanja Pušić, Ph.D. Deputy: Prof. Željko Penava, Ph.D.</p>

Fig. 6. Departments of the Croatian Academy of Engineering 2022-2026

The above figure also lists the names of the Secretaries of the Departments and their Deputies elected for the 2022-2026 mandate. The Departments are founded, merged, divided, abolished and operate pursuant to the decision of the Assembly of the Academy.

Committees of the Academy

Committees are inter-departmental bodies of overall importance for the work of the Academy. Prominent experts from business and persons who are not members of the Academy may collaborate in the Committees. The number of such collaborators cannot be higher than 40% of the total number of the members of the Committee.

Committees of the Academy					
Committee	Committee for Economic and Regional Co-operation	Committee for International Co-operation	Committee for Awards	Committee for Ethics	Committee of the Science Foundation
Chairperson	Prof. Emeritus Nedjeljko Perić, Ph.D.	Assoc. Prof. Anita Tarbuk, Ph.D.	Prof. Vlatka Jirouš-Rajković, Ph.D.	Prof. Lidija Čurković, Ph.D.	Prof. Damir Žarko, Ph.D.
Deputy-Chairperson	Prof. Stanislav Kurajica, Ph.D.	Prof. Zvonimir Guzović, Ph.D.	Prof. Trpimir Kujundžić, Ph.D.	Prof. Snježana Rimac-Drije, Ph.D.	Prof. Željko Arbanas, Ph.D.
Members	Prof. Verica Dragović-Uzelac, Ph.D. Prof. Igor Kuzle, Ph.D. Prof. Nevenka Ožanić, Ph.D. Prof. Damir Modrić, Ph.D. Prof. Božidar Kliček, Ph.D. Assoc. Prof. Željko Knezić, Ph.D.	Prof. Stela Jokić, Ph.D. Prof. Adrijan Barić, Ph.D. Prof. Goran Martinović, Ph.D. Prof. Irena Galić, Ph.D. Prof. Edouard Ivanjko, Ph.D.	Prof. Emeritus Stanislav Bolanča, Ph.D. Prof. Davor Bonefačić, Ph.D. Prof. Željko Domazet, Ph.D. Prof. Dražen Lončar, Ph.D. Prof. Marko Rogošić, Ph.D. Prof. Darovan Tušek, Ph.D. Prof. Bruno Želić, Ph.D. Prof. Drago Žagar, Ph.D.	Prof. Srećko Pegan, PhD. Prof. Davor Grgić, Ph.D. Assist. Prof. Miroslav Mikota, Ph.D. Prof. Aleksandra Sander, Ph.D. Prof. Gordana Bedeković, Ph.D. Ivan Petrović, Academician	Prof. Hrvoje Mlinarić, Ph.D. Prof. Tomislav Josip Mlinarić, Ph.D. Prof. Emeritus Jurica Sorić, Ph.D.

Fig. 7. Committees of the Croatian Academy of Engineering 2022-2026

Figure 7. shows the organizational structure of five committees of the Academy, their chairpersons and members elected for the 2017-2021 mandate.

Center of the Academy

Center is a scientific research unit of the Academy established for a all field of technical and biotechnical sciences with the aim of conducting scientific research intended for immediate application in the economy. Center is established pursuant to the By-law of the Organization of Centers of the Croatian Academy of Engineering. The initiative to establish a Center is given by the Departments, the proposal is determined by the Governing Board, and the decision is made by the Presidency of the Academy.

The Program Committee is a coordinative body of the Center. The activities of the Center are coordinated by the Head of the Center (Fig. 8).

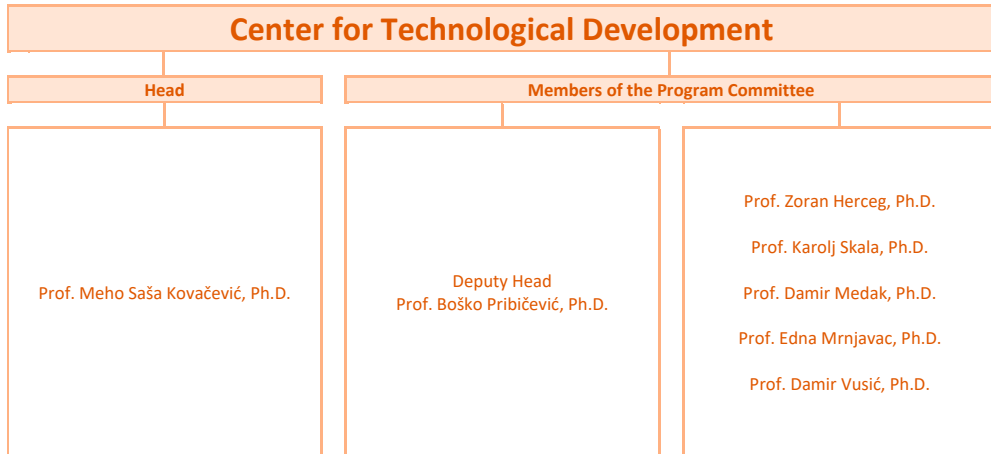


Fig. 8. Center for Technological Development 2022-2026

The head of the Center represents the Center at the Presidency of the Academy and reports on the activities of the Center.

Entrepreneurial Council of the Academy

The Entrepreneurial Council of the Academy is an advisory board of the Academy for the cooperation between the Academy and the economy. The Entrepreneur Members of the Academy constitute the *Entrepreneurial Council of the Academy*. A Ph.D. title is not required to acquire the status of an entrepreneur member of the Academy. The reputation of an entrepreneur member of the Academy is based on his/her exceptionally personal contributions in fields such as: development and production business in the industry; management business in industry and economy; technology transfer; patenting original industrial processes, technologies and entrepreneurship. An entrepreneur member of the Academy should be a person who, through his/her work in the economy, has made a significant contribution to his/her company and in the wider community, and preferably on the international scene. The Chairperson of the Committee of Economic Cooperation convenes sessions of the Entrepreneurial Council of the Academy and chairs them.

Other Forms of Organization

In addition to the current organization scheme of the Academy, the Academy may establish councils, committees and other organizational forms of temporary character. Decision to establish such bodies will be taken by the Presidency which may cause a change in the organization scheme to a smaller extent.

The Academy has a Professional Service to perform administrative, technical, financial, accounting and other duties necessary for the realization of the activities of the Academy. Secretary-General of the Academy is the head of the administration.

The Academy may entrust an authorized organization with a partial or complete performance of the duties, if it is so decided by the Presidency.

Normative Acts of the Academy¹

Prof. Emerita **Nediljka Gaurina-Medimurec**, Ph.D.

Prof. **Bruno Zelić**, Ph.D.

The Croatian Academy of Engineering is a scientific organization that brings together distinguished domestic and foreign scientists in the field of technical and biotechnical sciences in order to support the effective scientific and economic development of Croatia without gaining any profit. Its activity is regulated by a series of normative acts, which are adopted by the Assembly of the Academy or the Presidency of the Academy. The Assembly of the Academy adopts the Statute of the Academy and the Bylaw on Membership, whereas the Presidency of the Academy adopts other normative acts pursuant to Article 13 of the Law on Associations (Official Gazette 17/14, 70/17, 98/19 and 151/22) the Croatian Academy of Engineering has the Statute which is its fundamental general act and nine other general acts (bylaws/rules of procedure) which comply with the Statute of the Academy.

Over the past 30 years the normative acts were amended according to the needs of the Academy, and each amendment contributed to a more efficient action of the Academy. The First Statute of the Academy was passed by the Assembly of the Academy at its session on 19th January 1993. Thus, in the mandate of the previous Board (2017-2022) some existing normative acts were adopted or amended.

The Assembly of the Croatian Academy of Engineering at its 34th session held on April 29th 2018 adopted the **Statute** of the Croatian Academy of Engineering. **The Bylaw on Election to Membership** was adopted at the same Assembly session.

The Presidency of the Croatian Academy of Engineering at its sessions in 2018 and 2022 adopted the following normative acts:

- Bylaw on the Organization and Activities of the Committees of the Croatian Academy of Engineering (October 15th 2018)

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

- Bylaw on the Collection, Processing and Protection of Personal Data (October 15th 2018)
- Bylaw of the on the Organization and Activities of the Centers of the Croatian Academy of Engineering (April 25th 2022)
- Rules of Procedure of the Work of the Scientific Council (October 15th 2018)
- Rules of Procedure of the Work of the Committee for Ethics (October 15th 2018)
- Rules of Procedure of the Work of the Entrepreneurial Council (October 15th 2018)
- Rules of Procedure of the Work of the Committee for Economic and Regional Co-operation (October 15th 2018)
- Rules of Procedure of the Work of the Committee for International Co-operation (October 15th 2018)

Below is a brief description of areas regulated by a particular normative act.

Statute of the Croatian Academy of Engineering

This Statute regulates the provisions on the name, seat, representation, seal and flag, objectives and scopes of activity as well as economic activities pursuant to the law and the way of ensuring the support of the public where the Croatian Academy of Engineering operates. Furthermore, regulated are the provisions on the conditions and procedure of joining and termination of membership, rights and obligations, and disciplinary liability of members and the procedure of keeping the list of the members, on the Academy bodies, their composition and the way of convening sessions, election, recall, powers, decision-making and terms of office and regular manner of convening the assembly as well as in the case of expiry of the mandate; election and recall of the liquidator of the Academy as an association, dissolution of the Academy; on the assets, the method of acquisition and disposition of assets; asset management in the event of the dissolution of the Academy, and on the manner of settling disputes and conflicts of interest within the Academy and other issues of importance for the Academy.

Bylaw on Membership in the Croatian Academy of Engineering

The Bylaw on Membership regulates the procedure for election of members and termination of membership and criteria for the election into the Croatian Academy of Engineering.

Bylaw on the Organization and Activities of the Committees of the Croatian Academy of Engineering

The Bylaw on the Organization and Activities of the Committees determine the way the Committee works, making decisions, electing members and appointing the chairman and deputy.

Bylaw on the Organization and Activities of the Centers of the Croatian Academy of Engineering

This bylaw, along with the underlying principles, regulates the organization and functioning of the Centers. The Centers are established for specific fields of science with the aim of promoting scientific and development research intended for immediate application in the economy, and thus make a contribution to the overall faster technological progress of the Republic of Croatia. The Bylaw applies to all existing Centers and those to be established in the next period.

Bylaw on Awards and Recognitions of the Croatian Academy of Engineering

The process of nomination for the Academy awards and medals, and deciding on them is stipulated by the Bylaw on Awards and Acknowledgements of the Academy.

Bylaw on the Scientific Fund of the Academy

The Scientific Fund participates in co-financing scientific projects in which the Academy participates; providing funds for awards awarded by the Academy; helping young scientists of technical professions, winners of the Vera Johanides Award, in acquiring knowledge and skills, and encouraging their international affirmation through education, participation in scientific conferences and advances in scientific research.

Bylaw on the Financing and Material and Financial Operations of the Croatian Academy of Engineering

Financial and material operations of the Croatian Academy of Engineering are conducted in accordance with this Bylaw, the Law on Financial Operations and Accounting of Non-Profit Organizations (Official Gazette 121/14 and 114/22) and other laws and regulations. The regulations of the Bylaw on the Financing and Material and Financial Operations of the Croatian Academy of Engineering stipulate income and distribution of income; costs and expenses; the right to create liabilities; liquidation of documents; cash maximum and the management of long-term assets.

Bylaw on the Acquisition and Distribution of Income of the Croatian Academy of Engineering

This Bylaw determines the method of acquisition and distribution of income of the Croatian Academy of Engineering.

Labor Bylaw of the Academy

This Bylaw regulates the organization of work and systematization of jobs, and the rights and obligations of employees who are employed at the Croatian Academy of Engineering.

Code of Ethics

The Code of Ethics is not one of the normative acts of the Academy in the form of bylaws and rules of procedure, but it obliges the members of the Croatian Academy of Engineering to behave ethically. The Code of Ethics states that the members of the Academy are aware of the importance of the impact of their knowledge and teaching, projects and achievements, technologies and processes, consulting and services on economic development, competitiveness of Croatian products and quality of life by accepting their personal obligation to the profession and committing themselves to the highest ethical and professional conduct.

Rules of Procedure

The Rules of Procedure Procedures of the Croatian Academy of Engineering regulate the work of the Committees, the Centers and the Scientific Council. The provisions of these Rules of Procedure refer to the work of the Committees, the Centers and the Scientific Council, to the preparation and convening of sessions and to the way of decision-making.

Conclusion

The Croatian Academy of Engineering is a complex and organized system, which is evident from a number of complex normative acts. The normative acts adequately cover all aspects of the organization and activities and contribute to the organized and efficient work of the Academy as an important scientific institution of the Republic of Croatia.

The first ten years of the Academy

Prof. **Dražen Aničić**, Ph.D.

For the first ten years, the Academy was run by two presidents and two general secretaries. For the first four years, the president was Josip Božičević, and the general secretary was Juraj Božičević. For the next six years, the Academy was led by President Juraj Božičević and Secretary General Dražen Aničić. When it first started, there were no permanent employees, no offices or PCs; one had to get around the facility by using the same tools they used at their own jobs. There were only two seals and a Statute in the Academy. The Croatian Academy of Engineering was established on January 19, 1993 at the founding assembly, which was attended by fourteen full university professors. They were Dražen Aničić, Branko Bonefačić, Josip Božičević, Juraj Božičević, Leo Budin, Husein Džanić, Zijad Haznadar, Marin Hraste, Mirko Krpan, Darko Maljković, Ivo Marković, Tomislav Mlinarić, Osman Muftić and Ivo Soljačić.



Josip Božičević, president 1993 – 1997



Juraj Božičević, president 1997 – 2003

Following the assembly and two open invitations to faculties and institutes, the Academy quickly increased to about 100 members. Ten years later, it had 218 members divided into eight categories. The Statute was amended to add honorary members, emeritus members, friend members, and corresponding members to the categories of full and extraordinary members, associate members, and supporting

members. There were now thirteen departments instead of the previous eight. The first rule limited membership to 30 full members, 42 extraordinary members, and 70 associate members. Due to the fact that it was not possible to include excellent scientists from all technical and biotechnological disciplines in this number, the Ordinance was amended to include 120 full and extraordinary members and 100 associate members. The status of emeritus member was introduced for all members who turn 70 in order to free up a specific number of departmental seats so that by accepting younger specialists, the Academy would remain active and working and not an honorary organization, *a council of the wise*. The Academy had 218 individual members after its first ten years, including 47 regular and 52 extraordinary members, 75 associate members, 13 honorary members, 18 emeritus members, and 13 friend members. Additionally, 40 supporting members-faculties, institutes, and work organizations-supported the work of the Academy.

The Academy was granted permanent and free-of-charge office space at Hercegovačka street 111 in the area of the former local community in July 1999, thanks to the generosity of the City of Zagreb. The office space allocated was only 9 m², but that was enough to accommodate the publications and archives of the time, and there were also two nice meeting rooms, one with 60 seats and the other with 150.

With increased activity came more work, so in November 1999 a professor of sociology was hired on a full-time basis as a business secretary. She handled the majority of the Academy's administrative duties and written communications with its members, associates, and partners. Additionally, a personal computer was acquired, laying the foundations for a thriving business.

The Academy released two publications in the first four years of operation: a year-book with member papers and the proceedings of its first conference. In the next six years, eighteen publications were published, six of them in cooperation with the Croatian Systems Society. Over 3,000 pages of texts were published in the first ten years; approximately 440 authors, or a much larger group of authors than Academy members, contributed to their creation.

After undergoing the verification process, the Academy was granted membership in the CAETS (International Council of Academies of Engineering and Technological Sciences) in 1999. The heads of academies of engineering from countries with a longer history (Sweden, Finland, Great Britain, the United States, and Australia) as well as from countries with a shorter history (China, Czech Republic, Slovakia, Hungary, Poland, Ireland, Korea) met with the Academy's leadership for the first time in Helsinki. It was an opportunity to reflect on one's existence purpose and learn about the issues dealt with by other academies in the area.

In the mid-1990s, the Academy encountered some difficulties in its activities. The Croatian Parliament rejected the Academy's request based on the law, as well as the request of the Croatian Academy of Medical Sciences, to keep its original name and determined the current name, i.e. *the use of Croatia in the genitive case*. Because of this, the acronym HATZ was kept, and the name Croatian Academy of Engineering was created.

Even former employees of the then Ministry of Science and Technology did not have a high opinion of the Academy at that time. On the basis of the Scientific Research Activities Act, the Academy filed an application for entry in the register of scientific associations in June 1996. There is silence on the part of the administration and instead of a decision on whether or not to accept the application, a completely incoherent and unfounded response was delivered. After three and a half years of correspondence and *outwitting* the state administration, the Ministry finally issued a certificate of registration of the Academy in the Register of Scientific Associations in January 2000.

In several cases, the same Ministry did not respond at all to grant applications for printing scientific publications or organizing conferences. The Academy is given symbolic sums for regular activities that do not even cover the cost of postage. The big project to write an English-Croatian technical dictionary cannot be tackled because ministry officials do not have the courage to reject the proposal and have remained silent for several years. Even though they themselves have difficulties in business, supporting members provide the Academy with invaluable financial and moral support.

Collaboration with the business community is conducted along the line of scientists-entrepreneurs in a discussion cycle titled "Products and Production in Croatia - What Will Croatia Live On?" in an effort to combat the country's growing deindustrialization and disregard for production. Sixteen discussions covered topics such as energy, shipbuilding, the food and metal industries, construction, chemicals, textiles, wood, and graphics. However, the subjects of these discussions – the policy makers – rarely attend such meetings. The results of these meetings do not reach decision-makers.

The internal life of the Academy is realised through the organisation of Academy Conferences, which are developed and organised by the departments of the Academy and in which current events in the fields of science, technology and economics are discussed. Members were encouraged to engage in interdisciplinary conversations. After about 30 meetings and the decreasing number of participants, it was found that there was no interest in such discussions because members were limited to their narrow professional sphere and were not interested in the problems of others. Consequently, the organisation of new meetings was abandoned.

Standing Committees, eight of which were established with the goal of establishing a broad working platform, bringing together members and employees of business and state administration, and initiating cooperation with external factors (industry, cities, institutes, other academies, Croatian scientists abroad), have not even begun working for several years after their establishment. The appointed chairmen of these committees only attended presidency meetings on rare occasions.

The Academy's leadership was dissatisfied with the work of the departments. Their secretaries were expected to initiate the work. Instead of departments becoming the centres of the Academy's activities, launching new initiatives to address specific issues in the profession, science, and industry, the Academy's activities were mostly manifested through the work of the Presidency or even the narrow leadership itself. In many interventions, the departments were primarily concerned with the admission of new members and had difficulty meeting their other obligations (sending contributions for the Yearbook and Bulletin). The departmental meetings held 2-3 times a year were clearly not enough to get the work going.

Some members still saw their election to the Academy as recognition for their previous work rather than as an incentive to devote some of their time to Academy activities.

The guiding principle was that the Academy, as an association of outstanding scientists in the technical and biotechnological sciences, should act in the future in such a way that it is constantly present in the decision-making of the state leadership on fundamental questions of engineering and technology, and that it is widely recognized as a place for discussion of the most important issues of the present and future.

This was also written when the Academy was handed over to the new management for the second decade of activity and the new century twenty years ago:

By cooperating with organizations and specialists in the social, economic, natural and medical fields, Academy, as one of the places of concentrated and excellent technological and biotechnological knowledge, must constantly strive to be at the centre of an interdisciplinary approach to solving current problems in Croatia.

If Academy is made up of scientists who have a little more vision than the average person and who work primarily in universities, then it ought to take an active part in reforming the universities and bringing them in line with European solutions.

Membership in this Academy is not only a recognition of the chosen ones, but also a commitment to active work, because the main difference between this Academy and the Croatian Academy of Sciences and Arts is that it gathers scientists who are at the top of their professional and scientific careers. Therefore, its members should be more involved in the future projects of the Academy than before. Their participation

in the Academy's programmes is a prerequisite for their continued membership. As a non-profit, non-partisan and non-governmental association, the Academy should reflect its socially beneficial activity in the activities of its members.

Because Croatia's future depends on the renewal of industrial production and its integration into European trends, the Academy must become a constant link between modern scientific and technological achievements and their application in industry. Our capabilities in this area continue to be underutilized.

The critical remarks listed here are written with the intention of ensuring that the Academy's new leadership accomplishes what the previous one could not. We cannot serve Croatia with our intellectual abilities unless the leadership and members work together to establish our social recognition. After all, our code of ethics requires us to do so.

Unknown about the known

Prof. emeritus **Zlatko Kniewald** PhD, MSc, BSc, Biotechnology Engineer
President of the Croatian Academy of Engineering
in the mandates of 2003-2005 and 2005-2009
on the occasion of the 30th anniversary of the foundation
Croatian Academy of Engineering (HATZ)

We still remember the long and stormy year of 1993, when a group of enthusiastic engineers decided to found the highest professional association in the field of technical and biotechnical sciences in Croatia called the Croatian Academy of Technical Sciences. The head of that group was academician, Josip Božičević PhD in cooperation with prof. Juraj Božičević, PhD and other scientists who formed the founding core of HATZ. The fact that all HATZ members are at least PhD in the following text, names without titles are given for HATZ members.

The history of HATZ since its foundation is described in the reports of their presidents in the yearbooks on the occasion of HATZ's 20th and 25th anniversaries. In this Jubilee edition, on the occasion of the 30th anniversary of the founding of HATZ, it will be possible to recall some details that were not emphasized enough on the occasion of earlier anniversaries. Presenting my report from 2003-2009 I want to focus on the meaning of the word engineer.

These were my motives when I became a member of HATZ in 1998, and its president in 2003. As the president of the Faculty of Food Technology and Biotechnology (PBF) Science Committee, I followed and supported all the activities of the establishment of HATZ from the very beginning. It should be mentioned here that since the founding of HATZ, in addition to acad. Josip Božičević and Juraj Božičević as first and second presidents of HATZ Dražen Aničić and Darko Maljković also played a significant role as a members of the Management Bord at that time.

Today, out of a total of 277 HATZ members, 20.5% are women, and this ratio varies according to individual HATZ Departments and has not changed significantly in the past period. An increasing number of women are participating in STEM (Science, Technology, Engineering, Math) field studies, so their participation as HATZ mem-

bers should be gradually harmonized. The basic idea at the founding of HATZ was the expertise of each of its members, who will pay a membership fee for their membership in HATZ and perform all their activities on a volunteer basis. This also applies to the Board and members of all working bodies. We wish for an even more significant involvement of engineers in all levels of management of the Republic of Croatia and a faster development of our economy and Croatia as a whole. This also implies the strengthening of regional centers other than Zagreb, such as Osijek, Rijeka and Split respectively, where a significant number of HATZ members come from. Participation in international cooperation through CAETS and EuroCASE spread worldwide knowledge about the state and quality of technical and biotechnical sciences in Croatia. Perhaps our English name “Croatian Academy of Engineering” says it best.



Fig. 1.

In these few words, I have summarized the guidelines by which I, as President of HATZ, guided myself in the operation and further development of HATZ. After my first mandate in 2003-2005 and the second one from 2005-2009, I entrusted the completed and started activities to the next president, Stanko Tonković, with the desire to continue and improve the state in which HATZ remained in 2009. The Handover Record (Fig. 1.) contains all important documents from the past period.

During my terms in office, an archive was collected and preserved, which is available to all interested parties. Regardless of modern data storage media, paper storage is still the most secure way of archiving. Computer scientists will not agree with that, and I ask myself how does one read the record on punched cards or magnetic tapes today, when my new PC doesn't even have a CD input. I mentioned this, because in our archive there are Registers with numbers 9-49 (item 6 of the handover minutes dated June 30th 2009) in which there are collected essential documents from 2003-2009. The registers from 01 to 08 contain materials from the establishment of HATZ until the assumption of mandate in 2003. It would be useful for HATZ members, as well as all those who want to know how HATZ was created and developed over the past 30 years, to study some earlier discussions and conclusions both domestically and internationally (We have been a member of CAETS since 2000 and an associate member EuroCASE since 2005, and full-fledged since 2009). Towards the end of my first mandate in 2005, the Presidency proposed, and the Assembly accepted, that the mandate of the HATZ President be four years with the possibility of another four-year re-election, and that decision was written into the HATZ Statute. (Art. 33) I did not use another mandate of four years, although due to changes in the Statute there was a formal possibility.

To obtain summary information during my terms of office 2003-2009. the reader has at his disposal:

1. HATZ Jubilee Yearbook on the occasion of the 20th anniversary of its establishment ISBN 978-953-7076-22-1, "TWENTY YEARS OF THE CROATIAN ACADEMY OF ENGINEERING (HATZ) 1993-2013", Zagreb, 2014
 - "Prof Emer Zlatko Kniewald, PhD Croatian Academy of Engineering 2003–2009" pp. 63-74,
 - "Prof Zdravko Terze, PhD, Prof Jasna Kniewald, PhD, Prof Vladimir Medved, PhD International Cooperation of the Croatian Academy of Engineering for the period 1997-2014" pp 93-105,
2. HATZ Jubilee Yearbook on the occasion of the 25th anniversary of its establishment ISSN 1332-3482, "JUBILEE ANNUAL 2017-2018 OF THE CROATIAN ACADEMY OF ENGINEERING," Zagreb, 2018,
 - "Croatian Academy of Engineering 2003-2009"¹, Kniewald, Z. Past-President of the Academy (2003-2009)¹ pp 49 -66.
 - "International Cooperation of the Croatian Academy of Engineering in the Period 1997-2018" Terze Z., Kniewald† J., Medved V. pp. 105–120.

¹ This is an updated and amended version of the original article by the same author, originally published under the same title in 2014, in the Jubilee Monograph "Twenty Years of the Croatian Academy of Engineering (HATZ) 1993-2013".

Creation of prerequisites for the successful operation of HATZ

Since the establishment of the Croatian Academy of Technical Sciences (under that name it was registered on the occasion of its establishment in 1993), the administration and all activities have been housed in the building of the Faculty of Chemistry and Technology in Zagreb, Savska c. courtyard (Juraj Božičević's Department). The meetings of the working bodies and the assembly were held at different locations in Zagreb, and financial operations were managed by a private person on a part-time basis.

At the moment of the opening of the candidacy procedure for the new president of HATZ in 2003, the issue of finding a permanent space for the work of HATZ was also opened. As stated in the report of the previous president Juraj Božičević, together with the Dean of PBF Damir Karlović and the Rector of the University of Zagreb, Prof Helena Jasna Mencer PhD, it was agreed to conclude the Agreement on the accommodation of HATZ at Kačićeva St 28 with the obligation to provide funds for the renovation and improvement of the space from by HATZ.

Until the renovation of the HATZ space at Kačićeva St 28, all HATZ activities and obligations assumed by the previous HATZ president, new activities as well as the accommodation of the administrative employee Melanija Strika were carried out at the PBF premises at Kačićeva St 30 in the Laboratory for Animal and Plant Cell Technology and biotransformation (head Zlatko Kniewald). The space was used free of charge, due to the cooperation with PBF, which has been a member of HATZ since its foundation.

At the time of taking over the space, in addition to the current building, there were two other old buildings on the site that first had to be removed and the environment cleaned (Fig. 2. and Fig. 3.).



Fig. 2. The building was the Dean's Office in 1956.



Fig. 3. The building was the Biochemistry Laboratory



Fig. 4. The view on the HATZ place from Kačićeva Street before the renovation

The Ministry of Science, and Technology of the Republic of Croatia (MSES) provided funds for construction reconstruction and improvement of the HATZ building and environment. (request for funds from July 15, 2003 below).

Tender announcement and selection of the most favorable contractor, monitoring of works, completion of construction works, furnishing of space with furniture and necessary technical means was carried out under the supervision and in excellent cooperation with HATZ member Jure Radić. The landscaping of the building was carried out according to the project of the Faculty of Architecture of the University of Zagreb, organized and under the leadership of HATZ member Mladen Obad-Šćitaroci.



Fig. 5. Letter dated July 15th, 2003 to MSES



Fig. 6. The approach to the HATZ building is decorated for people with reduced mobility



Fig. 7. One of the first laurel groves and cherry trees for a green fence in the city

Landscaping in the park and setting up a green fence around the park, planting trees in the park and creating a parking lot in the HATZ park for the needs of its members was carried out simultaneously with the decoration of the HATZ building.



Fig. 8. Arrangement of the external appearance of the HATZ building



Fig. 9. HATZ Presidency

The first session of the HATZ Presidency in the area of the reconstructed, renovated and fully furnished HATZ building was on February 13th, 2004, on the first floor of the building (Fig. 9), that is, approximately 7 months after the start of the design documentation.

In 2003, HATZ had a Management Board consisting of: Zlatko Kniewald - President, Tomislav Filetin - Vice President, Stanko Tonković - Vice President, Miljenko Lapaine - Secretary General, and Juraj Božičević - former President, and the members of the Presidency were:

Secretaries of 13 HATZ Departments, Zvonko Benčić, Mladen Figurić, Zoran Gomzi, Slavko Krajar, Vladimir Medved, Mladen Obad-Šćitaroci, Franko Rotim, Branko Salopek, Siniša Sriblić, Mate Sršen, Ivica Veža, Branka Zovko-Cihlar and Vilko Žiljak.

Chairs of the Standing Committees: Marin Hraste – For Promotion, Miljenko Lapaine – Cooperation with Academies and Scientific Societies, Jasna Kniewald – International Cooperation between Academies, Ivan Ilić – Cooperation with Scientists Abroad, Vilko Žiljak – Cooperation with Towns, Petar Đukan – Cooperation with Economy, Borivoj Modlic – for Awards, Marijan Bošnjak – for Ethics. (HATZ Annual 2004. pp 173-174)

The HATZ library (Fig. 10) was arranged in the room on the ground floor on the right thanks to a donation from Croatian Electricity Company (HEP). A plaque with the name of the donor was placed on the door of the HATZ library as a sign of gratitude.



Fig. 10. HATZ library



Fig. 11. HATZ flag

Fig. 12. Flags in the HATZ park

Fig. 13. HATZ park at night

The installation of the flags carrier and installation of the flag of the Republic of Croatia and the HATZ flag (Fig 11.) in the park of the HATZ headquarters was completed in 2006, and the EU flag was installed in 2009, when HATZ became a full member of EuroCASE (Fig. 12.), and before the entry of the Republic of Croatia into the EU. HATZ headquarters and surroundings at the night (Fig. 13.)

The HATZ Assembly, at its session held on February 28, 2006, adopted an amended and clarified text of the HATZ Statute, where, among other things, in Art. 4. determined what the HATZ Flag looks like. In addition to the Flag in dimensions according to the HATZ Statute, commemorative small table flags were made and distributed to interested HATZ members for their work space.



Fig.14. Stainless steel entrance door to the HATZ park with stylized letters H A T Z, (Design by Z. Kniewald)



Fig. 15. The appearance of the green fence cherry laurel after 18 years (picture taken in January 2023)

During the adaptation of the space, regular HATZ activities were held according to the annual plan and program. A HATZ promotional poster (Fig. 16.) with HATZ activities was created and delivered to all cooperating HATZ institutions in the Republic of Croatia. The poster lists, among other information, 28 specialized courses that HATZ members can organize for the needs of the economy in HATZ Centers or in their home institutions, but under the auspices of HATZ.



The establishment of HATZ Centers and the improvement of their activities continued.

Fig. 16. HATZ promotional poster

In the period from 2003-2009 the following Centers operated in HATZ:

1. Center for development studies and projects. Leader Juraj Božičević
2. Center for accidents and disasters. Leader Dražen Aničić
3. Biotechnical center. Leader Zlatko Kniewald
4. Center for lifelong education. Leader Tomislav Filetin
5. Center for geoinformatics and cartography. Leader Nedjeljko Frančula
6. Center for graphic engineering. Leader Vilko Žiljak
7. Center for environmental protection and development of sustainable technologies. Leader Đurđa Vasić-Rački.



Fig. 17. Attendees and employees from Belupo inc. and teachers course in Animal Cell Technology in the organization of the HATZ Biotechnical Center on February 22, 2008.

The activities of the HATZ Biotechnical Center on the domestic and international level were particularly intensive with PLIVA Inc. on joint projects on the application of animal cells in the production of vaccines and holding international meetings on important areas of biotechnology. The meetings were held in the large hall of the Ministry of Economy of the Republic of Croatia in English language, without registration fee and with the participation of scientists from the Republic of Croatia and abroad.

The following institutions participated in the organization of the scientific meetings on Biotechnology: HATZ, Scientific Council for Agriculture and Forestry and the Department of Technical Sciences of the Croatian Academy of Sciences and Arts (HAZU), the Croatian Society of Biotechnology, the Academy of Medical Sciences of Croatia, PBF and PLIVA inc.

After the meetings Proceedings were published in the Edition “Current Studies of Biotechnology volume I–IV:

Biomedicine 2000, Environment 2001, Food, 2003, and Immunomodulatory Drugs 2005.

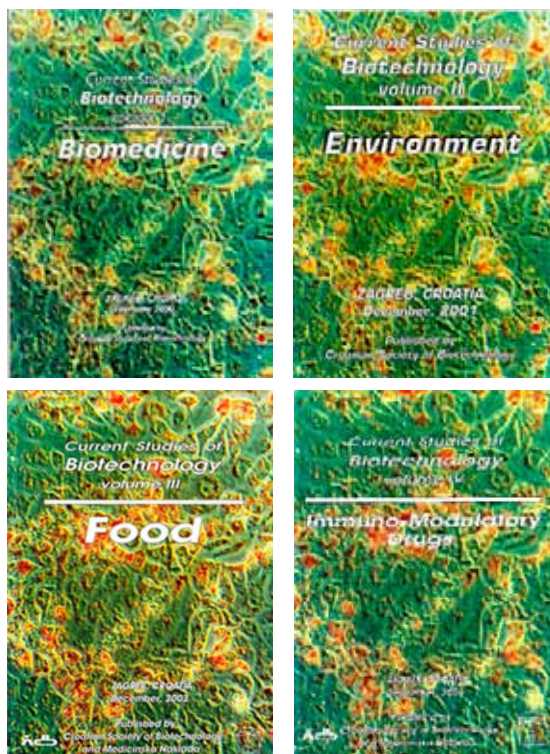


Fig. 18. Current Studies of Biotechnology vol. I - IV



PREFACE

Dear reader,

It is my great pleasure that I can present you the 4th Volume «Biotechnology and Immuno-Modulatory Drugs» of the scientific edition «Current Studies of Biotechnology». The entire edition is a result of the scientific conferences that have started in 1999 in Zagreb, Croatia with the Croatian participants, but also with the scientists from several countries all around the world.

The topics that were previously presented were Biomedicine, Environment and Food, and now we are glad that we can present you the selected papers related to Immuno-Modulatory Drugs as the topic of this Volume.

This Conference, as the previous ones were, was organized jointly with the Croatian Society of Biotechnology, Croatian Academy of Engineering, Croatian Academy of Medical Sciences, Scientific Council for Technological Development of the Croatian Academy of Sciences and Arts, PLIVA Croatia, Ltd. and Faculty of Food Technology and Biotechnology, University of Zagreb.

The 4th Volume, «Biotechnology and Immuno-Modulatory Drugs», was published at crucial time when the environmental influence has all the greater impact on the human immune system, and the pharmaceutical industry, biotechnologists and physicians are trying to find the best way to overcome all visible effects as well as those still unknown.

Our next conference, «Biotechnology and Energy», is scheduled for February, 2007, and the next volume (5th Volume – «Energy»), will be issued somewhere at the end of 2007.

Instead of printing of the reprints, each author will receive the author's copy and CD with full text of this Volume.

Zagreb, December, 2005

Editor-in-Chief

Fig. 19. Impressum and Preface for vol. IV. Immunomodulatory Drugs

Through HATZ, the Biotechnical Center actively participated in the Annual Exhibition of Innovations ARCA, where the exhibited works of the HATZ Biotechnical Center received special awards in 2005 and 2006 (Fig. 20.)



Fig. 20. participation of HATZ at the ARCA exhibitions

By connecting to the University Computing Center (SRCE), permanent internet communication was achieved. Therefore, already in 2003, and thanks to the activities of HATZ secretary and HATZ member Miljenko Lapaine, the first HATZ websites prepared earlier were put into operation. The pages were well visited because of their content. Interest in the pages was followed by visits, which were expressed numerically and HATZ members were informed about them. Due to the international co-

operation with CAETS and EuroCASE, the pages were in Croatian and English. By 2009, the website had more than 350,000 hits.

The Committee for International Cooperation chaired by Jasna Kniewald played an important role between 2003 and 2009 due to the inclusion of HATZ in several significant projects in the Republic of Croatia, the conclusion of bilateral agreements, as well as obligations towards CAETS and EuroCASE in the activities in which HATZ participated. Lectures were held at meetings in Cairns, Tokyo and Budapest and published in HATZ yearbooks.

Project “Meaning and role of the profession of engineer”



Fig. 21. Hungarian Parliament



Fig. 22.

At the beginning of this text, I listed all my titles, but which any individual can acquire during his working life and training. And that should be appreciated, but by studying at technical and biotechnical faculties today, during the undergraduate studies, the basic title of bachelor's degree in professional engineering is acquired. Everything else, including the bachelor's degree, is an upgrade and improvement, so the bachelor's degree ends with the title of Master of Science in Engineering, with further improvement in other titles. The profession of engineer is fundamentally different from all other professions in higher education, which should always be emphasized. The Hungarian Academy of Engineering (HAE) invited us to be present at the founding of their Engineers' Day in 2006 and at the same time take an active part in the 7th World Federation of Engineering Organizations (WFEO) World Congress in Budapest on 3-7. March 2006. The solemn ceremony of declaring the Day of Hungarian Engineers was held in the Parliament (Fig. 21.) under the chairmanship of the President of Hungary HAE Prof. Janosz Gintzler PhD. At the invitation of the organizers of the 7th WFEO Congress, I participated in a lecture on the development of

the profession of biotechnology engineer in Croatia over the past 45 years (Fig. 22.). On that occasion, I pointed out the fact that the title of engineer in the Republic of Croatia has been abolished. After the discussion that took place on that occasion, the chairman thought that I was confused, when I confirmed the fact, it was concluded that the Government of the Republic of Croatia should be informed in writing that a mistake had been made. This was done, and in the coming period, MSES, with the great cooperation of the Deputy Minister prof. Slobodan Uzelac PhD corrected the resulting error.

Based on the agreement with the President of HAE during my stay in Budapest, an agreement on bilateral cooperation between HATZ and HAE was signed later on June 28, 2006, in the HATZ Headquarters in Zagreb, in the presence of representatives of the Hungarian Embassy in Croatia. During my stay in Budapest, a visit to the Intellectual Property Office of Hungary was organized, where I introduced their representatives to the translation of the International Patent Classification (IPC) 6th (1995) and 7th (2000) editions into Croatian that has been completed. Croatia is one of the few countries which has a translation into its own language (Fig. 23).

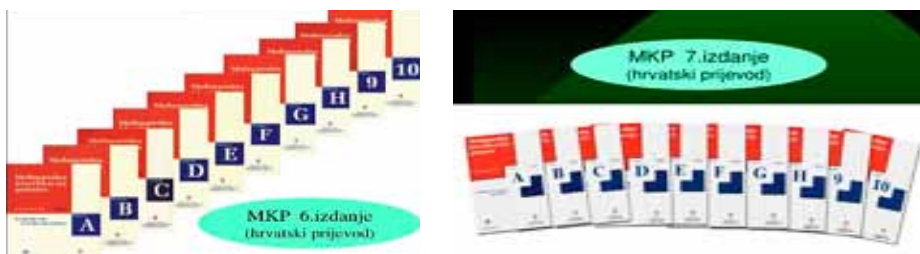


Fig. 23. Croatian editions of IPC

I was a member of the Editorial Board of the editions, Editor of Section C and one of several translators from PBF.

The announcement about the Proclamation of Engineers' Day held in Budapest was published in *Tehničke znanosti HATZ* 14(1)2007. p16. Back in 2006, the HATZ Presidency and Assembly accepted a proposal to establish Engineers' Day in Croatia. The initiative was launched together with the Croatian Engineering Association (HIS), but it was not established until March 13, 2015. That day leaders and associates of HAZU, HATZ, HIS, the Rectorate of the University of Zagreb, the Croatian Military Academy "Petar Zrinski" and Končar-Elektroindustrije inc. solemnly declared the establishment of the Day of Engineers in Croatia in the hall of the Ministry of Economy of the Republic of Croatia. It was only at its 40th session held in November 2019 that UNESCO made the decision to hold "World Engineering Day for Sustainable Development to raise awareness of the role of engineering in modern life" every

year on March 4. The Day of Engineers is a day to mark a tradition of the engineering profession, but also a moment when experts in the basic profession of engineer talk with other participants from Croatia and abroad and agree on how to apply and adapt modern technology to nature, the environment and man.

Project “2006 Year of Nikola Tesla”

(extensive presentations published at Annual 2006 of the Croatian Academy of Engineering pp 77-431)

In 2005, the Parliament of the Republic of Croatia decided to declare 2006 the year of “Nikola Tesla” on the occasion of the 150th anniversary of his birth. Under the chairmanship of the Speaker of Parliament Vladimir Šeks, a Committee was organized to which I was elected as President of HATZ. At the suggestion of the Minister of MSES, Prof Dragan Primorac PhD, HATZ was in charge of organizing all the major events during the “Year of Nikola Tesla”.

The central event was a celebration in the Vatroslav Lisinski Concert Hall on June 27, 2006, which was already written about in the jubilee editions on the occasion of the 20th and 25th anniversary of HATZ, as well as the HATZ periodicals Tehničke znanosti and Engineering Power.



Fig. 24.



Fig. 25.

The celebration was organized under the patronage of the President of the Republic of Croatia, HE Stjepan Mesić. The anthem of the Republic of Croatia, „Our Beautiful Homeland“, was performed at the beginning of the celebration by primadonna Ivanka

Boljkovac (Fig. 24, 25). Due to Nikola Tesla's significant contribution during his life and work in the USA, the US Embassy in Zagreb participated in the organization of the central celebration, which ensured the arrival and introductory lecture of Prof. Harold Forsen PhD.. The celebration was also attended by the doyen of electrical engineering in Croatia, prof. Vladimir Muljević PhD at the age of 93 years (Fig. 27.).



Fig.26. Mr. and Mrs Forsen



Fig. 27.

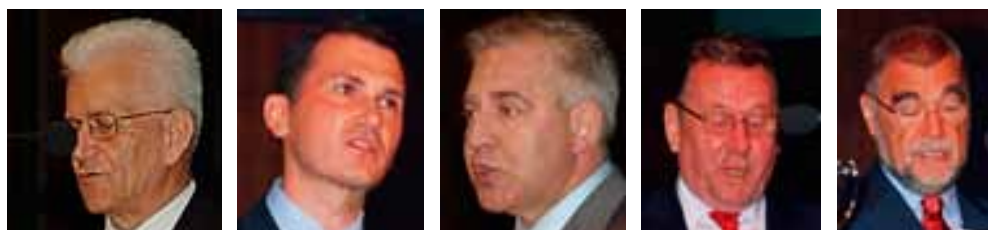
The celebration was attended by the President of the Republic of Croatia Stjepan Mesić, President of the Parliament of the Republic of Croatia Vladimir Šeks, Prime Minister of the Republic of Croatia Ivo Sanader, the mayor of Zagreb Milan Bandić, ambassadors or their representatives who were invited to celebrate the Year of Nikola Tesla, and other guests Fig. 28, 29).



Fig. 28



Fig. 29



Zlatko Kniewald

Dragan Primorac

Ivo Sanader

Vladimir Šeks

Stjepan Mesić

Fig. 30.

Harold Forsen

Carl-Henric Svanberg

Kurt Richter

Aleksandar Marinčić

Stjepan Car

Nikola Toljan

Fig. 31.

After the introductory presentations, the celebration was opened by the President of the Republic of Croatia, HE Stjepan Mesić (Fig. 30.), and then thematic lectures on the life and works of Nikola Tesla were held. Those presentations were addressed by Harold Forsen PhD. USA, Carl-Henric Svanberg, CEO Ericsson Inc. Sweden, Kurt Richter, the Austrian Academy of Sciences, Aleksandar Marinčić PhD the Serbian Academy of Sciences and Arts, Prof. Stjepan Car PhD, R. Končar Inc., Nikola Toljan PhD, Ericsson Nikola Tesla, Zagreb (Fig. 31.).

On June 28, in the morning, was a trip by bus to Gospić and the birthplace of Nikola Tesla Smiljan. Visit was organized also to the Tesla's memorial museum built in 2006, in the year which in the Republic of Croatia is marked with his name.

28.–29. June 2006. The international scientific and professional meeting “Life and work of Nikola Tesla” was held under the chairmanship of Stanko Tonković, in the hall of the Faculty of Electrical Engineering and Computing, University of Zagreb (Fig. 32.).



Fig. 32. Proceedings and organizational bodies

From 7-11 October 2006, in the organization of Marie Skłodowska-Curie Actions (MSCA) in Zagreb and then in Belgrade, a meeting of previous MSCA scholarship holders was organized with the aim of exchanging experiences and informing each other about the possibilities of future cooperation (Fig. 33, 34). The Youth Scholarship Foundation was organized by the EU/European Commission to support research in the European research area. About 100 participants from Croatia, Serbia and EU took part in the meeting.

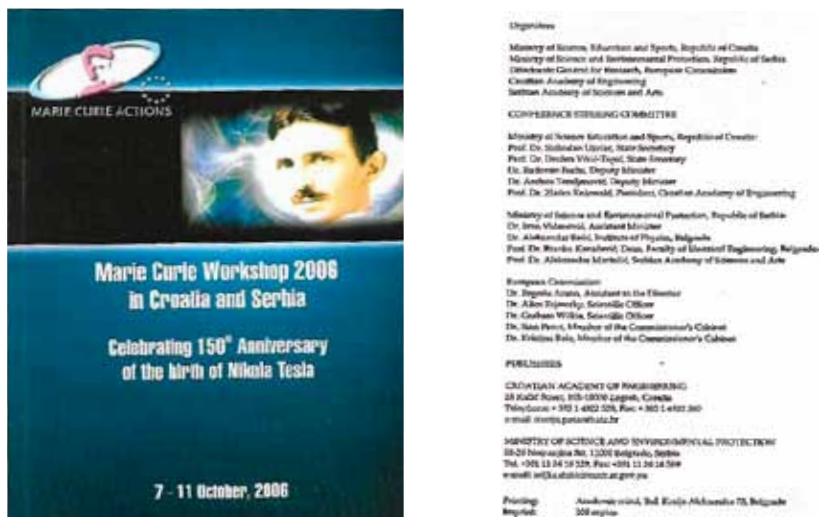


Fig. 33. Marie Curie Workshop 2006

Year 2006 is marked with the celebration of the 150th anniversary of the birth of Nikola Tesla, one of the world's greatest inventors in the field of electricity and magnetism. This anniversary is of special national importance in Croatia and in Serbia, having in mind that Nikola Tesla was an ethnic Serb born in Croatia. The Serbian and Croatian governments therefore initiated a joint event to commemorate Nikola Tesla and asked the European Commission for its auspices. The Commission kindly offered a workshop under the Marie Curie scheme to be organized in Zagreb and Belgrade, 7-11 October 2006. The workshop is held on 7-9 in Zagreb, and 9-11 in Belgrade. Commissioner Janaz Potočnik takes part at both venues giving support to this joint event.

For this event about 100 participants have been registered, Marie Curie fellows from EU countries and Serbian and Croatian research fellows. They contribute their poster and oral presentations, representing their institutions and their work in different topics: electronics, automatics and devices, computing science, material and physical sciences, environmental and life sciences. There are also several contributions that cover more general problems and also the advantages and challenges of the Marie Curie Programme itself. There are 72 submitted abstracts that make the body of this Proceedings. The length of abstracts has been limited to 200 words, and the editors did not intervene in the contributions. The conference will be addressed by about 40 senior speakers ranging from politicians, prominent researchers, science managers and industrial captains.

We hope that this workshop will enhance the information exchange between the young researchers that are using the benefits of being associated to the EU research scheme, with those in Croatia and Serbia who are aiming to use these benefits. We deeply believe that the personal contact of these young people will enrich them by providing new counterparts in research and by sharing the joint experience of visiting Zagreb and Belgrade. We also believe that this joint effort will further support the collaboration between Serbian and Croatian researchers and administrations, on the common way of the two countries towards the EU association.

Prof. Dr. Zlatko Kniewald, President
Croatian Academy of Engineering

Dr. Ivan Videnić, Assistant Minister
Serbian Ministry of Science and
Environmental Protection

Fig. 34. Text of the Introduction

In the booklet with the program in Zagreb and Belgrade and summaries Lectures.

On **November 24, 2006**, HATZ organized the Tesla evening “With Tesla in the development of Croatia.” The scientific evening was held in the MIMARA Museum with the participation of leading businessmen, scientists and representatives of state institutions and diplomatic missions (Fig. 35, 36).



Fig. 35. Scientific evening program



On that occasion, the President of the Management Board of Končar - Elektroindustrije d.d.: Darinko Bago presented “New products based on the inventions of Nikola Tesla” and on that occasion all those present had an exclusive opportunity to learn about the newly announced achievement of this company, namely the low-floor regional train.

Fig. 36. Program booklet of the scientific evening

On **September 13, 2006**, the “Tesla in Croatia” conference was organized at the UNESCO headquarters in Paris under the auspices of the President of the Republic of Croatia, HE Stjepan Mesić. The conference was led by Stanko Tonković, and the leader through the program was Helga Vlahović. On behalf of the sponsor, the conference was attended by Prof Izet Aganović PhD. Among the other participants at the conference the lecture was given by the president of Ericsson Nikola Tesla, Gordana Kovačević. (Fig. 37, 38)

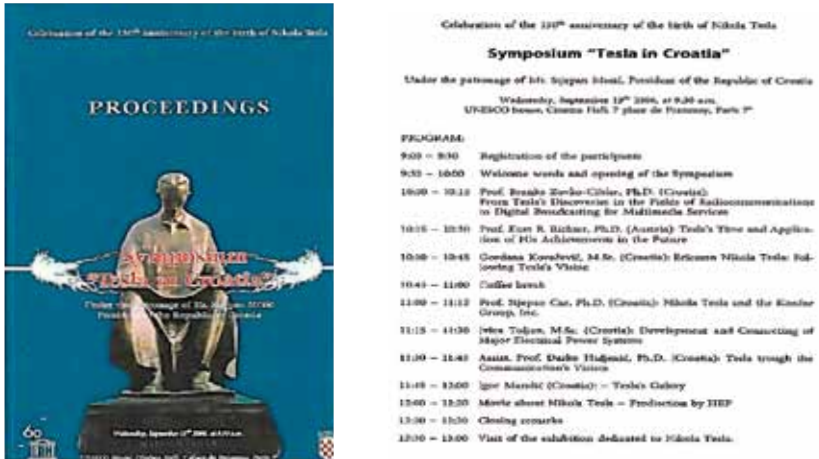
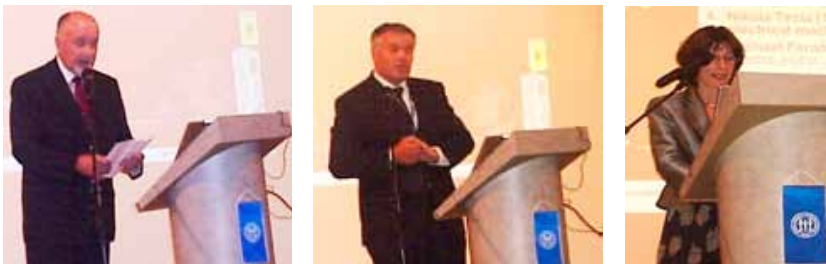


Fig. 37. Program booklet



Stanko Tonković

Izet Aganović

Gordana Kovačević

Fig. 38.

Before the conference, the Ministry of Culture of the Republic of Croatia in the presence of Božidar Galić, Ambassador of the Republic of Croatia in France opened an exhibition dedicated to the life and work of Nikola Tesla (Fig. 39).



Fig. 39. Opening of the exhibition dedicated to Nikola Tesla at the UNESCO headquarters in Paris.

At the proposal of the Minister of MSES, prof. Dragan Primorac PhD I participated in the „Nikola Tesla Days“ in Madrid, where an exhibition from the Republic of Croatia about Nikola Tesla was open from October 24 to December 12, 2008.

On **November 12, 2008**, I gave a lecture “Nikola Tesla - From Childhood to the New Yorker Hotel” at the Technical College.

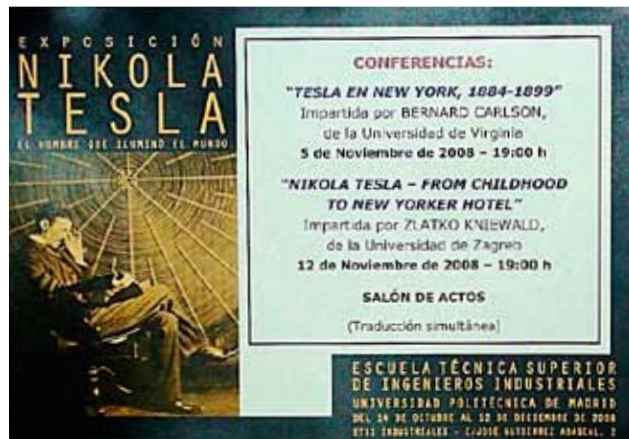


Fig 40. Notice of lectures in Madrid

The New Yorker Hotel was Nikola Tesla’s last residence in the USA, where he died on January 7, 1943. This year (2023), the 80th anniversary of his death is being mentioned in the Republic of Croatia.

The Embassy of the Republic of Croatia in the Kingdom of Spain announced on October 14, 2008. a wider text, a part of which is attached below.

“Several accompanying events are planned during the two months of the exhibition. First of all, it is a series of lectures by world-renowned scientists and experts. From the Spanish side, Brian Bowers from Great Britain, author of the books “Lengthening the Day” and “A History of Electric Light and Power” and Bernard Carson, a professor at the University of Virginia, USA, who is currently writing a book about Tesla, were invited. According to the proposal of the Ministry of Science, Education and Sports of the Republic of Croatia, on the Croatian side, the lecture will be held on November 12 of this year by a Ph.D. Zlatko Kniewald, director of the Croatian Academy of Technical Sciences.” *Downloaded from Google on 1/30/2023. at 23.42.*

December 8, 2009. The HRT show “Među nama” (Fig. 41) was hosted by Jasna Burić PhD in duration 54 min. Topic “Life and work of Nikola Tesla”. On that occasion, a CD with all the patents of “Nikola Tesla” prepared by HATZ in 600 copies back in 2006 was available to all viewers. A video recording of the entire show on USB is available in the HATZ library as well as CD with all the patents of „Nikola Tesla“.



Fig. 41. HRT show

Among other activities, in 2006, the moving of the “Nikola Tesla” monument from the Ruđer Bošković Institute to the beginning of Nikola Tesla Street in Zagreb should be mentioned. The monument is the work of sculptor Ivan Meštrović. The transfer was organized by the city of Zagreb in cooperation with the Ministry of Science, Education and Sports of the Republic of Croatia.

Projects

The first congress of Croatian scientists from the country and abroad Zagreb–Vukovar 15.-19. November 2004

The second congress of Croatian scientists from the country and abroad Split 7.-10. May 2007

At the proposal of the Prof. Dragan Primorac PhD Minister of MSES, HATZ actively participated in the organization of the First and Second Congress of Croatian scientists from the country and abroad. At the First Congress, personal research results were published in oral presentations in all scientific fields.

Occasional oral presentations were made in the second part of the Congress held in Vukovar on November 18 and 19 2004. The presented results were published in the Proceedings (Fig. 42.), which contains contributions to presentations at the first congress of Croatian scientists from the country and abroad, and are organized around the following units: economy, natural sciences, technical sciences, biomedicine and health, social sciences, humanities and biotechnical sciences. Domestic and foreign achievements were presented and conclusions were accepted. Editor Prof Pavo Barišić PhD

The goal was to motivate young scientists to actively promote the results of their work outside their narrow professional community. Therefore, in the program of the First Congress, HATZ organized a section of works by scientific novices who were presented at scientific gatherings abroad in 2002, 2003 and 2004. In the preparation of the congress, it was observed that the best new scientific results of young scientists are presented abroad, and that scientists, as well as the economy and society as a whole in the Republic of Croatia, are not aware of this. Therefore, a large poster section was arranged at the Westin Hotel Zagreb, where the congress was also held and posters from all scientific fields were presented (Fig. 43-46).



Fig. 42. Proceedings



Fig. 43. Collection of poster presentations



Abstracts of the posters were published in the book Part I for Natural Technical and Biotechnical Sciences and Part II. Section for Biomedicine and Health, Social Sciences and Humanities.



Fig. 44. Research novices – volunteers during participant registration



Fig.45. HATZ labels on T-shirts student volunteers.



Fig. 46. Among other participants the poster section was visited by Director of PBZ Božidar Prka



Fig. 47. Memorial cemetery

The first Congress was organized so that after arriving in Vukovar from Zagreb on November 17th 2004, Congress participants took part in the memory procession from the hospital to the memorial cemetery (Fig. 47.) on November 18th 2004 in the morning. Then transportation to Ovcara and the visit to the memorial was organized. (*A more detailed presentation of HATZ participation in the Memorial Procession was described by HATZ member Milena Mandić from Osijek. It was published in Engineering Power/Tehničke Znanosti 2007*). After the memorial visit to the victims of Vukovar, the working part of the Congress was held (Fig. 48, 49), which ended with the adoption of a joint declaration.



Fig. 48. Presidency of the Congress in Vukovar



Fig. 49. One of the lecturers at the Congress.

The Second Congress of Croatian Scientists from Homeland and Abroad

Second congress of Croatian scientists from home and abroad in 2007. (Fig. 50.) was a continuation of the connection of scientists from Croatia and abroad, which began at the First Congress held from November 15 to 19, 2004 in Zagreb and Vukovar. This time the goal of the Congress was “Croatia 2010 - a Society based on knowledge”, and the activities during the Congress tried to point out the possibilities of Croatia’s intellectual capacities for faster connection with European and world trends in technological and social development.



Fig. 50. Proceedings of the 2nd congress

Fig. 51. Program of the 2nd congress

On the first day, (Fig. 51.) presentations were held by leaders of all scientific fields: natural, technical, biotechnical, biomedical and healthcare, as well as humanistic and social sections.

On the second day of the Congress, several workshops were held in different thematic areas, for which the organizers believed that there were real possibilities and a need to connect scientists and economy for the development of 21st century technologies.

On the third day, a Plenary session was held with the conclusions of the thematic units, which were formulated into a single document, which was adopted and signed. The conclusions were signed by: the Minister of MSES, the President of the National Council for Science, the President of the National Council for Higher Education, and the rectors of all Croatian universities.



Thank you note by MSES that the HATZ activity existed at the First and Second Congresses (Fig. 52.).

Fig. 52.

Some of the wider activities of HATZ in the period 2003-2009



Fig. 53. HATZ members actively participated in above-mentioned activities

The END

It was an honor to be the president of HATZ from 2003 to 2009. and I want to thank all members of HATZ as well as the administrative staff for their unreserved help

*Zlatko Kniewald
President of the Croatian Academy of Engineering
2003-2005 and 2005-2009.*

*Zlatko Kniewald –
essential parts of the CV that allowed me to always be an engineer*

- 1962.-1967. Yeast and spirit factory “Žumberak” Savski Marof,
1968.-1970. Ford Foundation scholarship. Institute of Pharmacology,
University of Milan, Italy
1972.-1979. Grant of the Ford Foundation for research in Zagreb in the field of
reproductive biology,(252.000 US\$)
1976.-1987. Secretary of the Assembly of the Republican Community for
Scientific Work of SRH,
1986. Annual prize for scientific work “Ruđer Bošković” of the Parliament of
SRH, field of chemistry,
1991. “The British Council” Seminar “Research Management in Higher
Education”, Manchester, Great Britain
1995. “The British Council” seminar “Industry and higher education working
together”, Southampton, Great Britain,
2000. - present European Science Foundation, ARRS, MSES expert, reviewer:
Biotechnology, Biochemical engineering, Environmental protection*

Croatian Academy of Engineering 2013-2022

President in the mandates 2013-2017 and 2017-2022
Prof. **Vladimir Andročec**, Ph.D.

Abstract

Changes in the Board of the Academy and other bodies continued in 2013, with the integration of scientists from the fields of technology and biotechnology and a stronger focus on cooperation between science and business. In addition, successful collaborations were concluded with other academies and cooperation partners in the field of Academy activities. Even after 2017, active cooperation with Academy members continued, which was particularly evident in the project with the Tehnix Company and individual Academy members. Cooperation with various scientific and business institutions increased the number of supporting members and joint activities, and an economic and regional cooperation committee was established within the Academy. During the Covid-19 pandemic, the number of activities and participation of members in physical form significantly decreased, but the number of applications allowing remote participation increased. However, despite the difficult working conditions, the Academy regularly issued its publications, which were available on the Academy's website as well as in print, and continuously carried out its work activities.

Governing Board of the Academy

2013-2017

The Governing Board of the Academy composed of:

1. Prof. Vladimir Andročec, Ph.D., President
2. Prof. Zdravko Terze, Ph.D., Vice-President
3. Prof. Vladimir Medved, Ph.D., Vice-President
4. Prof. Dubravko Rogale, Ph.D., General Secretary

was elected in 2013 at the 28th Annual Assembly whose mandate started on July 1st 2013 and lasted to June 30th 2017. Prof. Emeritus Stanko Tonković, Ph.D., joined the Governing Board in compliance with the Statute as a Board Member.

Thinking about the future of the Academy as a scientific community and with the intention of acting in order to support its existence, the new Governing Board studied the experiences of other academies and scientific societies in the world and it was concluded that in the new period the Academy should become a work unit that will help individuals and organizations and the society as a whole in:

- systematic preparation for the future;
- acquiring skills of prediction and discussion;
- support and development of innovation culture;
- acquisition and application of knowledge;
- communication with the authorities and with economy; and
- connecting science with industry.



Fig. 1. Governing Board 2013-2017 (Prof. Emeritus Stanko Tonković, Ph.D., Board Member, Prof. Zdravko Terze, Ph.D., Vice-President, Prof. Vladimir Andročec, Ph.D., President, Prof. Vladimir Medved, Ph.D., Vice-President, Prof. Dubravko Rogale, Ph.D., General Secretary)

2017-2022

The Governing Board of the Academy composed of:

1. Prof. Vladimir Andročec, Ph.D., President,
2. Prof. Dubravko Rogale, Ph.D., Vice-President,
3. Prof. Zdravko Terze, Ph.D., Vice-President, and
4. Prof. Emerita Nediljka Gaurina-Međimurec, Ph.D., General Secretary,

was elected in 2017 at the 32nd Annual Assembly whose mandate began on July 1st 2017, adopted a strategic program with the plan of activities and their implementation.

At the same Assembly Prof. Slavko Krajcar, Ph.D., was elected as a Board Member of the HATZ for the mandate 2017-2021.

In May 2018, the Academy marked its 25th anniversary with a series of activities. That year, changes and additions to the Statute and normative acts of the Academy were made. The amended Statute was submitted to the relevant state institutions and published on the HATZ website.



Fig. 2a. Governing Board in mandate 2017-2022 (Prof. Zdravko Terze, Ph.D., Vice-president, Prof. Emerita Nediljka Gaurina-Medimurec, Ph.D., Secretary General, Prof. Vladimir Andročec, Ph.D., President, Prof. Dubravko Rogale, Ph.D., Vice-President, Prof. Slavko Krajcar, Ph.D., Board Member)



Fig. 2b. Governing Board in mandate 2017-2022

In October the same year, Prof. Emerita Nediljka Gaurina-Medimurec, Ph.D., resigned from the duty of the Academy's General Secretary. By the decision of the Assembly made at the 36th electronic session held on February 26th 2019, Prof. Vladimir Mrša, Ph.D., became the new General Secretary of the Academy.



Fig 3. Governing Board in mandate 2017-2022 (Prof. Dubravko Rogale, Ph.D., Vice-President, Prof. Vladimir Androćec, Ph.D., President, Prof. Vladimir Mrša, Ph.D., Secretary General, Prof. Slavko Krajcar, Ph.D., Board Member, Prof. Zdravko Terze, Ph.D., Vice-President)

In June 2021, after the sudden death of Prof. Slavko Krajcar, Ph.D., Prof. Vedran Mornar, Ph.D., was elected as an acting Board Member of the Governing Board by the decision of the Presidency made in the 20th electronic session.



Fig. 4. Governing Board in mandate 2017-2022 (Prof. Vladimir Mrša, Ph.D., Secretary General, Prof. Vedran Mornar, Ph.D., acting Board Member, Prof. Vladimir Androćec, Ph.D., President, Prof. Zdravko Terze, Ph.D., Vice-President, Prof. Dubravko Rogale, Ph.D., Vice-President)

Academy elections were scheduled for 2021, which meant the election of the new Governing Board, Presidency, departments, committees and centres of the HATZ.

Due to the standard restrictions and health protection of Academy members during the corona virus pandemic and the precautions taken to prevent the spread of infection, it was decided at the 41st electronic Assembly to extend the mandate of the HATZ existing administrative bodies until formal conditions are in place to hold larger meetings and allow members of the Academy Assembly to attend meetings and hold elections in person.

On July 1st 2022, the new Governing Board, Presidency, Departments, Committees, Centre, Economic Council and Scientific Council started their work. The 44th solemn assembly held in June was the last in the formation: Prof. Vladimir Andročec, Ph.D. (President), Prof. Dubravko Rogale, Ph.D. (Vice-President), Prof. Zdravko Terze, Ph.D. (Vice-President), Prof. Vladimir Mrša, Ph.D. (General Secretary), and Prof. Vedran Mornar, Ph.D. (acting Board Member).



Fig. 5. Governing Board in mandate 2017-2022 (Prof. Vladimir Mrša, Ph.D., Secretary General, Prof. Vedran Mornar, Ph.D., acting Board Member, Prof. Zdravko Terze, Ph.D., Vice-President, Prof. Vladimir Andročec, Ph.D., President, Prof. Dubravko Rogale, Ph.D., Vice-President)

Academy Membership

Number of members after the 20th anniversary celebration and the 28th HATZ Annual Assembly in May 2013 was:

Members of the Academy	104
Emeriti members of the Academy	65
International members of the Academy	9
Associates of the Academy	78

Honorary members of the Academy	8
Amici members of the Academy	15
<u>Supporting members of the Academy</u>	<u>49</u>
IN TOTAL	328

Number of members after the 5th (electronic) session of the Presidency (outside of the session) in April 2018 was:

Members of the Academy	102
Emeriti members of the Academy	85
International members of the Academy	13
Associates of the Academy	66
Honorary members of the Academy	10
<u>Supporting members of the Academy</u>	<u>62</u>
IN TOTAL	338

Number of members after the 44th HATZ Annual Assembly in June 2022 was as follows:

Members of the Academy	98
Emeriti members of the Academy	86
International members of the Academy	19
Associates of the Academy	74
Honorary members of the Academy	8
Entrepreneur members	9
<u>Supporting members of the Academy</u>	<u>64</u>
IN TOTAL	358

Between 2013 and 2022 the Academy held 9 internal calls to elect new emeriti members of the Academy, 5 public calls to elect new associates, international and honorary members, 4 internal calls to elect new (regular) members of the Academy, 2 internal calls to elect new leadership and members of Departments, Committees, Centres and the Scientific Council and 2 internal calls to elect the new Governing Board of the Academy.

The Academy's small membership has changed over the years for a number of reasons:

- A number of members had their membership terminated due to non-fulfilment of membership obligations;
- According to the Statute (members who have not advanced from associate member status to regular member status by the age of 70);
- Members who resigned from the Academy at their own request due to the impossibility of active participation in the work of the Academy.

These procedures lead to the initiation of the proceedings for the dismissal of members of the Academy.

Over the years, the Academy's Governing Board has attracted members from numerous successful and prominent business entities, as well as scientific institutions, thereby increasing the number of supporting members. Currently, the Academy has 64 supporting members in its membership.

As the Academy is a non-profit organization, the contributions of its members are extremely important. With their membership fee and cooperation, the members support the Academy in carrying out the plans and activities of the Academy that are in the interest of the scientific, technological and economic development of our country.

The activities of the Academy in recent years have made a significant contribution to the development of technical and biotechnological sciences, and the names of its supporting members are always in the foreground.

The activities of the Academy

From 2013 to 2017 the Governing Board of the Academy held 90 sessions, the Presidency held 17 sessions, 4 plenary sessions of the Assembly, and 5 electronic sessions of the Assembly were held.

From 2017 to 2022 the Governing Board of the Academy held 88 sessions, the Presidency held 23 sessions, 2 plenary session and 9 electronic sessions of the Assembly outside the session were held.

Departments, committees, centres and councils held their sessions regularly according to the planned work program.

The work of the Academy has been recognized by many national and international institutions, numerous requests for cooperation and sponsorship, invitations to organize and co-organize meetings, participation of HATZ representatives and members at meetings and meetings of public interest; it is understandable that the number of invitations to sponsorships and partnerships has declined significantly during the pandemic. The spread of the coronavirus has reduced the number of conferences with physical attendance by delegates. Meetings were mostly held in the form of virtual conferences and meetings.



Fig. 6. Webinar Hydrogen in Energy Transition, online, March 4th, 2021



Fig. 7. Conference Printing & Design, online, June 4th, 2020

During the mandate years 2013-2017 and 2017-2022, the Academy received more than 200 applications for patronage, more than 400 invitations to participate in events of public interest, and co-hosted or organized more than 80 events.



Fig. 8. Conference “Buildings 3+, safety, comfort, quality”, February 17th - 18th, 2022



Fig. 9. MIPRO 2022 Conference, May 27th, 2022



Fig. 10. Conference “Cementary days“ and „Climate and clean water“

Department secretaries, committee chairmen, heads of centres and council presidents played a major role in organizing events and connecting institutions.

The creation and installation of a bust of Prof. Vatroslav Lopašić, Ph.D., in 2016, can be mentioned as part of the Academy’s activities. Prof. Vatroslav Lopašić, Ph.D., the late Honorary Member of the Croatian Academy of Engineering, was an outstanding Croatian physicist – a classic of the Croatian physics, scientist, expert and university teacher, who had educated many generations of young engineers and made an immeasurable contribution in terms of establishing scientific institutions and studies as well as promoting and developing studies of natural and technical sciences in Croatia.



Fig. 11a and 11b. Installation of the bust of Prof. Vatroslav Lopašić, Ph.D., October 17th, 2016

On May 21st, 2018 the 35th solemn annual Assembly took place on the occasion of the 25th Anniversary of the Academy's establishment and activities. For this purpose, a special edition of Annual was published.



Fig. 12. The 35th HATZ Assembly, May 21st, 2018

In May, 2018, the Academy unveiled a bust of Prof. Juraj Božičević, Ph.D., one of the founders of the Croatian Academy of Engineering and second president for two mandates (1997-2001 and 2001-2003), on the occasion of its 25th anniversary.



Fig. 13a and 13b. Installing the bust of Prof. Juraj Božičević, Ph.D., May 7th, 2018

On June 6th, 2022, the 44th regular annual Assembly of the Croatian Academy of Engineering was held in Zagreb. Members of the Academy and high-ranking visitors from science and business attended the meeting. On this occasion, the diplomas were presented to the new full and emeritus members of the Academy, as well as the diplomas to the winners of the Academy Awards for 2021, who had previously been confirmed by the Presidency and the Assembly of the Academy. Over the years, communication with the members has also changed significantly. A new website was created, which is a kind of mirror of the Academy. The most important activities of the Academy and its members are published on the website. We followed the successes and achievements of the members, published information about conferences and workshops that have already been held, as well as much other information. There was daily communication with the members. The activities of the Academy and Academy members are published on the HATZ website and regularly sent to Academy members by electronic mail.

Very often, the Board and members of the Academy promoted the activities and name of the Academy in the media and participated as speakers at various events, always emphasizing their affiliation with the Academy.



Fig. 14. In February 2021, an interview with Prof. Vladimir Androžec, Ph.D. was published on the YouTube channel of the B media portal



Fig. 15. Participation of Prof. Vladimir Androćec, Ph.D., in the RTL Danas show, July 2020

Cooperation between HATZ and other institutions

Between 2013 and 2022 the Croatian Academy signed several contracts with cooperating institution in Croatia and abroad.

– HAZU

The Academy's cooperation with the Croatian Academy of Arts and Sciences (HAZU) was particularly fruitful, and in July 2014 a cooperation agreement was signed with the Croatian Academy of Arts and Sciences. HATZ members were elected as HAZU members.

– HAZU, LZMK

Recognizing the importance of preserving cultural and technical heritage, the Croatian Academy of Engineering, the Miroslav Krleža Institute of Lexicography, and HAZU concluded/signed the Tripartite Cooperation Protocol on the crucial project «Croatian Technical Encyclopaedia» in October 2014. The first two volumes of the Encyclopaedia were published as a consequence of the preceding years intensive effort on the project. A number of Academy members have been especially involved in these projects.

– AMZH, APZH, AŠZH

The Academy also achieves excellent cooperation with the relevant professional academies of the Republic of Croatia: the Croatian Academy of Medical Sciences, the Croatian Academy of Legal Sciences and the Academy of Forestry Sciences.

In 2012, a quadrilateral cooperation agreement was signed by these four sister academies, and in 2016, as well as in previous years, a number of successful joint activities and projects, meetings, forums, and seminars were implemented for the four Academies 'Modern Technologies: Ethics of Use and Legal Regulation' should be particularly mentioned. It was initiated by the Croatian Academy of Medical Sciences and held on March 17th, 2017 at the Croatian Medical Association in Zagreb.

Four academies cooperate through the Council and Coordination of the Academies as their joint coordinating bodies.

– IAS

In September 2017 the Engineering Academy of Slovenia (IAS) and HATZ signed a Cooperation Agreement between countries in the field of engineering and technical sciences. Within the framework of their resources, both parties will maintain friendly contacts and promote mutual cooperation between scientists and engineers.



Fig. 16a and 16b. Signing of the Cooperation agreement between IAS and HATZ, September 28th, 2017

– MIPRO

In December 2017, representatives from the Croatian Academy of Engineering and MIPRO Croatia - the Croatian Association for Information and Communication Technology, Electronics and Microelectronics met in Zagreb to discuss future cooperation and the signing of a mutual support membership agreement.

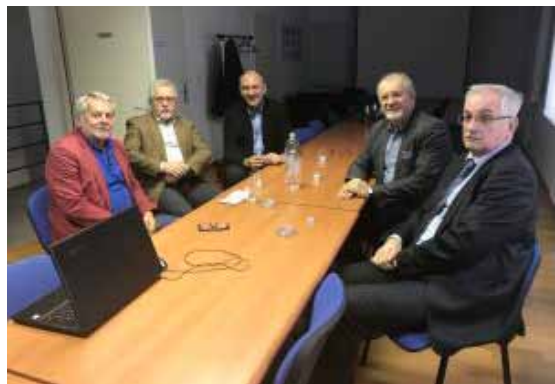


Fig.17. Signing of Agreement between MIPRO and HATZ, December 6th, 2017

– HAZU BIH

In October 2018, the Croatian Academy of Science and Art in Bosnia and Herzegovina (HAZU BIH) and HATZ signed an Agreement on the establishment and development of cooperation in technical and biotechnical sciences based on the concept of mutual interest.



Fig. 18a and 18b. Signing of Agreement on the establishment and development of cooperation between HAZU BIH and HATZ, October 8th, 2018

– EPTS Foundation

In February 2019, European Platform of Transport Science (EPTS Foundation) and HATZ agreed to encourage cooperation among the both sides in the field of engineering and technical science for mutual benefit and signed the Agreement of Cooperation. Both sides will use the expertise of their members to formulate common strategic policy guidelines in the area of mutual interest, which will assist both institutions to promote social and economic development and address global challenges in the future.



Fig. 19a and 19b. Signing of Agreement of Cooperation between EPTS Foundation and HATZ, February 13th, 2019

– HIS

A contract for collaborative research and professional development was signed by HATZ and the Croatian Association of Engineers (HIS) in December 2013. The highly effective collaboration led to the development of the Engineer's Day Celebration in the Republic of Croatia, which these two organizations have been co-ordinating since 2015. Zagreb hosted the 9th Engineer's Day Celebration in March 2023.



Fig. 20. Engineer's Day of the Republic of Croatia, March 2015



Fig. 21. Engineer's Day of the Republic of Croatia, March 2016



Fig. 22. Engineer's Day of the Republic of Croatia, March 2017



Fig. 23. Engineer's Day of the Republic of Croatia, March 2018



Fig. 24. Engineer's Day of the Republic of Croatia, March 2019



Fig. 25. Engineer's Day of the Republic of Croatia, March 2020



Fig. 26. Engineer's Day of the Republic of Croatia, March 2021



Fig. 27. Engineer's Day of the Republic of Croatia, March 2022

Cooperation with the Economy

Considering the engineering background of the Academy, one of our goals is cooperation with the economy, and within the framework of the Academy a Committee for cooperation with the economy and regional cooperation was established in 2018 that has lately promoted and implemented various forms of cooperation. It is especially pleasant that the number of supporting members of the Academy from the business world is increasing significantly, especially well-known and technologically advanced companies with which we cooperate in the development of new technologies. In 2013, there were 49 members, and in 2022 – 64 supporting members.

In 2018, it became necessary to include representatives of large companies supporting the work of the Academy as members of the Academy, and to form a business council among entrepreneurs. Thus, the connection between the Academy and the business community has deepened.



Fig. 28. HATZ Economic Council Meeting, held in Tehnix d.o.o., Donji Kraljevec



Fig. 29. HATZ Economic Council Meeting, March 2019

Realizing that a completely new technological revolution called Industry 4.0 is taking place that will significantly change the world in the near future, especially in the area of IT technology and robotization, we decided to connect the reality of the Academy more closely and involve it in business development. Therefore, in 2018, the new Statute introduced a special institution of membership – Entrepreneurial members and Economic Council. Entrepreneurial members are elected on the basis of the criterion of a significant contribution to our economy and its development, and the Entrepreneurial Council made up of Entrepreneurial members acts as an advisory body to the Academy and encourages the members of the Academy to cooperate with the economy on joint development projects.

The activities of the Academy include connecting excellent scientists and professional potential in the field of technical and biotechnical sciences and cooperation with the economy. Thus was born one of the highly successful three-year collaborations of the IRI project “Development of the TEHNIX plant for bioreactor composting of biodegradable municipal waste”, in which distinguished members of the Academy participated.

Cooperation with the Ministry of Science and Education of the Republic of Croatia and definition of the legal status of the Academy

The Academy wants to offer its scientific and professional potential, as well as international contacts to the state institutions of the Republic of Croatia, especially in the creation and implementation of projects, as well as attracting more funds to Croatia from EU funds. Since the Academy can thus contribute far more not only to stronger positioning and financial stability, but also to the Budget of the Republic of Croatia -

from which it is minimally financed through the Ministry of Science and Education, exclusively for a specific purpose using public calls for co-financing the work of associations, publication of scientific books, organization of conferences and applying for membership fees in international scientific organizations. Over the past period, we have undertaken very intensive activities with the aim of further legal regulation of the academic status of the Academy and the re-accreditation carried out by the Agency for Science and Higher Education.

The result of these joint efforts is promising, and we expect the announced legal regulation of the scientific status of our Academy and other vocational academies: Croatian Academy of Legal Sciences, Croatian Academy of Medical Sciences and Academy of Forestry Sciences.

Publications

In 2013-2022 the Academy continued to publish its most successful publication, the HATZ Annual, with many Academy members contributing their work.

During this nine-year period, the Academy published:

1. Annuals

- 2014 – Jubilee Monograph on the occasion of the 20th Anniversary of the HATZ including ‘Who is Who in the Croatian Academy of Engineering – written in English
- 2016 – Annual 2015 of the Croatian Academy of Engineering – written in Croatian
- 2017 – Annual 2016 of the Croatian Academy of Engineering – written in Croatian
- 2018 - Jubilee Annual on the occasion of the 25th anniversary of the Academy, with the latest section ‘Who is Who in the Croatian Academy of Engineering – written in English
- 2019 – Annual 2018 – “Innovations and patents of HATZ members” – written in Croatian
- 2020 – Annual 2019 – “Croatian technical and industrial heritage” – written in Croatian
- 2021 – Annual 2020 – “Projects of cooperation between members of the Academy and the economy - new products, services and improvements of economic interest” – written in Croatian
- 2022 – Annual 2021 – “Contribution of members of the Academy to the development of the system of scientific and teaching institutions” – written in Croatian

- The editors, Prof. Dubravko Rogale, Ph.D., and Prof. Vladimir Mrša, Ph.D., contributed significantly to the development of these Annuals. Together with the authors of the works published in the publication the editors made their efforts, responded to invitations and participated in the production of the Annuals.



Fig. 30. Covers of individual editions of the HATZ Annuals

2. Technical Science /Engineering Power

Academy members participated as guest editors of the HATZ Bulletin called “Engineering Power”, which continues to be published quarterly in English since 2017, and is distributed to many addresses of collaborating institutions in Croatia and around the world. Until 2017, the Academy published a publication in the Croatian language called “Tehničke znanosti”.



Fig. 31. Covers of individual editions of the HATZ bulletin Engineering Power

3. Books/Monographs

In February 2018, a contract was signed for the publication of the monograph “Faust Vrančić - Life and Inventions” by Prof. Gojko Nikolić, Ph.D. - the third expanded and revised edition. In previous years, the Academy was also involved as co-publisher of monographs on Faust Vrančić, first and second editions (2015 and 2016).

In 2021, the fourth edition of Prof. Gojko Nikolić, Ph.D. book “Truths and misconceptions about Faust Vrančić and his inventions” was published with the sponsorship and co-publishing of HATZ.



Fig. 32. Contract on the publication of the monograph by Prof. Gojko Nikolić, Ph.D., “Faust Vrančić - Life and inventions” (3rd expanded and revised edition)

In 2014, HATZ recognized the importance of cooperation with the Miroslav Krleža Institute of Lexicography and HAZU and signed a cooperation protocol to create the Croatian Technical Encyclopaedia (HTE).

A large number of HATZ members participated in the creation of the Encyclopaedia. The HTE print edition consists of four volumes, each covering a circular thematic unit that corresponds to the broader areas of the online edition. The volumes will be completed and printed at regular intervals adapted to the dynamics of the modern era. The final volume will include general technical terms common to all professions, a general presentation of the development of technology in certain Croatian cities and time periods, and an index of terms. HTE is a project focusing on the history and development of technology in today’s Croatia, from prehistory to the present day, including current state and achievements.

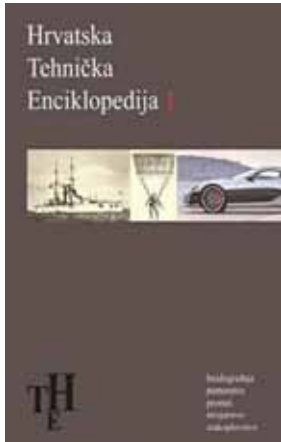


Fig. 33. Presentation of the 1st volume of the Croatian Technical Encyclopaedia, December 2018



Fig. 34. Presentation of the 2nd volume of the Croatian Technical Encyclopaedia, July 2022

The Academy also published:

- 2017, the Book of Abstracts of the Round Table Discussion of the Academy “Status and Future of Technological and Biotechnological Sciences in Croatia in the 21st Century”;
- 2017, Book of abstracts of the Scientific and Professional Meeting “Application of Mathematical Modelling and Numerical Simulations in the Chemical Process Industry”;
- 2022, „Food, nutrition and environment: Position in Central European space“.

International Activities (CAETS, Euro-CASE, SAPEA)

In order to work on its development and progress, the Academy became an equal member of CAETS, the International Council of Academies of Technical Sciences and Engineering based in Washington, DC, USA, in 2000, a member of Euro-CASE, the European council of academies of applied sciences, technologies and technical sciences based in Paris, France, in 2005, and in 2009 it was recognized as a scientific organization in the system of the Ministry of Science, Education and Sports of the Republic of Croatia. It is important to highlight the participation of HATZ members in Euro-CASE projects. One of the most significant activities was the participation of Prof. Vladimir Mrša, Ph.D., in the working group of the project “Challenges for Science and Technology in the Post-COVID Period - Challenges for European Science and Technology driven innovation in Europe” in 2020.

The Academy has been actively involved in the field of international cooperation, especially by joining CAETS and Euro-CASE organizations as members and regularly participating in online conferences. As the current President of the Academy I was also a Board Member of CAETS and Euro-CASE. Based on the highly successful cooperation with these two organizations, the Academy has been awarded the option to organize annual conferences: the Euro-CASE Annual Conference in 2020 and the CAETS Annual Conference in 2023.

On December 13, 2016, the important European SAPEA project was officially launched, which was signed by the European Commission with all the academic associations of the European Union, and in which HATZ participates through its membership of Euro-CASE. SAPEA is a working group that brings together scientists from the fields of technical, medical, humanities and natural sciences who share their latest reports and findings with scientists from many countries. Members of our Academy regularly participate in report writing. There are two notable projects that HATZ members have been involved in:

- 2018, Novel carbon and utilisation technologies Evidence Review Report, Prof. Neven Duić, Ph.D.;
- 2020, Sustainable food system for the European Union, Prof. Verica Dragović-Uzelac, Ph.D.

The Croatian Academy of Engineering (HATZ), as a long-standing member of Euro-CASE, hosted the annual international scientific and professional conference Euro-CASE 2020 entitled “Dealing with Challenges of the European Energy Transition” on November 20th, 2020.



Fig. 35. Cover page of reports “Novel carbon and utilisation technologies Evidence” and “Sustainable food system for the European Union”

The Euro-CASE 2020 Annual Conference, originally scheduled for June 2020, was rescheduled for November 2020 due to the coronavirus situation in Croatia and worldwide. In order to avoid social contacts, the conference was held on November 20th, 2020 using Zoom application with technical support from the Euro-CASE. The conference drew 170 registered attendees, exceeding the expectations of the Academy Management and the Programme-Organising Committee. The meeting was attended by the presidents or deputies of 21 of the 23 national academies that comprise Euro-CASE. The Euro-CASE board meeting took place as part of the conference.



Fig. 36. Vizual identity of conference “Euro-CASE 2020”

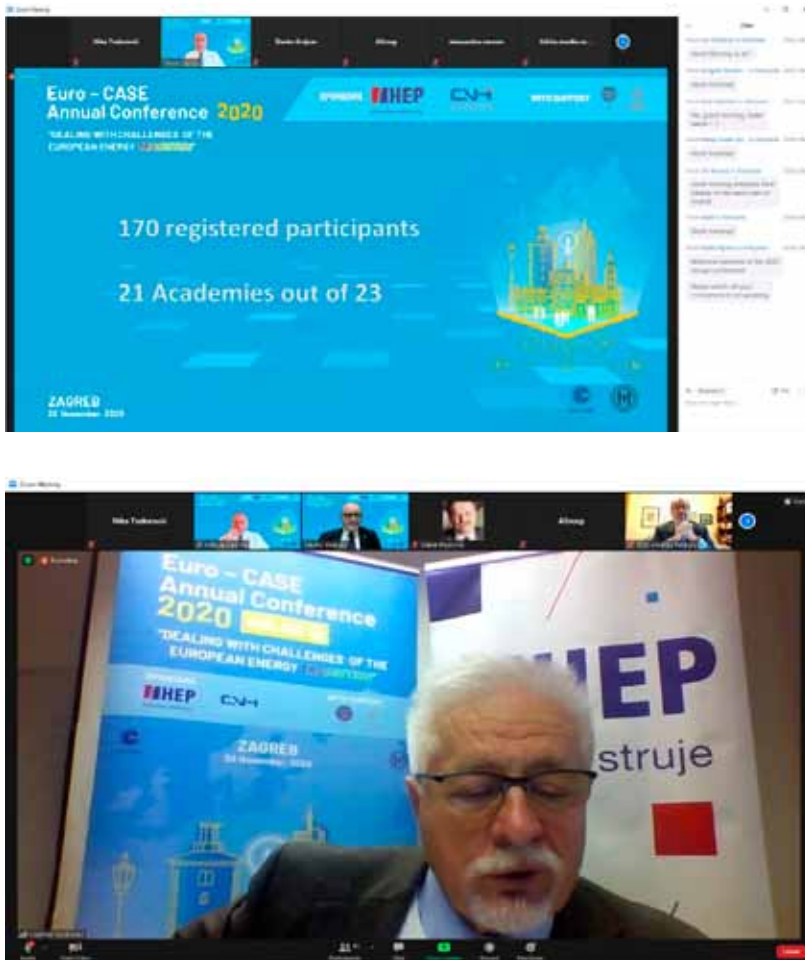


Fig. 37a and 37b. Printscreens of conference Euro-CASE 2020

As a member of the CAETS Board, I actively worked to improve cooperation and recognition of the Academy in the international environment. The Academy was given the honour of hosting the 2023 conference.

In October 2023, the Croatian Academy of Engineering will host the CAETS 2023 annual conference. We will combine this event with our 30th anniversary celebration and I am confident that the new management will be successful. The conference will bring together representatives of CAETS member Academies in Zagreb.

In addition to participating in the SAPEA project, in the next mandate the Governing Board of the Academy will directly encourage members to apply for projects funded by the EU Research Funds. In this context, it will - in cooperation with other relevant

institutions such as Agency for Mobility, Croatian Academy of Sciences and Arts, Croatian Chamber of Economy and similar institutions – support the organization of information workshops of individual EU programs and inform members about the details of their implementation. By networking all participants in the process the absorption of EU funds will be improved, and the activities accompanying the work of the Academy - such as timely finding suitable partners for specific project ideas - will provide additional support to project teams, especially for research at an interdisciplinary level. Also, through contacts within relevant international organizations attempts will be made to influence the formation of the future direction of research funded by EU programs in the coming period, which may align with the priorities of the Croatian research community. Likewise, linking local research institutions with local authorities in order to successfully implement new technologies in everyday social practice (e.g. development of earthquake protection programmes and other disaster protection programmes, use of satellite images for civilian purposes, development of related software support, improvement of traffic connections, security and signaling, etc.) will be stimulated.

Awards and Recognitions of the Academy 2013-2018

At annual Assemblies of the Academy in the period from 2013 to 2022, a total of 8 HATZ Lifetime Achievement Awards ‘The Power of Knowledge’, 19 Rikard Podhorsky Annual Awards, 35 Vera Johanides awards for prominent young scientists from the science system were granted and 6 Vera Johanides Awards for Successful Young Scientists from the Business Sector.

All winners will be posted on the Academy website. We actively participated in the announcement of award tenders, especially encouraging young scientists to apply.

Programme Guidelines of the Governing Board of the Croatian Academy of Engineering

2013-2017

Based on the results achieved so far, partially renewed Governing Board of the Academy (consisting of Prof. Vladimir Andročec, Ph.D., President of the Academy, Prof. Zdravko Terze, Ph.D., Vice-President, Prof. Dubravko Rogale, Ph.D., Vice-President, Prof. Emerita Nediljka Gaurina-Medimurec, Ph.D., General-Secretary, Prof. Slavko Krajcar, Ph.D., 5th member) continued its work, building on the good results and the activities, and in this sense it prepared an ambitious program for the new mandate period.

In the period of a prolonged general crisis in Croatia, the previous and future tasks were extremely difficult to complete without the state institutions and business community acknowledging the significance of the Croatian Academy of Engineering, and they could only be completed on the basis of the actual accomplishments of all Academy members and their participation in the Academy's governing bodies as well as the Croatian public.

The previous Governing Board initiated several activities that significantly increased the level of membership activity, and by applying several new elements to membership mobilization, it planned to increase overall membership mobilization. The benefits were reflected in the following points:

- More useful information is sent by email to the membership of the Academy, which will continue with the positive feedback from the members
- The Academy's updated websites provide members with additional information that they may use to respond, and this can only be increased by continually upgrading the website content.
- Regular publications of Annuals and HATZ Bulletins Engineering Power / Tehničke znanosti allows members to get their works published. The Governing Board plans to publish a series of thematic issues which will be edited by members of individual Departments. Additionally, this will motivate the participants to publicize their upcoming activities.
- In order to increase the financial discipline in the payment of personal membership fees in this mandate, we removed twenty members from the membership list who had not paid the membership fee for more than three years. It was proposed that members who did not pay their membership fee for more than one year are removed from the membership list to create place for active members who demonstrate their commitment to the Academy.
- By restricting the number of roles and mandates in the Academy normatively, the opportunities for members in all bodies of the Academy are extended, allowing a greater number of members interested in serving in the Academy to be granted these chances.

In the next mandate the Governing Board must:

- monitor the work of individual departments and their responsibility to organize conferences with greatest care, and this activity will increase the mobilization of membership for work in the Academy, the Departments and particular professions
- organize the Open Door Day of the Department during which the Department will be able to present its professional and scientific activities and achieve-

ments. Members of the other Departments who are interested in interdisciplinary activities might learn about the capabilities of others in this way.

- pay great attention to our members' actions during status advancement and on occasions of giving Academy awards, as inspired by this Governing Board by changing normative acts and analysing the membership's contributions,
- organize the presentation of distinguished scientists from different Departments where they will present their science and research work, laboratory and instrumentation potentials and achievements by discussing possible forms of cooperation with other members of the Academy,
- motivate the members that the establishment and the work of the Centres can help them in achieving their professional and scientific activities, organization of symposia and the like using the infrastructure of the Academy,
- encourage calls for proposals and implementation of domestic and European projects by the Academy for interested members of the Academy.

2017-2022

Thanks to the dedicated work of the previous administrations, the Academy has acquired a great social reputation. However, we felt that there is plenty of room for improvement. We believe that after decades of ignoring the importance of production and industry, the Republic of Croatia is increasingly aware that the future of the country cannot depend solely on tourism and trade, and that we can only achieve improvements by increasing investment in production. By manufacturing, we understand production and remanufacturing as essentially high-tech activities, where the products are not only physical, but also know-how, patents, energy or software. The COVID epidemic, which is still ongoing, demonstrated that high-tech enterprises were by far the most robust, achieving growth even through the most challenging circumstances for the economy. This is where we envision the Academy playing an essential role.

- Although the Academy as an institution is recognized nationally among businessmen, scientists and engineers through the activities carried out by its bodies, we believe that these activities should be promoted more intensively through social networks as one of the simplest ways to access a wider circle of external stakeholders, as well as the membership itself. At the same time, greater emphasis should be placed on providing opinions and taking a clear position on current technical issues, such as the current (long-term) issue of gas supply to the market from alternative sources, oil derivative prices, food prices, supply chain disruptions, etc.
- Increasing the visibility of the Engineering Power Bulletin should be one of the main areas of activity, which will bring additional awareness to the Academy. In addition to changing the working model of the Editorial Board

to ensure publication continuity, the next phase should focus on integrating journals into relevant databases, primarily DOAJ (Directory of Open Access Journals) and then SCOPUS. As one of the measures to increase the availability of works to a wider circle of readers, the introduction of DOI (Digital Object Identifier) for each published work should be considered.

- Academy members and associates should be encouraged to continue working with the Institute of Lexicography and HAZU in the 3rd and 4th volumes of the Technical Encyclopaedia. As it is almost the most important publishing activity of the Academy, members and associates of the Academy should be actively involved in it, paying attention not only to deadlines, but also to the quality of the articles that will be found in the Technical Encyclopaedia.
- The Statute of the Academy and other associated papers that govern its operations should be updated on a regular basis in order to react to changes in current rules while also improving the legal foundation for day-to-day operations.
- The Academy, as an institution uniting the most prominent Croatian scientists in the field of technical and biotechnical sciences, must be actively involved in the preparation of national strategic documents that are important for the development of the engineering profession and the development of the Croatian economy and society. The results and the importance of the engineering profession and the STEM field are not sufficiently appreciated in the documents.

The Academy should take a more active role in the formation of the national legislative framework in its sphere of activity, and its members should engage in public discussions when new laws are passed. At the same time, the opinion of the Academy as an institution should be clearly expressed.

- Special attention will be paid to the organization of events related to the celebration of the Academy's 30th anniversary, and together with the solemn meeting of the Academy as the central event, several events should be organized for this anniversary. The solemn anniversary should certainly be accompanied by an appropriate topic that will be covered in the Academy's Yearbook, as well as gatherings and work tables in which the role and importance of the Academy will continue to be promoted among scientists and businessmen whose field of activity is primarily oriented towards technical and biotechnical sciences. The main event to further promote the Academy's 30th anniversary internationally is of course the organization of the CAETS 2023 Annual Conference.
- In addition to the mentioned activities, cooperation with HAZU and other national Academies should definitely be continued. Cooperation with HAZU should be continued through other similar projects and the organisation of

joint events, in addition to existing projects such as the production of the Croatian Technical Encyclopaedia, in which many Academy members are involved. The coordination of the national academies, the Croatian Academy of Medical Sciences, the Croatian Academy of Legal Sciences and the Croatian Academy of Forestry Sciences, as well as the work of the Council, which was instigated by our Academy, should be further strengthened, especially to resolve common status issues, but also through the implementation of various joint dissemination activities.

- The continuation and promotion of cooperation with technical academies in the area, whether through joint working meetings, organizing various events, or creating joint announcements/statements on current technical profession topics, will undoubtedly contribute to the Academy's international recognition and influence. At the same time, special attention should be paid continuing activities to explore the possibility of establishing academies of technical sciences in the countries of South-Eastern Europe, in line with the policy initiated and promoted by CAETS.
- The greatest strength of the Academy is its multinational membership. In addition to increasing the number of Academy members worldwide, special attention will be paid to their more active participation in the Academy's activities, such as publishing articles in the Academy's newsletter or holding (virtual) lectures and seminars.
- The Academy's strong participation in international organisations will undoubtedly continue, especially through Euro-CASE and CAETS, but also through bilateral collaboration with other academies. To this end, the Academy should promote the participation of its prominent members in the international bodies of Euro-CASE and CAETS, as well as in the professional and scientific activities coordinated by the Academy's international partners. Using the work of the Euro-CASE and CAETS committees, members of the Academy should actively participate in the creation of priority topics that should be popularized and brought to the attention of the public. The main event that will further increase the Academy's participation in international associations is the CAETS 2023 annual conference, which is already being organized.
- It should be noted that Prof. Neven Duić, Ph.D., candidate for the position of Vice-President of the Academy, was elected Chair of the Organising and Programme Committee of the CAETS Conference 2023. The organization of the conference should be used to strengthen the position of HATZ in the global environment by contacting other participants during the organization and implementation of the conference.
- Academy members should be encouraged to participate in Euro-CASE and SAPEA working groups. Members of the Academy have engaged in two

working groups to produce guidelines and recommendations during the last two years, one in the sector of food production and agriculture and the other in the field of higher engineering education. Participation in working groups improves the Academy's importance in the worldwide community, among other reasons.

- Strengthening the activities of the Academy in the national regional university centres (Osijek, Rijeka and Split) can contribute to the mobilization of members by organizing meetings of the Management Board and the Presidency. Informal discussions with members revealed that they would like to get more involved, but that travelling to Zagreb was an obstacle for them. For this reason, the regional distribution of activities related to the organization of round tables, workshops and meetings organised by the Academy should be promoted. Greater involvement of members in the activities of the Academy should also be ensured by, for example, changing the conditions for promotion from associate status to member status, where as a mandatory condition for promotion, some activity related to the Academy should be introduced, such as the publication of papers in the Yearbook or Engineering Power Bulletin or active participation in the organization of a round table in the name and on behalf of the Academy, etc.
- Scientists working in the business community are very interested in becoming members of the Academy. Due to the nature of their work, they don't have much time to write scientific papers, but we consider major business breakthroughs as important as journal publications. Their greater involvement in the work of the Academy would, among other things, increase the possibility of working on joint projects. We would therefore proceed with an evaluation of the criteria for selecting members in order to better recognize significant industrial achievements.
- A significant part of the Academy's income comes from the membership fees of the supporting members. Attracting new supporting members will increase the sources of funding for the regular activities of the Academy, while also creating new opportunities for joint projects. At the same time, a model should be developed in which potential group members will recognize their interest, because without this, it is unlikely that any company will make a significant contribution today.
- An activity that should definitely continue to be maintained in the future is the celebration of Engineers' Day. This ongoing cooperation with the Croatian Engineering Association provides an opportunity to address more scientists and engineers, as well as HIS members from the business world, where carefully selected topics for Engineers' Day can have a significant impact on the wider field, and the Academy can focus more strictly on current affairs related to technical professions.

- The great strength of the Academy is in its multidisciplinary membership. This allows the Academy to continue its activities related to the involvement of Academy members and associates in the implementation of projects with the business community, which is funded by European funds and where the Academy acts as a sponsor of activities through its centres. The completion of such projects permits the Academy's appropriate financial operations and is the Academy's primary source of income, in addition to membership fees. Therefore, it is necessary to intensify work on the realization of these activities. In this regard, it is necessary to step up efforts to implement these measures. As mentioned earlier, the Future Academy's Technology Transfer Centre should continue to implement cooperative initiatives with the business sector.

Both plans of the Governing Board were substantially fulfilled.

Finance

The financial structure of the Croatian Academy of Engineering has been stable in recent years, allowing the Academy to fulfil its function in the system of scientific institutions of the Republic of Croatia and especially all of the tasks outlined in the work plan.

The total assets of the Academy in 2013 were HRK 516.665,35 (EUR 68.573,30). The financial situation of the Academy recorded a growth trend from year to year. The positive financial situation was aided by an increase in the number of supporting members who regularly fulfil their membership requirements and prudent financial management.

The Academy's financial situation improved in 2021, when total income reached HRK 1.149.919,93 (approximately EUR 152.620,60) due to payments related to the IRI project Development of the Tehnix plant for bioreactor composting of biodegradable municipal waste, which was carried out through the Centre for Development Studies and Projects.

The Academy annually participated in the tenders announced by the Ministry of Science and Education of the Republic of Croatia and used its right to provide financial support to the Association's activities by issuing publications and paying worldwide membership fees.

FINANCIAL STATUS OF THE ACADEMY AS OF THE DATE: DECEMBER 31	AMOUNT (currency: KUNA)	AMOUNT (currency: EURO)
2013	514.160,13	68.240,78
2014	516.907,42	68.605,40
2015	587.446,14	77.967,50
2016	625.210,55	82.979,70
2017	810.706,01	107.599,18
2018	788.881,61	104.702,58
2019	794.701,80	105.475,05
2020	961.188,34	127.571,62
2021	1.149.919,93	152.620,60
2022 (June 2022)	925.650,45	122.854,93

Table 1. Financial status of the Academy between 2013 and June 2022

Croatian Academy of Engineering 2009 – 2013¹

Prof. Emeritus **Stanko Tonković**, Ph.D.

Past-President of the Academy (2009 – 2013)

In the electoral process of the Electoral Commission for elections of the new Governing Board in the spring of 2009 at the Assembly held on March 14, 2009 the new leadership, the new Governing Board and the composition of the new Presidency of the Croatian Academy of Engineering for a mandate period from July 01, 2009 to June 30, 2013 was confirmed. The leadership of the Croatian Academy of Engineering was elected: Prof. Stanko Tonković, Ph.D., President, Prof. Miljenko Lapaine, Ph.D., and Prof. Vilko Žiljak, Ph.D., Vice-Presidents and Goran Granić, Ph.D., Secretary-General, and according to the Statute of the Croatian Academy of Engineering the former President, Prof. Emer. Zlatko Kniewald, Ph.D. was associated to the Governing Board. The joint session of the new and former Presidency the Croatian Academy of Engineering was held on June 30, 2009.

The opening (constituting) session of the new Governing Board of the Croatian Academy of Engineering was organized on Tuesday, July 7, 2009, in the Academy House, Kačićeva 28, Zagreb. During the four-year mandate the Governing Board held 27 sessions, and the Presidency held 13 sessions, dealing with activities according to the Statute of the Croatian Academy of Engineering and the activities of the regular work of the Croatian Academy of Engineering. The Scientific Council of the Croatian Academy of Engineering held 3 sessions (3rd Session – Joint Session of Scientific Council and Governing Board on February 2, 2012). Four Assemblies of the Academy were held (March 27, 2010; May 05, 2011; December 20, 2012 and May 21, 2013).

In the beginning of the mandate, as President, I participated at the CAETS conference (CAETS Convocation 2009 – Global Natural Resources – Management and

¹ This is the reprint of the article published under the same title in 2014, in the Jubilee Monograph “Twenty Years of the Croatian Academy of Engineering (HATZ) 1993-2013”. The permission for reprint has been granted by the author.

Sustainability) in Calgary, Canada, from 13 to 17 July, 2009. From 2009 to 2011 I was a member of the Board of Directors of CAETS. Successful cooperation with CAETS continued throughout all the mandate period.

On September 11, 2009 the Ministry of Science, Education and Sports issued **License for Scientific Activity** in the scientific field of Engineering Science. Accordingly, the Croatian Academy of Engineering was entered into the Register of scientific organizations under number 0338.

In the meantime effort was being performed on the text of the Statute of the Croatian Academy of Engineering. Special recognition for this activity goes to Goran Granić, Ph.D.

The 25th Annual Assembly of the Academy was held on Saturday, March 27, 2010. At the Assembly the new Statute of the Croatian Academy of Engineering and Ordinance on the Election of members of the Croatian Academy of Engineering (amended in the fall of 2012). Basic features of the new Statute are the simplification and harmonization with the statutes of most similar academies in the world, the ending of the status of extraordinary members, and the introduction of the electronic voting as equal to other models of voting.



Fig. 1. Assembly of the Academy, March 27, 2010

According to the new Statute the Croatian Academy of Engineering has members, associates, emeriti, honorary members, international members, members amici and supporting members. During the entire mandate, and thereafter, the process of transition of extraordinary and full members in the unique status member of the Academy, and the recruitment of new associate members continued. The procedures were very complex and time consuming.



Fig. 2. Prof. Marijan Bošnjak, Ph.D. receiving the Academy Award for his life – long activities in the Academy at the Assembly of the Academy, March 27, 2010

In September 2010, the Academy was visited by President of the Republic of Croatia, Prof. Ivo Josipović, Ph.D. We discussed the role of the Academy and Engineering Sciences in the development of the Croatian economy and industry. Acknowledgement and Medal of the Academy were given to the President.



Fig. 3. Presentation of Acknowledgement and Medal of the Academy to the President of the Republic of Croatia Prof. Ivo Josipović, Ph.D. while visiting the House of the Academy in September, 2010



Fig. 4. Rector of the University of Zagreb, Prof. Aleksa Bjeliš, Ph.D. visited the House of the Academy in April, 2011

In April 2011 the Rector of the University of Zagreb, accompanied by the Vice-Rector, member of the Academy Prof. Bojan Baletić, Ph. D. visited the Academy.

On January, 2014 the Symposium “Engineering Ethics and Croatian Economy” at the Faculty of Electrical Engineering and Computing organized by the Ethics Committee of the Croatian Academy of Engineering and the Faculty of Electrical Engineering and Computing was held.

The publishing activity of the Academy continued. During my mandate period two Annals of the Croatian Academy of Engineering (2009 and 2010/11) were published as well as three issues of the Bulletin “Tehničke znanosti / Engineering Power”.

Special mention should be made of Annual 2009 of the Croatian Academy of Engineering, in which, along with conceptual novelties, a new “Who is Who” was published, which required great efforts by of the Governing Board and Presidency of the Croatian Academy of Engineering.

The central celebration on the occasion of the 300th anniversary of the birth of Rugjer Bošković was held at Vatroslav Lisinski Concert Hall on May 17, 2011 organized by the Croatian Academy of Engineering and the Ministry of Science, Education and Sports. In front of a large audience, as President of the Academy, I opened celebration and expressed my admiration and praise of the character and work of Rugjer Bošković.

The Minister of Science, Education and Sports Radovan Fuchs, Croatian Parliament Speaker Luka Bebić and Croatian President Ivo Josipović gave their occasion speeches too. In the opinion of those present and the press much credit for the success of this celebration goes to Krešimir Dolenčić (director), Aljoša Paro (scenic design), Willem Miličević (video and photo processing) and executive producer Goran Granić, Ph.D. As President I especially expressed gratitude to Secretary-General Goran Granić, Ph.D., who was one of the main organizers of the celebration.



Fig. 5. President of the Academy, Prof. Stanko Tonković, Ph.D., opening speech on the occasion of the celebration of the 300th anniversary of the birth of Ruder Bošković, Vatroslav Lisinski Concert Hall, May 17, 2011



Fig. 6. President of the Republic of Croatia, Prof. Ivo Josipović, Ph.D., opening speech on the occasion of the celebration of the 300th anniversary of the birth of Ruder Bošković, Vatroslav Lisinski Concert Hall, May 17, 2011



Fig. 7. Assembly of the Academy, May 17, 2011

The 26th Annual Assembly of the Croatian Academy of Engineering was held on Tuesday, May 17, 2011, after the celebration of the 300th anniversary of the birth of Rugjer Bošković at Vatroslav Lisinski Concert Hall.

Pursuant to articles 16 and 46 of the Statute a new categorization of membership was implemented, and full members became Academy members, most of extraordinary members were converted to the status of Academy members, associate members became Academy associates, corresponding members became international members of the Academy, members emeriti became Academy emeriti, honorary members became honorary members of the Academy, member friends became friends of the Academy, and supporting members became supporting members of the Academy. Decisions were given to all members of the Academy. As President, I particularly thanked Prof. Juraj Božičević, Ph.D. (who performed the duties of Secretary-General and President of the Academy) and Prof. Dražen Aničić, Ph.D. (former Secretary General of the Academy), who are also among the founder members of the Academy, for their great contribution to the development and work of the Academy.

On 28 September, 2011, the Croatian Academy of Engineering marked the life and work of its honorary member Prof. Emeritus Vera Johanides who died in 2000, with an appropriate scientific symposium. Prof. Vera Johanides was the founder of biotechnology, in particular biochemical engineering in Croatia. Marking the work of Prof. Emeritus Vera Johanides was performed jointly by Croatian Academy of Engineering and Faculty of Food Technology and Biotechnology, University of Zagreb in cooperation with the Biotechnology Foundation of the Faculty of Food Technology and Biotechnology of the University of Zagreb, Croatian Society for Biotechnology and donors from the industry.



Fig. 8. Prof. Jasna Franekić, Ph.D. receiving the Academy Award “Power of Knowledge” at the Assembly of the Academy, May 17, 2011

On this occasion the memorial bust of Vera Johanides was unveiled in the park of the Academy House. The bust was made by sculptor Prof. Slavomir Drinković, Ph.D. In this way the Academy honored one of its first members, a renowned and acknowledged scientist from the field of biotechnology.

In the winter of 2012 problems with my health unfortunately began. They lasted, with brief interruptions, until the end of my mandate, of course affecting my activity and work in the Croatian Academy of Engineering.

For health reasons, I could not perform my duties in the period **from January 23, 2012 to June 11, 2012 and from November 20, 2012 to June 20, 2013**. Pursuant to Article 35, paragraphs 2 and 3 of the Statute of the Croatian Academy of Engineering Secretary-General Goran Granić Ph.D. and Prof. Vilko Žiljak, Ph.D., Vice-President of the Academy deputized for me during my absence.

In the first period Goran Granić, Ph.D., led a series of sessions of bodies of the Croatian Academy of Engineering, especially of the Awards Committee and the procedure for the election of new members, for which I am sincerely grateful.

In July 2012, members of the Governing Board Prof. Miljenko Lapaine, Ph.D. (July 10, 2012) and Goran Granić, Ph.D. (July 04, 2012) resigned from all their positions in the Croatian Academy of Engineering.

In March 2012 the Croatian Academy of Engineering signed the Agreement on Scientific and Technical Cooperation with the Academy of Medical Sciences of Croatia, the Croatian Academy of Legal Sciences and the Academy of Forestry Sciences.

Unfortunately, because of illness I was not present at a very successful meeting held on September 3, 2012, in Zagreb (Sheraton Hotel) between senior representatives of the Chinese Academy of Engineering and the Croatian Academy of Engineering. The meeting was led by Prof. Vilko Žiljak, Ph.D., Vice-President of the Croatian Academy of Engineering and by Prof. Pan Yunhe, Vice-President of CAE. As a result of the meeting the Agreement on Cooperation between the Croatian Academy of Engineering and the Chinese Academy of Engineering was signed on January 23, 2013

After long discussions and consultations, at the initiative of Prof. Juraj Božičević, Ph.D., Head of the Center for Development Studies and Projects of the Academy and Prof. Franjo Jović, Ph.D., Secretary of the Department of Systems and Cybernetics “The Talks about the Present and Future of Engineering in Croatia” were initiated which encourage socializing, thinking and exchange of views on major development issues.

The 27th Annual Assembly of the Croatian Academy of Engineering was held on December 20, 2012. Besides the regular items on the Agenda of the Assembly, I particularly emphasize the election of new members and associates of the Academy, the announcement of the public competition for the appointment to the remaining places in the Departments of the Academy and the election of the Commission for starting the official announcement of the competition and the election of the new leadership of the Croatian Academy of Engineering for the mandate period from July 1, 2013 to July 1, 2017.

Along with the co-organizers the University of Zagreb, Faculty of Food Technology and Biotechnology, Croatian Society of Biotechnology and Biotechnology Foundation, the Academy was the organizer of the second international symposium “Vera Johanides – Biotechnology in Croatia by 2020”. This exceptionally successful symposium was held 10 – 11 May 2013 in the Great Hall of the University of Zagreb. A detailed report with peer-reviewed papers in the Annual 2013 of the Croatian Academy of Engineering was foreseen.

During the spring of 2013, pursuant to the Statute of the Academy the elections of the new leadership of the Academy were held. At the session held on May 14, 2013 the Presidency of the Academy accepted the Report of the Commission for the election of new leaders of the Croatian Academy of Engineering chaired by Prof. Karolj Skala, Ph.D. It was decided to conduct electronic voting.

The new leadership of the Croatian Academy of Engineering was elected by voting for a mandate period from July 01, 2013 to June 30, 2017 in the following composition:

- Prof. Vladimir Andročec, Ph.D., President
- Prof. Vladimir Medved, Ph.D., Vice-President
- Prof. Zdravko Terze, Ph.D., Vice-President
- Prof. Dubravko Rogale, Ph.D., Secretary-General

On 21 May, 2013 the 20th anniversary of founding the Croatian Academy of Engineering was held at the Mimara Museum. In a festive environment, along with other guests and occasion speeches, the celebration was led by my deputy, Prof. Vilko Žiljak, Ph.D. The course of the celebration is also available on video recording.

The 28th Annual Assembly of the Croatian Academy of Engineering was held after the anniversary celebrations, on the same day, May 21, 2013. I did not attend the Assembly, but all data can be found in the Minutes and the video recording of the Assembly. The most important fact is that the Assembly accepted the new leadership of the Academy in the abovementioned composition. New leadership began operating on July 1, 2013.

In the second mentioned period Prof. Vilko Žiljak, Ph.D. was, among other things, especially active and involved in the preparations of organizing and holding the 27th and 28th Annual Assembly of the Academy and the celebration of the 20th anniversary of founding the Croatian Academy of Engineering for which I am very thankful to him.

More detailed information about everything that happened in this period can be obtained at the Secretariat of the Academy, or from me personally or from the members of Governing Board, particularly for the periods when Goran Granić, Ph.D. (February 23, 2012 to June 11, 2012) and Prof. Vilko Žiljak, Ph.D. (November 20, 2012 to June 20, 2013) deputized for me.

I would like to express my sincere gratitude to the whole Governing Board for their efforts, conscientiousness, and time taken to execute ungrateful and burdensome obligations and enable the successful work of the Academy in the mentioned period.

International Cooperation of the Croatian Academy of Engineering

Prof. **Zdravko Terze**, Ph.D.

Prof. **Nikola Čavlina**, Ph.D.

Prof. **Neven Duić**, Ph.D.

Introduction

Croatian Academy of Engineering has been a member of the International Council of Academies of Engineering and Technological Sciences (CAETS - International Council of Academies of Engineering and Technological Sciences) based in Washington, USA since October 2000.

It has been an associate member of the European Council of Academies of Applied Sciences, Technology and Engineering (Euro-CASE) based in Paris since January 2005, and it became a permanent member of Euro-CASE in 2009.

Bilateral agreements

Representatives of the Academy signed five bilateral agreements (Agreement on cooperation in the field of engineering and technical sciences between the Croatian Academy of Engineering, Republic of Croatia and the Chinese Academy of Engineering, People's Republic of China, 2004; Agreement on mutual understanding between the Croatian Academy of Engineering and Academy of Engineering of Hungary, 2006; Agreement on cooperation between the Croatian Academy of Engineering and the Austrian Academy of Sciences (Annex I of the Agreement included), 2009; Agreement on cooperation between the Croatian Academy of Engineering and the Chinese Academy of Engineering, 2013; Agreement on cooperation between the Croatian Academy of Engineering and the Slovenian Academy of Engineering, 2017).

Also, Croatian Academy of Engineering was a supporting institution of the number of distinguished scientific conferences, such as “Conference on Sustainable Development of Energy, Water and Environment Systems – SDEWES”, in total 12 of them held in Rio de Janeiro, Novi Sad, Lisbon, Dubrovnik, Buenos Aires, Gold Coast, Sarajevo, Cologne, Vlore, Sao Paulo, Paphos, “ECCOMAS - Multibody Dynamics 2013”, (ECCOMAS - European Community on Computational Methods in Applied Sciences) which was held in Zagreb in 2013 (two years after Brussels in 2011, and two years before Barcelona 2015). It was organized under the auspices of the Croatian Academy of Sciences and Arts and sponsored by two Croatian companies (e.g. Končar and AVL), but also by the most prominent world organizations in the field of mechanical engineering, and computational and applied mechanics (ASME, IUTAM, ECCOMAS, IFToMM etc). Selected expanded papers of the Conference “ECCOMAS - Multibody Dynamics 2013” were published in a book by the international publisher Springer in the year 2014. The editor of the book is a member of the Croatian Academy of Engineering Prof. Zdravko Terze, Ph.D., and - according to the publisher’s sales statistics - the book ranked among the top 25% most successful scientific editions in the pertinent category in the years to follow.

In 2009 Prof. Vladimir Medved, Ph.D., was elected to serve as a Chair of the Committee for International Cooperation, and the members of the Committee were Prof. Stanko Tonković, Ph.D., Prof. Vladimir Koroman, Ph.D., Prof. Bernard Franković, Ph.D., Prof. Jasna Franekić, Ph.D. and Prof. Mislav Grgić, Ph.D., who occupied their posts until 2013. Prof. Zdravko Terze, Ph.D., was elected to serve as a Chair of the Committee for International Cooperation in period 2013-2017. The members of the Committee in that mandate were: Prof. Ana Marija Grancarić, Ph.D., Prof. Biljana Kovačević Zelić, Ph.D., Prof. Bojan Jerbić, Ph.D., Prof. Karolj Skala, Ph.D., Prof. Mario Kovač, Ph.D., and Prof. Neven Duić, Ph.D. The most recent mandate started in 2017, with Prof. Nikola Čavlina, Ph.D., being elected as a Chair of the Committee, while the members of the Committee are Prof. Karolj Skala, Ph.D., Prof. Vladimir Mrša, Ph.D., Prof. emer. Dubravka Bjegović, Ph.D., Prof. Bruno Zelić, Ph.D., Prof. Biljana Kovačević-Zelić, Ph.D. and Prof. emer. Ana Marija Grancarić, Ph.D.

In the period of this report, four international cooperation agreements were signed: Memorandum of Agreement on Cooperation with the Chinese Academy of Engineering (2004) (with the Chinese Academy of Engineering an additional document “CAE-HATZ Memorandum of Understanding” was signed in 2013 after the visit of the CAE delegation to the Croatian Academy of Engineering in December 2012), Memorandum of Agreement on Cooperation with the Hungarian Academy of Engineering (2006), Memorandum of Agreement on Cooperation with the Austrian Academy of Sciences (2009), and Memorandum of Agreement on Cooperation with the Slovenian Academy of Engineering (2017) (Figures 1 and 2).



Fig. 1. Signing Memorandum of Agreement on Cooperation with the Slovenian Academy of Engineering (2017), Ljubljana, 2017



Fig. 2. Signing Memorandum of Agreement on Cooperation with the Slovenian Academy of Engineering (2017), Ljubljana, 2017

Bilateral cooperation with these and other academies has been continuing to the present day and Croatian Academy of Engineering permanently supports scientific collaboration with international academic institutions. Along this line, Prof. Xilun Ding, Ph.D. (currently Dean of the School of Mechanical Engineering and Automation) and his collaborators from renown Beijing University for Aeronautics and Aerospace (BEIHANG University), China - during his visit to University of Zagreb in 2017, Faculty of Mech. Eng. & Naval Arch, Chair of Flight Vehicle Dynamics - visited Croatian Academy of Engineering as well as Croatian Academy for Sciences and Arts (Figure 3). Such international collaboration is furtherly promoted by active participation of the

Academy members in the events organised by CAETS and Euro-CASE. For example, Academy members Prof. Karolj Skala, Ph.D., and Prof. Bernard Franković, Ph.D., participated in the CAETS annual meeting and symposium “Innovative Approaches to Engineering Education”, held in Budapest in 2013. Prof. Bernard Franković, Ph.D., was present as a representative of the Croatian Academy of Engineering in CAETS Board of Directors, while at the symposium ‘Innovative Approaches to Engineering Education’ Prof. Karol Skala, Ph.D., presented FP7 project “Embedded Computer Engineering Learning Platform-E2LP”, which was developed by Institute Ruđer Bošković and Faculty of Electrical Engineering and Computing from Zagreb, in cooperation with seven other EU institutions.



Fig. 3. Prof. Xilun Ding, Ph.D., Beijing University for Aeronautics and Aerospace (BEIHANG University), China, and his collaborators during visit to University of Zagreb, Faculty of Mech. Eng. & Naval Arch, Chair of Flight Vehicle Dynamics, and Croatian Academy of Engineering (2017).

In more recent times Prof. Vladimir Andročec, Ph.D., President of the Academy, and Prof. Zdravko Terze, Ph.D., Vice-President of the Academy, participated in Euro-CASE Board Meetings in Den Haag/Delft, Netherlands (2015) (Figure 4) and in Lyngby, Denmark (2016). Also, in 2017 Prof. Vladimir Andročec, Ph.D., and Prof. Zdravko Terze, Ph.D. attended CAETS 2017 Convocation at Real Academia de Ingeniería (RAI), Madrid, Spain, and visited University of Seville, where they had official meeting on the collaboration issues with Dean of the Faculty of Engineering Prof. Jaime Domínguez, Ph.D. (Member of RAI), and Prof. Zdravko Terze, Ph.D., delivered invited lecture ‘Geometric Integration of Rotational Quaternions’ for scientists and doctoral students of the Faculty.



Fig. 4. Participants of the Euro-CASE Board Meeting in Den Haag/Delft, Netherlands (2015)

In the present days, the Academy also continuously informs its members on the activities related to the application of scientific and development projects within the framework of EU research programs, such as Horizon 2020 and other programs. Furthermore, members and representatives of the Academy organize and participate regularly in the workshops, national conferences and information days in the promotion of the international activities. This practice encourages the cooperation of individual institutions in Croatia and abroad and creates a network framework for the flow of information and research ideas, especially when lecturers and participants are renown international scientists such as Prof. Aleksandar V. Efremov, PhD. (Moscow Aviation Institute), who delivered a lecture „Progress in Pilot Vehicle System Approach to Solution of Flight Safety and Manual Control Problems“ (2014)), Tin Komljenović, Ph.D. (University of California, Santa Barbara, US), who delivered a lecture “Integrated Photonics for LIDAR and Communications” (2017), organised by the Croatian Academy of Engineering, Department for Communication Systems, and Prof. Ivica Puljak, Ph.D. (The European Organization for Nuclear Research (CERN), University of Split) who delivered a lecture ‘Discovery and Measurement of Characteristics of Higgs boson’ (2018) (Figure 5), organised by the Croatian Academy of Engineering, Academy Scientific Consul.



Fig. 5. Lecture ‘Discovery and Measurement of Characteristics of Higgs boson’, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb (2018) (organised by Croatian Academy of Engineering, Academy Scientific Consul).

In this context, the Academy also organizes workshops and symposia in order to support further development of the traditional engineering fields within newly established international collaborations, but also with the aim of promoting new technologies and industrial challenges of the future. These activities should allow for better incorporation of Croatian engineers and scientists into competitive EU research ambient of the highly-advanced engineering fields, such as nanotechnology, artificial intelligence,

and space technologies. Speaking of space, Croatian Academy of Engineering organized successful international event “Horizon 2020 Space Workshop” in Zagreb (2014), where - for the first time in Croatia - space technologies and field potential for Croatian companies have been discussed, anticipating thus signing of the agreement of cooperation between Republic of Croatia and European Space Agency in February 2018. Recently, successful roundtable ‘Cyber Physical Systems and Internet of Things’ has been organised by the Committee for Economic and Regional Cooperation, Croatian Academy of Engineering, in collaboration with Croatian Chamber of Economy and Innovation Centre Nikola Tesla, 2018 (Figures 6 and 7).



Fig. 6. Roundtable ‘Cyber Physical Systems and Internet of Things’, Croatian Chamber of Economy, 2018.



Fig. 7. Roundtable ‘Cyber Physical Systems and Internet of Things’, organised by the Committee for Economic and Regional Cooperation, Croatian Academy of Engineering, in collaboration with Croatian Chamber of Economy and Innovation Centre Nikola Tesla, 2018.

As it was in the past, representatives of the Academy participate in number of activities organized by our international partners. For example, Prof. Vladimir Andročec, Ph.D., President of the Academy, participated in the meeting of representatives of the Academies members of Euro-CASE with representative of the European Commission in Brussels within the seminar “Independent Science-and Technology-Based Policy Advice from Euro-CASE” (2013). Also, reports on the activities of the Croatian Academy of Engineering are being published regularly in Euro-CASE Annual Reports over the recent years, our publications ‘Engineering Power’ and ‘Annual Report’ are being distributed to our collaborators on the permanent basis, and Academy participates in other international activities, such as voting a member of the CAETS Board of Directors for the period 2014-2016. As a member of Euro-CASE, Croatian Academy of Engineering actively participates in the EU Horizon 2020 project SAPEA (“Science Advice for Policy by European Academies”) that has been officially launched in Brussels on December 13 2016. The overall objective of the project is to pull together timely, independent and evidence-based scientific expertise from more than 100 European academies from over 40 countries for the highest policy level in Europe and for the wider public. To this end, Croatian Academy of Engineering has nominated it’s experts for different posts within the framework of the SAPEA project activities.

Organization/Coorganization of Conferences

- Croatian Engineer’s Day, Zagreb, Faculty of Chemical Engineering, Zagreb, February 22, 2019
- International Scientific Conference “Printing&Design”, Školska knjiga Zagreb, March 14, 2019
- Workshop of the Economic Council of the Croatian Academy of Engineering ”Needs of Croatian Economy for Lifelong Learning with Emphasis on Secondary Vocational Education” , Croatian Academy of Engineering, Zagreb, March 29, 2019
- Workshop “Patents and Patent Application”, Zagreb, April 3, 2019
- SED 2019/Energy Democracy Summit, Pula, April 20-12, 2019
- Croatian Engineer’s Day, Zagreb, Faculty of Chemical Engineering, Zagreb, February 22, 2019
- International Scientific Conference “Printing&Design”, Školska knjiga Zagreb, March 14, 2019
- Workshop of the Economic Council of the Croatian Academy of Engineering ”Needs of Croatian Economy for Lifelong Learning with Emphasis on Secondary Vocational Education” , Croatian Academy of Engineering, Zagreb, March 29, 2019

- Workshop “Patents and Patent Application”, Zagreb, April 3, 2019
- SED 2019/Energy Democracy Summit, Pula, April 20-12, 2019
- FSB, AMZH, HATZ, Lecture “Comanipulation for assistance to gesture with therapeutic applications”, Croatian Medical Association, Zagreb, December 5 2019
- HGK, ICENT, HATZ, Round table discussion “Digital innovative solution in food and agriculture sector”, FER, Zagreb, December 6, 2019
- Croatian Engineer’s Day, March 2, 2020, Zagreb
- Conference „Croatian Engineer’s Day - Engineers as Future Builders, HIS and HATZ, AGG faculties of the University of Zagreb, March 02, 2021, live with partially filled hall
- Webinar „Hydrogen in Energy Transition“, March 04, 2021, Department of Energy Systems of the Croatian Academy of Engineering, conferencing using Zoom platform
- International Scientific-Professional Conference, „Printing & Design 2021“, May, 2021
- International scientific conference „Printing & Design 2022“, University of Zagreb Faculty of Graphic Arts), Zagreb University of Applied Sciences, (North University, Varaždin – Koprivnica, Croatian Academy of Engineering, May 12, 2022, Zagreb;
- 7th Croatian Congress of Microbiology with International Participation, Croatian Microbiology Society and Croatian Academy of Engineering, May 24 to 27, 2022, Sv. Martin na Muri;
- Several International scientific conferences: „Conference on Sustainable Development of Energy, Water and Environment Systems – SDEWES“:
 - 1st Latin American SDEWES Rio de Janeiro, Brazil , 28-31 January, 2018
 - 3rd South East Europe SDEWES, Novi Sad, Serbia June 30 – July 4, 2018
 - 13th SDEWES Palermo, Italy, September 30 - October 4, 2018
 - 14th SDEWES Dubrovnik, 1 – 6 October, 2019
 - 2nd Latin American SDEWES, Buenos Aires, Argentina, 9 – 12 February 2020
 - 1st Asia Pacific SDEWES, Gold Coast, Australia, 6 – 9 April 2020
 - 4th South East Europe SDEWES, Sarajevo, Bosnia and Herzegovina, 28 June – 2 July 2020
 - 15th SDEWES Cologne, Germany, 1-5 September 2020
 - 16th SDEWES Dubrovnik, 10 – 15 October, 2021
 - 5th South East Europe SDEWES Vlorë, Albania, 22-26 May 2022
 - 3rd Latin American SDEWES Sao Paulo, Brazil, July 24-28, 2022
 - 17th SDEWES, Paphos, Cyprus, 06 - 10 November 2022

- Conference „10th International Congress of Food Technologists, Biotechnologists and Nutritionists“, Faculty of Food Technology and Biotechnology, Croatian Academy of Engineering, November 30 to December 2, 2022, Zagreb;

Euro-CASE 2020

Croatian Academy of Engineering organized Euro-CASE 2020 Annual Conference on “Dealing with Challenges of the European Energy Transition” (Figure 8).



Fig. 8. Euro-CASE 2020

Euro-CASE (European Council of Academies of Applied Sciences, Technology, and Engineering) is a non-profit association of national academies of engineering, applied sciences, and technology from 23 European countries. Founded in 1992 and based in Paris, Euro-CASE has access to over six thousand experienced professional engineers, offering independent advice with a clear European dimension. The mission of Euro-CASE is to pursue, encourage, and sustain excellence in engineering, applied sciences, and technology for the benefit of European citizens.

The annual Euro-CASE conference serves as the most important professional and political forum organized by the member academies. It brings together leading European scientists and experts to discuss the engineering aspects of issues of vital importance. Through these conferences, Euro-CASE aims to maintain a leading role in promoting excellence in applied sciences, engineering, and related critical issues in Europe. Moreover, Euro-CASE emphasizes the need to consider the social impact of technological change and to address environmental and sustainability aspects adequately.

Since its inception in 2008 with the first conference held in London, Euro-CASE conferences have been held annually. The selected topics cover areas of the greatest engineering interest, including innovation, energy, and engineering education. The annual conference plays a significant role in shaping Euro-CASE's positions and recommendations.

The topic of energy for the 2020 conference, held online on November 20th, 2020, was proposed by Prof. Vladimir Androćec, Ph.D. and Prof. Nikola Čavlina, Ph.D. during the Euro-CASE Steering Committee meeting in Paris in June 2019. The topic, along with HATZ as the conference organizer, was accepted. Originally scheduled for the first half of 2020, coinciding with the Croatian presidency of the Council of the European Union, the conference had to be rescheduled to the fall of 2020 due to the pandemic. Finally, on November 20th, 2020, the conference took place online due to the ongoing pandemic situation (Figure 9).



Fig. 9. Euro-CASE 2020 conference

To accommodate the circumstances, HATZ condensed the usual one-day Euro-CASE conference into a 3-hour session without breaks. The conference program comprised four invited lectures in the first section titled “Energy Policies - Challenges and Opportunities for Transformation” and presentations from five invited speakers in the second section titled “Implementation, Economic Impact, and Challenges.” The conference concluded with a question-and-answer session.

Euro-CASE 2020 Annual Conference had 170 participants registered for the conference, what was above expectations. Among the 23 national academies that make up Euro-CASE, 21 presidents or vice-presidents of academies were present.

The positive feedback received after the conference, indicates that the conference was well-organized. The conference program and all presentations and videos can be accessed on the website: www.euro-case.org/all_annual-conference/annual-conference-2020/.

CAETS 2023

Croatian Academy of Engineering is currently preparing **CAETS 2023 Annual Meetings and Technical Symposium “e²–mobility: Solutions and Opportunities”** (<https://caets2023.org/>) (Figure 10).



Fig. 10. CAETS 2023 Annual Meetings and Technical Symposium “e²–mobility: Solutions and Opportunities”

Croatian Academy of Engineering is presiding over International Council of Academies of Engineering and Technical Sciences (CAETS), world alliance of 31 academies, during year 2023, and its presidency will culminate in organisation of CAETS 2023 conference, to be held in Zagreb, on October 9-11, 2023.

Decarbonisation of transport will bring significant changes to the way humanity moves people and goods around. While electrification may help with both greenhouse and local emissions, it will also convey huge change to car production and servicing chains. Electrification of transport makes car more of IT product, having battery management software at the core

While the decarbonisation of transport is very wide now, and it is also changing quickly. Main topic will be covered by sessions, introduced by invited speaker, and then discussed by 4-5 panellists on electrification of transport and integration with energy systems, batteries – the core technology, hydrogen, fuel cells and electrofuels, autonomous driving and modal shift.

The organising committee is chaired by Prof. Neven Duić, Ph.D. and members are Prof. Vedran Mornar, Ph.D., Prof. Nikola Čavlina, Ph.D., Prof. Vladimir Mrša, Ph.D., Prof. Hrvoje Gold, Ph.D., Prof. Igor Kuzle, Ph.D., Prof. Bruno Zelić, Ph.D., Prof. Željko Tomšić, Ph.D. and Prof. Vladimir Andročec, Ph.D.

The conference will try to draw attention to Croatian potential role in transport electrification transition, as a site of significant R&D and super car development, but also as a country in which high peaks for charging electric vehicles during summer tourist season will soon be testing the infrastructure. Will Croatia electrify its roads, or perennially miss the markets of electrified higher middle class European tourists?

30 Years of Cooperation between the Croatian Academy of Engineering and Economy

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Abstract: *The Croatian Academy of Engineering (HATZ) is primarily responsible for promoting technological development in order to boost economic growth. The broader context of the collaboration among HATZ, academia and industry is provided, taking into account global trends in digital and green technologies. Particular emphasis is placed on collaboration in several key sectors: energy and transport, agriculture, digitization, automation and biomedical engineering. Some challenges for the future work of HATZ are briefly commented on. Through its committees, centres and councils, HATZ will encourage its members to concretely cooperate with the academic and business community and make suggestions to government institutions to improve relevant laws and regulations.*

Key words: *academic community, food production, automation, business community, digitization, energy, technological development*

INTRODUCTION

The vision and mission of the Croatian Academy of Engineering (HATZ) is to: (i) be a leading interdisciplinary community of innovative engineering; (ii) effectively and actively promote the development of technical science and the transfer of technological knowledge, which is essential for the prosperity of the Croatian economy and the wellbeing of people; (iii) promote the safe and efficient use of technology, protect the environment and people from misuse, to promote professionalism and responsible behaviour while maintaining high ethical standards. In its 30 years of

continuous operation, HATZ has promoted and carried out technical science research and development, worked on important national projects, projects for ministries, state agencies, and businesses, and promoted and organized scientific work, the creation of scientific-professional studies, expertise, projects, and studies. In addition, HATZ members, individually and through departments, committees, centres, scientific and economic councils, discuss their views on current issues in science, technology, innovation and economics and, to this end, organise scientific and professional meetings, issue publications and cooperate with related academies at home and abroad.

HATZ plays a vital role in the promotion of applied research and development of technologies and the transfer of knowledge and technologies from the academic/research community to economic sectors and social communities. The Committee for Cooperation with the Economy and Regional Cooperation, the Centre for Technological Development, the Scientific Council and the Economic Council are particularly active in this direction.

Therefore, this contribution to the 30th anniversary of HATZ will focus on the efforts to improve the vital economic sectors of the Republic of Croatia, especially those that establish its sovereignty and sustainability. According to the author of this text, these sectors are: energy, agricultural and food sector, transport infrastructure, manufacturing economy - complex automation and robotics, healthcare - biomedical engineering and material technologies. Modern civilization operates through digital transformation processes based on digital technologies. This contribution is thus shaped by information and communication technologies (ICT) that penetrate into all pores of economic and social life.

Over the last 10 years, the Committee for Cooperation with the Economy and Regional Cooperation, the Centre for Technological Development and the Economic Council have organized many meetings (round tables). The topics of these gatherings are of exceptional importance for the development of the economy and society, while also being related to current scientific achievements and scientific trends, with the aim of bringing the academic, scientific and business communities closer together.



a)



b)

Figure 1. a) The lifelong education needs of the Croatian economy with a focus on secondary vocational education (Economic Council meeting, March 29, 2018); **b)** New technologies for composting in bioreactors and waste management in line with the EU directive on achieving a circular economy (Economic Council meeting at TEHNIX, Donji Kraljevec, October 11, 2019).

CONTEXT OF COOPERATION BETWEEN HATZ AND THE CROATIAN ECONOMY

Croatia's economic position in the world can be seen from various reports, the most important of which are: WEF - Global Competitiveness Index (GCI); EU DESI index (Digitalization Economy and Society Index); EIBIS index (European Investment Bank Investment Survey); GEM report (Global Entrepreneurship Monitor Report); IMD report (International Institute for Management Development). All these reports point to an important part of our current economic situation. Many of these components are very warning, and it is necessary to look for effective and agile solutions to strengthen our economy through the development of Smart Industries. To do this, we must start with the facts: today's global transformation in the Fourth Industrial Revolution, with a focus on industrial transition and social transformation, is marked by the mission requirement for the proactivity of the academic community; the pandemic and post-pandemic crisis and technological disruptions, as well as the instabilities caused by the crisis, put new requirements on recovery, resilience and self-sufficiency; the Smart Industry concept arose as a result of technological changes and the acceleration of global development during the Fourth Industrial Revolution; digital ecosystems with associated virtual communities represent new forms of organization beyond the organizations themselves (companies and public institutions), creating new values and common well-being based on the principles of collaboration.

Digitization and smart industries

The above facts can serve as a starting point to develop a vision for the development of the smart industry in Croatia. The expert group gathered around the company Infodom, Zagreb, as a supporting member of HATZ, led by prof. Slavko Vidović, Ph.D., a member of the Economic Council, set a vision of digitization and smart industry of Croatia through the association CROSI – Croatian Smart Industry [1]. This vision was discussed in detail at the session of the Economic Council (July 8, 2021): (i) Croatia has a strong global presence and has been successful in developing smart industries which initiated and accelerated the industrial transition and its overall social transformation and; (ii) through the development of awareness and the building of readiness all participants in the transformation processes work in harmony to realize their visions of development in accordance with their own missions and shared beliefs, values, and principles. It is assumed that the achievement of the set vision is made possible if all key levers of economic and social development work in sync. These levers are: state (public) administration; local government (counties, cities and municipalities); economy, which includes economic associations and economic entities of all sizes and interests; proactive academic and research community. With the harmonized operation of the mentioned levers, it will be easier to achieve

national interests and goals and participate more successfully in advanced EU and world development trends. This will undoubtedly facilitate and accelerate the digital transformation of companies and their networking, as well as the development and application of advanced business models and advanced (digital) technologies as key pillars of smart industries.

The main digital technologies used in smart industries, but also in other areas, are: cloud computing, mobile technologies, social networks, big data, Internet of Things (IoT), Virtual/Augmented Reality (V/AR) and cyber security. They are accompanied by technologies that have proven themselves in the Fourth Industrial Revolution: artificial intelligence (AI), robotics, drones, 3D printing, energy storage, blockchain technology, autonomous systems and digital twins. It would be irresponsible not to mention other “non-digital technologies” without which many production sectors are unthinkable, such as: technologies for new materials; nanotechnology; advanced production technologies, industrial biotechnology, as well as space technologies.

All the technologies mentioned are represented to a greater or lesser extent in a wide range of technological sectors and social activities. A major challenge today and in the future is the integration of technologies into the system of technologies.

Most of the mentioned technologies have not yet reached the stage of high maturity, i.e. broad potential market application. Therefore, they, as well as those not listed, or upcoming ones, should be viewed through the horizon of further development, which is characterized by a high speed of evolution and significant disruptive potential. This will imply that technologies will converge towards a data economy (digital economy) with data spaces for their reliable exchange and reuse.

Therefore, in the context of smart industry development, the value of data as digital energy sources should be highlighted. The value of data is increased by the value chain and the following processes: data collection from sensors in technical equipment and data from social networks (event-driven data for Data Lakes with a unique ontology and data dictionaries); data storage in Data Lakes in the cloud for digital platforms; advanced analytics, based on artificial intelligence, to predict the future and propose decisions for the most likely future (mapped to the repository of business processes); automated response to unforeseen events using the Robotic Process Automation tool in order to achieve the execution of actions almost in real time; the Digital Services Infrastructure (DSI) allows for interoperable connection and interaction with other systems in order to map value data to billing systems and to corresponding official electronic documents and e-invoices.

In addition to all of the above, agility is necessary in strengthening the strategic level of cooperation between the government, the economy, and the academic and research community in order to trace the path of smart industry in Croatia as soon as possible, which we could also call smart reindustrialization.

Smart industries represent a strategic framework for the cooperation of the economy, government and the academic/research community in order to achieve the industrial transition in the Fourth Industrial Revolution [2]. These challenges will be even more pronounced in the coming Fifth Industrial Revolution with a special emphasis on social transformation [3].

National policies should recognize digitalization as an important basis for smart industry, because it is not a matter of choice but of time. We need to take advantage of the opportunity that the European Union offers with the Digital Europe Program. We need to increase investments in research and development, especially in applied research and development of technologies, where we are significantly below the European average, in order to be more competitive and to be able to integrate into global value chains. Such important and essential applications have an ontological character that requires individual and collective transformations. It is essential to raise awareness that we are discussing a completely new paradigm and a comprehensive competitiveness tool that permeates every pore of the economy and society. The development and use of technology, as well as the needs of the market, make digitization a priority for most jobs, regardless of the type of activity. This means that it will and already has a major impact on the attractiveness of investments, the creation of new jobs and the growth of competitiveness.

The changes brought about by the Fourth Industrial Revolution, as well as the upcoming Fifth Industrial Revolution do not only concern the production process and the monitoring of the product lifetime with the help of digital technologies. They directly affect changes in business paradigms, the way work is done and the skills required by employees. These are solutions that are not only used in industrial production, but also in many other sectors, such as construction, energy, logistics, transport... and are also necessary for public administration. Following the example of Industry 4.0 (Fourth Industrial Revolution), the concept of Energy 4.0 appears, which can be most easily represented through the so-called four D's - Digitization, Decarbonisation, Decentralization and Democratization. Technologies related to the term Industry 4.0 such as the Internet of Things, Machine Learning, Artificial Intelligence, Big Data are indispensable terms today.

By adopting the National Development Strategy until 2030 [4], the Republic of Croatia could develop and implement industrial transition and social transformation through sectoral strategies, national plans, development plans of local self-government units and through the horizontal Smart Specialization Strategy 2021-2029 [5].

One of the most important levers for joint action in the smart industry are economic associations - professional associations that must realize the opportunities of the digital age through digital ecosystems and public knowledge repository. For example, there is a great potential, and a significant role of the Croatian Chamber of Economy (HGK) in the implementation of smart industry and digital transformation in the Re-

public of Croatia. The HGK connects and networks interested parties in order to achieve progress and development of the economy and society in general. All participants in the smart industry work together in harmony, and through the development of awareness and readiness building synergistically and synchronously realize their visions of development. An example of good practice in Croatia on the way to smart industries and digital transformation is the successful implementation of the Digital Chamber [6] by the HGK, an EU funded project. This project allows the Chamber to better communicate with member companies and internally.

It is important to emphasize that the state must harmonize regulatory frameworks as soon as possible so that the application of innovations and new technologies is not impaired. A long-term strategy is required not only for local self-government but also for the state. A reliable and free infrastructure, for example, is the foundation for the development of smart industries.

The development of smart industries results from a high degree of digitization of the economy and the application of new technologies and processes that positively affect society and the economy. Public-private cooperation is needed to develop smart industries that will be the basis for healthy economic growth. Smart industries have the potential to accelerate and sustain Croatia's development.

The key prerequisites for effective digital transformation processes in our economy are: understanding what Industry 4.0 means; what are the opportunities and potential risks of digital transformation for the company; assess the level of maturity for Industry 4.0; revise strategies and business models; define the goals and priorities of Industry 4.0 and create detailed plans related to digital transformation.

Also, the state should be the main driver of development – a generator of growth [7, 8]. The state should be an integrator and disseminator of values, but it is extremely important to be a creator of values as well. The state as an integrator and disseminator is directed towards the creation of rules that enable the redistribution of existing values to various sectors, all based on the optimization of existing models, knowledge, principles and paradigms. However, the state, as a creator of value, must have a clear and bold vision as a guide for building new ecosystems - institutions and mechanisms - that will lead in a structured and meritocratic manner towards the realization of that vision. Such an ecosystem should be based on: (i) human capital; (ii) appropriate organizations; (iii) investors and companies focused on applied research and market placement of products/services. To initiate a more systematic development of smart industries and the digital transformation, our state should at an elementary level: encourage and ensure a strong basic infrastructure (Internet, cyber security, etc.) as a prerequisite for smart industries and digital transformation; strongly care for the processes of creating modern qualifications and retraining workers of all levels of education, which includes training for new skills, especially digital

ones; facilitate investment conditions for companies, respecting the positive practice in other European countries; improve communication and facilitate cooperation and partnership among all stakeholders in the process of developing smart industries and digital transformation.

The academic and research community plays a crucial role in the development of smart industries and digital transformation by thinking conceptually and abstractly, paving the way towards smart industries and digital transformation and directing newly created knowledge towards applications. Therefore, the academic and research community should “look to the future”, and not be predominantly “concerned with itself”.

Smart symbiosis of digital and green technologies

The development of smart industries should be viewed in conjunction with the European Green Deal (Figure 2). The European Green Deal is a framework of measures to improve the efficient use of resources by moving towards a clean circular economy to stop climate change, protect biodiversity and reduce pollution [9].



Figure 2. Schematic presentation of the European Green Deal

It covers all economic sectors, mainly: transport, energy, agriculture, waste management, building maintenance and construction, and industries such as steel production, cement, textiles and chemicals. By investing considerable financial resources over the next 30 years, the European Green Deal aims to enable European energy independence. However, the European Green Deal can also entail certain obstacles and consequences, such as: higher prices of the green transition than the existing estimates, an increase in the gap between the rich and the poor, an increase in business costs, i.e. a reduction in the competitiveness of EU companies, a CO₂ tax that will further impoverish developing countries exporting to the EU and others.

Aside from that, the European Green Deal with a series of ambitious steps forward represents an opportunity for the EU. It is a political and economic plan designed to benefit all its members in an equal way. It remains to be seen how the big countries, especially China, the USA and Russia, will deal with the European Green Deal?



Figure 3. Presentation by Darinko Bago, a member of Economic Council, at the session of the Economic Council on the topic *Impact of the European Green Deal and digital transformation on the future of Croatia* (October 21, 2021)

The European Green Deal is extremely important and relevant in both the global and national context. The future development of the Croatian society and economy, which should respect the digital and green transition, should be monitored, and in some way, linked to globally current facts and processes such as: multipolar world; climate changes; COVID-19 and its consequences; demographic processes and migrations at the global, regional and national levels; redesign of globalization.

The process of globalization must not take place at the expense of the development of the country as a comprehensive unit in the political, economic and cultural sense. Every state is built on people and their spiritual strength. Spiritual strength can and must create material conditions, i.e. territories with natural resources (soil, water, air) that are the basis for energy and food production, as well as the necessary (soft and hard) infrastructure to produce goods for domestic and international markets and provide services. In this sense, the level of the sovereignty of a state should be understood, which is largely determined by the amount of products and services it can produce. The fewer products and services a country offers on the market, the more globalized it must be in order to ensure a higher standard of living for its citizens; globalization sacrifices part of sovereignty. All countries today are more or less globalized, meaning that they are more or less open to the world market. The reason is

investment, without which there is no economic growth and no market to survive; the state must win investors, multinationals and others, but also oppose them if they seriously threaten the domestic economy. Today, there are no national states that are completely sovereign, so the concept of sovereignty should be understood differently today.

To understand Croatia's position and its development perspectives, it is necessary to present the relationship between the European Union and the world. The facts are as follows: the share of the EU in the world population is falling with an evident further downward trend; the EU has and will have an even more pronounced labour shortage; the EU is far from energy self-sufficiency; the EU is highly dependent on food imports; the share of the EU in world GDP is falling with a further downward trend; the EU's share of future technologies is falling; the share of EU companies among the top 10 (50) in terms of size in the world is falling; the EU has no strategic raw materials.

Croatia, that is, its decision-making factors, to preserve national sovereignty according to its capacities, needs to understand the trends of global technological development and "find its place under the Sun". This also applies to the implementation of the digital and green transformation of the Croatian economy and society.

With the digital transformation comes the paradigm "digital culture, identity and sovereignty". Digital culture, like any culture, is a process of mental maturation and acceptance, and it is associated with the fear of the new. Fear will decrease with increasing knowledge and skills in using new technologies, as well as responsible use of new technologies in a humane way. The near future will be characterized by the creation and strengthening of digital identity, and eventually digital sovereignty, which is especially important for "small" countries and nations.

In any case, digital transformation aims to achieve positive values, particularly care for people who should be creative, innovative and satisfied, regardless of how ambitious that statement may sound. Negative consequences of digital transformation? It depends on which aspect we look at the necessary changes brought by digital transformation. It has inevitably become an area of interest for social scientists.

Digital transformation is a worldwide process. What can prevent the EU from taking a leading role in this process? We look for answers in the facts: the EU is not and most likely will not be a single state; all labour force categories are in deficit, particularly in the ICT sector; EU countries compete for prestige and workforce; the danger of digital invisibility of "small" nations; a deficit in the concentration of multidisciplinary knowledge and disagreement about a unified vision; a deficit in the production of microchips and dependence on manufacturers from East Asia; lack of a single market; an underdeveloped investment system.

Role of Research and Technology Organizations in smart industries

A particularly important issue of the digital and green transformation of Croatia is related to the creation of an ecosystem that should serve the purpose of reindustrialization of Croatia in a cost-effective and environmentally friendly way. Croatia has an opportunity to move in the right direction - in the direction of the development of Croatian smart industry. Smart industries, based on modern technologies and new business models, are the direction we must go. The premise of smart industries is the creation of a scientific-technological-innovation ecosystem that systematically networks science and technology and a whole series of factors from the economy and public institutions. Smart industries focus on green and digital technologies. We need to invest in that ecosystem, for which the state is competent and responsible. With its measures, the state should promote the creation, dissemination and application of new and economically useful knowledge and technologies, and undertake transformative state investments, which are based on policies with a mission and vision, comprehensively observing the entire innovation chain, from basic to applied research, commercialization and initial financing of the companies themselves. Organizations for applied research and technology development (Research and Technology Organizations, RTOs) play an extremely important role in these transformative processes. They represent a “bridge” (systemic intermediaries) between the academic/research community and the economy and play an important role in the implementation of the Smart Specialization Strategy (S3), Figure 4. This form of organization has been developed and confirmed in most European (and world) countries adapted to the needs of national economies. As such, they represent a key link in the value chain: scientific research - applied research/innovation - production and commercialization. Therefore, it is extremely important that S3 Croatia focuses on smart industries and digital transformation in the period 2021-2029. In this context, the Innovation Centre Nikola Tesla (ICENT), a member of the European Association of RTOs (EARTO), as the only Croatian RTO in EARTO, plays an important role [10].

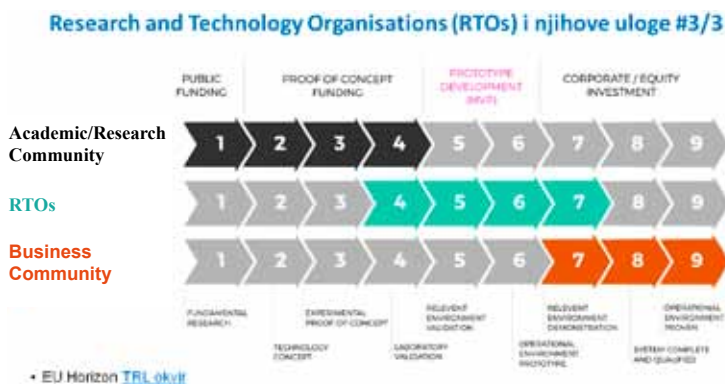


Figure 4. Connecting academic research and the economy through RTOs

There are several roles and missions of the RTO, and one of the most important is to implement applied research and technology development as the basis for the creation of innovative products/services.

The RTO's role in development support for small and medium-sized enterprises, which typically lack development capacities and infrastructure, is critical. This means that RTOs have key development and technology infrastructures (development laboratories) for the development of technologies and their transfer to individual economic sectors. Most RTOs are distinguished by the fact that they develop "general purpose technologies" with the characteristics of "platform-horizontal technologies" and are applicable in a broader range of industries. Examples of such technologies are computing and electronic technologies. These ubiquitous technologies are constantly being improved in terms of performance, ease of use and cost. Such technologies include AI technologies and related modern technologies. It should be emphasized that the states in the EU stand firmly behind the RTO institutions in their determination to support and encourage technological development and innovation in all forms. When creating an RTO, the role of the state as an investor is crucial: the state invests in physical and intellectual infrastructure that individual employees and entrepreneurs could not finance on their own due to the high fixed costs and the risks associated with such investments. Today, RTOs focus their work on developing technologies that accompany the Fourth Industrial Revolution and the digital and green transformation. At the same time, they are technologies that protect nature and mitigate climate change and enable adaptation to climate change.

Today's disruptive technologies, digital and green ones, which should be developed and applied symbiotically, must be included in (new) growth models. In such models, technologies are modelled as an endogenous result of the function of investment in research and development, which includes investment in human capital creation. Predictions based on modelling provide certain guidelines for risk-averse decision-makers. This paves the way for the knowledge economy and "innovation-led growth". And in these economic and development aspects, the role of RTO is extremely important.

University research as part of projects and as part of a PhD thesis usually results in the verification of concept in science and research (as a rule Technology Readiness Level 3 - TRL 3) that may have the potential and development through applied research that can then be used to create innovative products or innovative services (TRL level 7 and above).

It is important to remember that good scientific concepts are highly correlated with educational quality. Once more, a value chain with three essential links is present: scientific research - applied research and innovation - production with commercialization. Therefore, it is essential to understand the genesis - from idea to product.

The fact is that the Croatian industry is predominantly made up of small and medium-sized enterprises (over 99%), which do not have sufficient laboratory and development capacities; they need solutions of technological readiness level TRL 7 and above (system functionality in operational conditions). Practically, our industrial companies, except for a small number, need preliminary products that they will adapt in their production processes to the final product for commercialization in the market. This leaves the TRL 4 to TRL 7 space unoccupied (development, laboratory tests, integration, design, testing in a simulated and relevant environment, and demonstration in an operational environment). The “valley of death” is a colloquial term for this area“. Bridging the valley of death, i.e. reaching TRL 4 to TRL 7, is achieved through an organized process of applied research and development of technologies in organizations (RTOs) that are closely linked with universities on the one hand and with the economy (industry) on the other. This has long been common practice in technologically advanced economies in countries with mature technological innovation ecosystems [11]. Considering the technological level of our economy and its unsatisfactory connection with the academic/research community, the conclusion that Croatia needs RTOs is inevitable.

In this context, one may ask what objectives scientific research in the field of technology pursues with respect to the needs of our economy and society. Are the goals only the publication of high-quality scientific results or should a stronger emphasis be placed on a paradigm shift in how science is viewed? On the role of science (especially engineering), presenting applied research and technology development (which involves the development of innovative products and services) related to the needs of economic and social development. Are the legislation and regulations related to the policy of scientific and research work in Croatia moving in this direction? I leave the answer to this question to objective and responsible scientists and our state institutions responsible for science and technology.

FOCUS ON ECONOMIC COOPERATION WITH HATZ

The Croatian Academy of Engineering (HATZ), through its committees and councils, actively promotes and develops various processes that help connect the academic and research community, business and public administration, and promotes applied research and technology development as the basis for innovative products and services. It places special emphasis on sectors that are essential for economic and social devel-

opment: energy, transport infrastructure, the agri-food complex, health and biomedical engineering, and information and communication technologies. Many gatherings - round tables were organized with the slogan: *“With our round tables, we want to persistently stimulate the need for structural reforms in Croatia. Maybe someone will hear us and understand. We want to help for the benefit of our country”*. I want to believe that the competent state institutions understood us because we regularly sent them conclusions with proposals after the meetings.

For the conferences (round tables), suitable topics and lecturers were carefully selected who could competently present the needs and opportunities of business, state and municipal administration and academia. Below an overview of the contents of the conferences by economic sector is presented.

Energy and transport

Current challenges in the energy sector, as well as guidelines for the implementation of large energy projects, which are particularly important for Croatia, were discussed at round tables of the Committee for Economic Cooperation and Regional Cooperation and at Economic Council sessions. The digital transformation of the energy sector related to several important factors that determine future energy systems: the integration of large-scale renewable energy sources into the electric power system (EPS), which represents the starting point for a low-carbon economy, the construction of energy storage infrastructure to balance energy production and consumption, distributed energy production, protection of nature and the environment, prevention of climate change by reducing greenhouse gas emissions, the connection of EPS with transport systems. All of this needs to be viewed in the context of creating long-term and sustainable energy independence and security.

Energetics and energy are strategic for every country; energy has elements of a public good because it contributes to the general well-being of society.

Special emphasis was placed on renewable energy sources - wind and solar



Figure 5. Professor Ljubo Jurčić's presentation at the round table "Experiences and guidelines in the implementation of large projects in the field of energy" on the topic *Energy, Ecology, Economy* (November 20, 2017)

power plants as well as energy storage, all related to ecology and low-carbon energy. This means the transformation of the energy sector throughout the European Union and its member states, creating a 4D model: Decarbonisation, Decentralization, Digitalization and Democratization. The individual and collective action of citizens in the form of energy cooperatives is central to this because it contributes to energy democracy and sustainably promotes the growth of the local economy and employment.

The fact is that wind power plants and photovoltaic power plants, measured by the Levelized Cost of Energy (LCOE), are price-competitive sources of electricity production. It is important to point out that the production of components for wind and solar power plants in Croatia has been neglected, with the exception of company Solvis, Varaždin, as a manufacturer of photovoltaic panels.

Various aspects of modern energy are covered, such as: Possibilities of using solar energy in centralized heating systems in Croatia; Energy storage in the power system; Integration of electric vehicles into power systems with a high share of renewable energy sources; Advanced control for energy-efficient buildings.

As a Mediterranean country, Croatia lags behind other EU members in the application of solar energy according to most indicators. Solar centralized heating systems with seasonal thermal energy solutions represent a clean and renewable source of thermal energy, easy to install, maintain and operate. Low operating costs, an almost constant price of produced thermal energy, known in advance for up to 30 years, and the possibility of replacing fossil fuels and increasing the security of energy supply, give a significant advantage to the installation of solar systems in settlements and cities where centralized heating systems already exist.

Energy storage in the power system increases the possibility of installing renewable sources, increases supply security and reduces system operating costs. It is well known that in order for the power system to function, a balance must be maintained between power generation and consumption. The increasing integration of renewable energy sources, such as wind farms and solar panels, reduces the available flexibility and controllability of the system. Energy storage solutions have been used in the power system for many years in the form of reversible hydroelectric power plants, but in recent years, primarily due to lower battery prices, more and more emphasis has been placed on distributed storage solutions, both at the level of the transmission and distribution network, as well as among network users (consumers). In the future, we should expect a significant application of energy storage solutions based on hydrogen technology.

Likewise, electric vehicles provide significant space- and time-distributed capacity for electricity storage. This can be used to support the electric power system, for example from the point of view of equalizing the network load and better utilization of the potential of renewable energy sources. The modelling of the electric vehicle fleet is based on the principle of the aggregate battery, which includes the modelling and

control of energy flows at the vehicle level and the modelling of driving cycles. Energy costs can be reduced while driving missions are met by hierarchically optimizing the charging of the fleet of electric delivery vehicles. The modelling and optimal control approaches presented here are illustrated using a pilot study involving a fleet of delivery vehicles and the energy system of a distribution centre belonging to a leading regional retail chain.

Maintaining the indoor environment within comfort limits in buildings, which are complex dynamic systems and significant energy consumers, can be accomplished in a variety of ways with significantly different results in terms of energy consumption and realized energy cost. At the same time, energy consumption and energy costs should be distinguished in the dynamic environment of smart networks in which buildings operate. Significant temporal fluctuations in the energy price should be expected as a consequence of the integration of non-permanent renewable energy sources, and buildings will additionally use local energy production and storage systems to optimize energy costs. All this has motivated the development of a modular approach to building management, using model predictive control at the building area level, a central system for providing heating and cooling media, and the construction of microgrids. At the same time, the predictive control methodology enables a strong interaction with energy networks. The goal is to reduce building energy costs as much as possible through the simple implementation of such controls in various building configurations, as well as to include innovative companies in this process of evolution toward smart

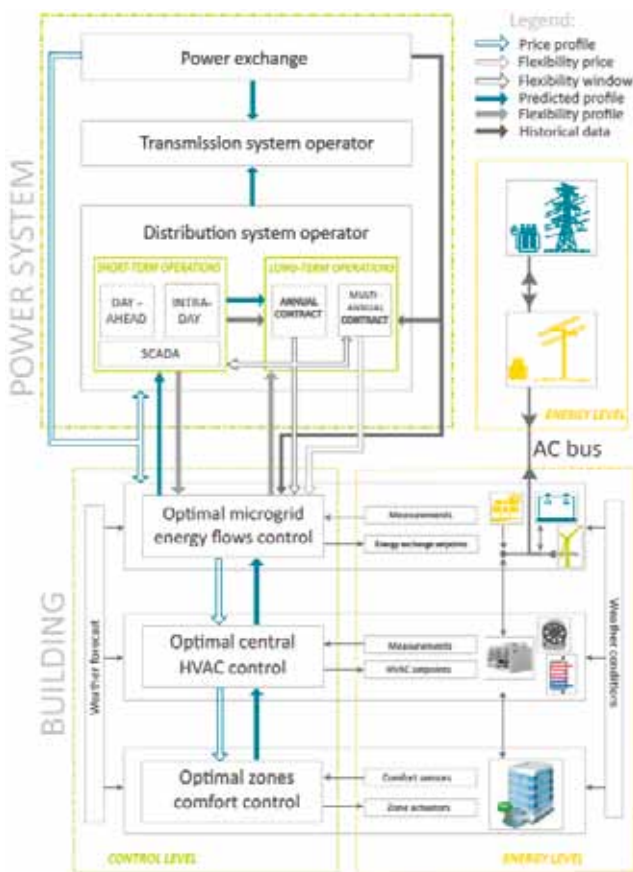


Figure 6. Block diagram of the modular system implemented in the 3 Smart project (author Professor Mario Vašak)

networks, cities, and communities. A very successful project that illustrates this issue is Smart Building – Smart Grid – Smart City (*3Smart*) financed by the European Union through the Danube Transnational Cooperation Program [12], Figure 6.

It is evident that the further development of the energy sector will be determined by the application of new digital and green technologies, which will enable the accelerated development of smart energy systems into which the cyber security of automated systems will be incorporated. A good example of this are the very successful solutions of the Končar Group. This involves the application of internationally accepted standards (such as the new edition of the IEC 61850 standard) and the upgrade of the SCADA system with innovative functionalities.

It is also evident that the architecture of the energy system will be transformed (Figure 7). Bearing in mind Croatia's energy resources (solar and wind potential), the modernization and digitization of the Croatian energy sector presents challenging opportunities.

Croatia's future energy system will be mainly based on renewable energy sources (RES). That means: more dominant production of electricity in solar power plants, production and installation of electricity storage systems and restructuring of the electricity supply system in order to include it in the complete energy supply system, including transport, heating, cooling and industrial processes (intelligent connection of sectors based on smart technologies). The integration of fluctuating energy sources (solar, wind) requires a disruptive transformation of the energy system. This includes both energy storage and sector connections (such as gas system connections) as well as complete digitalization of the energy system as a whole.



Figure 7. An integral view of the smart energy system

(Source: National consultation on economy and entrepreneurship (Rabac, October 18, 2018) - *Blue Growth Opportunities in Digitized Sustainable Energy Economy* (presented by E. R. Weber, Fraunhofer Gesellschaft))

At the same time, the increasing share of variable energy sources (solar, wind) requires radical changes in the paradigm of the energy supply model. This problem did not exist in traditional power systems, which were dominated by thermal power plants. New data-driven energy systems will continuously balance energy production and consumption through the complex interplay of timely load management, stronger interconnection of the electricity and heat energy sectors and transport, as well as the occasional use of flexible energy production such as gas power plants. In addition, it will be necessary to use energy storage technologies: electrical, thermal and chemical. The organization and management of such complex systems - energy production and consumption - will be based on modern predictive methods.

All this can be achieved only with the help of digitization techniques and methods. Additional complications arise when the requirement for international integration of the EPS is added.

Focusing on the modernisation and digitalization of the Croatian energy system could also mean initiating the production of certain components of the system through green field investments, which would have a number of positive effects.

FOOD PRODUCTION COMPLEX

Croatia faces imports of food products, often cheaper and of questionable quality, which results in the non-competitiveness of Croatian products. This situation can be changed making agriculture a strategic sector for Croatia. In addition to all other necessary measures that create a framework for the development of agriculture (legislation, incentives...), it is necessary to focus on the development and application of appropriate modern technological solutions. This applies both to larger agricultural complexes and to rural areas. In other words, it is necessary to accept the global trends of digital transformation and apply them in agriculture and related activities.

Taking into account the global digital economy, there are several key components that could change agriculture in a digital direction: Internet of Things and sensors installed on agricultural areas; IoT and sensors embedded in agricultural equipment; drones and crop monitoring; robotics in agriculture and production of agricultural products; RFID (Radio- Frequency IDentification) sensors and product tracking from field to the table; machine learning and advanced analytics to determine trends and predictions.

IoT and field sensors represent a huge opportunity for food producers, allowing them to monitor their crops from anywhere in the world using image recognition. Sensors embedded in the field send relevant information to farmers in real time, based on which they can take appropriate measures to increase crop productivity and quality. IoT and sensors built into agricultural equipment enable the monitoring of the work-

ing capabilities of various agricultural machines in accordance with the requirements of “precision agriculture”. Tractors and other agricultural machines are equipped with navigation systems and GPS to compensate for uneven terrain or devices for yield mapping and harvest documentation. Drones and crop monitoring on larger agricultural areas are effectively used, for example in the USA, to monitor crops and soil with the help of 3D images as well as the work activities they can perform (e.g. spraying crops). Robotics in agriculture, like robots and artificial intelligence in other industries can significantly increase productivity in crop collection and treatment. Given that agricultural production frequently necessitates labour-intensive activities, robots serve as a replacement for human labor. Following crop harvesting, RFID sensors can be used to track food from the field to the store, allowing consumers to see what they are eating. Using machine learning and performing advanced analytics on collected data to identify various trends and predictions in agricultural production is perhaps one of the most innovative aspects of digital transformation.

Where is Croatia on the global road to digitization of agriculture? Agrokor (now Fortenova Group) was the most important player in Croatia’s agri-food sector, which, thanks to a high level of automation of logistical and technological processes, came close to meeting global agri-food sector digitization trends. It is believed that the Fortenova Group will remain in the Croatian economic system as the backbone of the agricultural and food sector. However, all of the necessary conditions for the development of family farms (in Croatian, Obiteljsko Poljoprivredno Gospodarstvo, OPG), which is especially important in rural and island areas of Croatia, should be created on a permanent basis. In this respect, the use of advanced technologies, especially digital ones, can play a significant role.

Several university centers in Croatia are involved in digitization in agriculture through research and development projects (Zagreb and Osijek). This research should be linked in order to create appropriate digital platforms to support wider digitalization in agriculture. It is encouraging that there are also companies that have identifiable digital solutions and ambitious plans in the agriculture sector (e.g. Agrivi, GDi, InfoDom, In2 group, KING ICT and others) and that are focusing their future development on connecting with the academic and research community through joint research and development projects for the benefit of the agri-food sector.

The Committee for Cooperation with the Economy and Regional Cooperation of HATZ held round tables on the topic of digital transformation and digital innovative solutions in the agricultural and food sector, which included development trends in the world and the situation in Croatia. The objectives of those round tables were: to point out the significance of the development and application of modern and upcoming technologies - especially digital and green ones in the agri-food sector, all in the context of the Fourth Industrial Revolution and the European Green Deal. Of particular note are: (i) scientific research as a basis for application in precision agriculture;

(ii) application of sensors and sensor networks as the basis for complex automation of the agricultural and food sector; (iii) the role of robots and robotic systems in work and production processes of agriculture and the food industry; (iv) application of artificial intelligence to strengthen the value chain of production, processing and distribution of food products.



Figure 8. Professor Davor Romić’s presentation at the roundtable “Digital transformation in the agri-food sector - development trends in the world and the situation in Croatia” on the topic of *Advanced techniques in scientific research as a basis for application in precision agriculture* (June 11, 2019)

In addition, it emphasizes the importance of answering the following questions: (i) how engineering and technology can help us to have a healthy coexistence with nature, that is, how we can rationally use natural resources: land, water and air without destroying nature; (ii) how the synergy of domain knowledge (agronomy, biotechnology,...) and digital technologies, by promoting interdisciplinary and transdisciplinary, can result in great shifts in the agri-food sector, which requires “togetherness” at all levels of activity: from individuals, groups, institutions, sector and smart policies; (iii) how to start and maintain a conversation between interested parties from the academic/research community, public and local administration, and the agri-food sector; (iv) how to promote common-good and public-interest thinking and action in the agri-food sector.

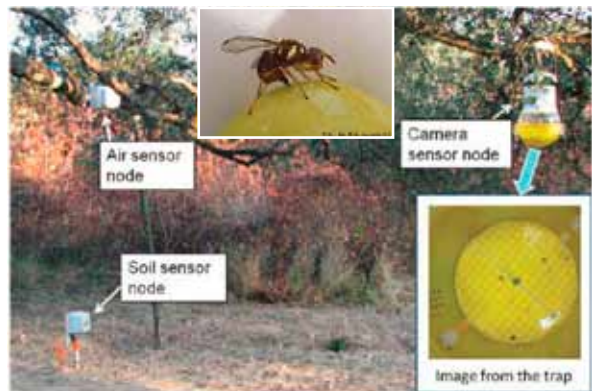


Figure 9. MasliNET system (G1) deployment in an olive grove in Petrčani, October 2008.

The mission of precision agriculture is to use modern agricultural technologies to monitor crop growth and development and cultivation activities with “fine” spatial and temporal resolution in order to make timely decisions, reduce costs, and increase production and product quality so that agriculture is sustainable.

Precision agriculture holds great potential for improving agricultural production by covering every specific production unit, almost every plant, and considering economic, production and ecological conditions. Its development is increasing around the world, but in Croatian agriculture, unfortunately, it is only at the beginning. Nevertheless, recognized research groups in Croatia achieved notable results in the application of modern technologies, for example in water management in agriculture, as well as in special water management in the cultivation of vineyards on meliorated karst (Faculty of Agriculture, University of Zagreb), indicating the need to develop water transport models in specific conditions of meliorated karst.

Ecological agricultural production should be prioritized as much as possible in agricultural production. Organic farming provides an opportunity to change the world’s current relationship with nature at a time when the world is struggling with the increasingly obvious consequences of human impact on the environment. Contrary to traditional methods of growing plants, organic growing is a labour-intensive process that avoids the use of environmentally harmful pesticides, with a comparatively lower yield. The aforementioned characteristics make the products of organic cultivation comparatively more expensive compared to conventional production, which directly reduces their competitiveness on the market, and indirectly causes a weaker representation in the total production. Reduced production costs are required to enable widespread consumption of organic farming products. One of the possible solutions is the introduction of heterogeneous robotic systems with the aim of reducing the working hours of workers, thus maintaining all the advantages of organic production while reducing the total product prices.

An important source of data needed for automation in agriculture is provided by networked sensor systems, i.e. the Internet of Things. The application of IoT in agriculture can result in significant economic effects, by creating a value chain. IoT technology can be effectively used in several aspects such as: monitoring pests, building advanced systems to support irrigation, building an ecosystem that integrates relevant microclimatic and agronomic data from different sources for processing in the field of agronomy and plant sciences to assess the physiological state of crops in real-time. This makes it possible to predict yields based on the measured indicators and optimize fertilization, as well as to monitor the implemented agrotechnical and phytomedical measures to control compliance with legal directives. This will provide practical applications for different stakeholders in agricultural production, while infrastructure owners will be able to sell or share their data in the future agronomic data market enabled by the IoT-field ecosystem.

Our round tables also presented part of Croatian experiences in the application of digital solutions in both large corporations and small family farms. It was pointed out that the experiences of developed agriculture in the world and in the EU demonstrate that digitization offers many opportunities to improve the competitiveness and sustainability of the agricultural economy. Domestic experience shows that investments in the digital transformation of individual family farms must be reasonably adapted to each individual farm. Otherwise, there is a risk of increasing production costs.

Science plays a major role in the progress of the agri-food sector, i.e. applied research and development in specific scientific fields, but also interdisciplinary scientific links. This mainly applies to: (i) domain knowledge in agronomy, food technology and related areas; (ii) technical and technological knowledge, especially modern digital technology and its applications, which includes IoT, robotics, data science, artificial intelligence and related disciplines.

A science that is an end in itself is meaningless (or as Nikola Tesla would say, perverse). Science should serve society and the economy. Consequently, it is necessary to consider the synergy of three factors in the agricultural-food sector: the scientific community, the economy and public administration. These three factors should promote the development and application of new digital technologies in question.

As a result of the above, it is necessary to ensure close interaction between the groups of faculties, especially in the fields of technology, biotechnology and natural sciences. With the help of the Ministry of Agriculture (and other ministries), this group should act in a unified manner towards the business sector of the agricultural and food industry. The key word of this concept is cooperation, which cancels out all the negative effects of isolation, fragmentation, and various particularisms.

In summary, some important challenges of modern agriculture facing the agri-food sector are: (i) digitization and automation; (ii) the development of modern agricultural personnel and (iii) changing the perception of farmers.

Complex automation of production and work processes

Complex process automation is based on scientific research of control theory and the application of modern digital technologies, primarily artificial intelligence and robotics.

At the round tables of the Committee for cooperation with the economy and regional cooperation of HATZ, the following topics were discussed: “Cyber-physical systems and the Internet of Things”; “Development and application of robotics in Croatia” and “Artificial intelligence – perception and reality”.

Cyber-physical systems and the Internet of things, services, and people are the main paradigm of the Fourth Industrial Revolution, i.e. digital transformation [2]. In this regard, some important questions arise, such as: (i) how is today's expanding virtual world or virtual reality related to the real physical world - physical reality?; (ii) what is the scope of digital transformation?; (iii) is there room for fear of the Fourth Industrial Revolution?; (iv) how to connect modern economy, technique/technology and organization of companies - business models?

Connecting the physical and virtual (digital) worlds through the use of software platforms to network devices from our environment allows for remote access and control of distributed devices. At the same time, interoperability is of particular importance for the further development of IoT and its widespread application in practice, with a number of open questions related to security, privacy, scalability and decentralization.

With the digital transformation of business in the context of the Fourth Industrial Revolution, new trends and practices of the digital economy are emerging, such as game-changing scenarios of the application of newly developed and emerging digital technologies in various industries, which are characterized by new business models. Innovative smart companies and upgrading in the direction of smart industries are based on them.



Figure 10. Professor Mario Spremić's presentation at the round table "Cyber-Physical Systems and the Internet of Things" on the topic *Digital Business Transformation and Industrial Revolution 4.0* (April 11, 2018)



Figure 11. Presentation by Sergio Galošić (President of the Klimaoprema Management Board) at the round table "Development and application of robotics in Croatia" on the topic *Business success based on technological development* (December 6, 2017)

Today's complex systems, such as critical infrastructure systems, are actually systems of systems that are the focus of the Fourth Industrial Revolution and the concept of cyber-physical systems, and are based on the optimal control theory. In terms of control, cyber-physical systems (CPS) consist of cooperating computer units that control physical objects, in which control algorithms play an extremely important role. The control architecture of CPS often consists of spatially distributed units for data col-

lection, estimation, control and actuation. There are many research and development challenges in CPS control, such as: integrated control system design; communication and computing; multiple levels of decision-making; dynamic reconfiguration of connected CFSs; coordination mechanisms for CPS guided by economic approaches; compensation of uncertainty and disturbances during balancing and global optimization of CPSs.



Figure 12. Professor Mate Baotić's presentation at the round table "Cyber-Physical Systems and the Internet of Things" on the topic *Optimal Control System* (April 11, 2018)

Modern digital technologies have reached such levels where very complex digital twins (DTs) can be developed and applied as replicas of real physical systems. DTs rely on simulations, optimizations and predictions in order to create the best scenarios and decisions. This will have significant effects on the overall development of the economy and society. CPSs are being upgraded as DTs are developed, which will undoubtedly contribute to even higher levels of automation. In this sense, second-generation DTs will be of greater interest in the upcoming Fifth Industrial Revolution.

Despite many unfulfilled promises, it was unmistakably stated at the round tables where artificial intelligence was discussed that artificial intelligence and data science, as drivers of digital transformation, have already become serious scientific disciplines with a transformational effect on the economy and the way of doing business. The advancement of artificial intelligence, particularly machine learning, in conjunction with the availability of large amounts of data, has led to the development of a new interdisciplinary field - data science - as a fundamental driver of digital transformation and one of the drivers of the Fourth Industrial Revolution. The rapid development of artificial intelligence and the widespread application of data science techniques also have brought numerous challenges to society, from the impact on the labour market to a number of ethical questions.

The development of artificial intelligence throughout history (from the middle of the 20th century) to today's mega-trends that integrate physical, digital and biological reality are the drivers of the disruptive technologies of the Fourth Industrial Revolution. It is very likely that digitization based on artificial intelligence will also determine the development trends of the upcoming Fifth Industrial Revolution which will likely focus on the following areas: energy, energy storage and efficiency, with strong im-

plications for climate change mitigation, materials science and further advances in data science and information.

There are many specific (and open) questions about artificial intelligence and application sectors, such as: artificial intelligence in autonomous driving; artificial intelligence in cyber security; artificial intelligence in public administration; artificial intelligence in mobile networks of the new generation (5G); HPC development for artificial intelligence implementation. All of the above issues, and many more, are global challenges with China leading the way, followed by the US and the EU. The EU declared its digital development through the Digital European Program (DEP), which will run from 2021 to 2027. The efforts of the Croatian academic community in terms of research and application of artificial intelligence should certainly be respected and further encouraged. The Centre of Artificial Intelligence (Faculty of Electrical Engineering and Computing, University of Zagreb) should also be mentioned.

The technological level of maturity of the economy is reflected in the level of automation and the application of robotics in production and work processes, which is decisive for the commercial success of the company, i.e. for optimizing costs and achieving competitiveness on the world market and for global positioning.

The round table discussions also covered the following topics: autonomous and cooperative robotic systems; perspectives for the development and application of aerial robotics in Croatia; perspectives for the development and application of underwater robotics in Croatia.

The greatest challenges for robotics in the coming decade are related to the development of robotic systems that can autonomously perform complex tasks and safely cooperate with humans in unstructured environments. Such robots are likely to change our everyday lives and industrial processes. Education plays an important role in the research, development and applications of robotics in various fields. Robotics is a scientific and technical discipline that combines knowledge from mechanical engineering, electrical engineering, computing, control and materials science, with additional knowledge from natural, social and other sciences. As a result, it represents a strong magnet for primary and secondary students, encouraging their motivation. There is no systematic solution in Croatia for the introduction of robotics at the level of the entire educational system, but there is a strong movement to popularize robotics within the framework



Figure 13. Professor Ivan Petrović's presentation at the round table "Artificial intelligence – perception and reality" on the topic *Artificial intelligence in autonomous robotic systems* (July 3, 2020)

of optional (additional) student activities. The goal is to create an educational framework that will use robotics as a locomotive for quality mastery of knowledge across the entire field of technical education.

An important part of digital transformation is digital security (cyber security) and privacy, which will slow down the adoption of digital technologies to some extent. With the increasing intensity of ICT use, companies and individuals face greater digital security and privacy risks. Large companies tend to have a high level of digital security, while small and medium-sized businesses tend not to, so they are in particular need to adopt or improve their digital security risk management practices. Many countries have national digital security strategies, but few countries in the world have a national privacy strategy. Nowadays, privacy risks are mainly related to possible fraud when trading over the Internet, which can slow down the growth of e-commerce.

Biomedical engineering

Advances in modern medicine are largely determined by technologies within biomedical engineering as an interdisciplinary field. The purpose of the round table on „Trends in the development of biomedical engineering” was to point out the importance of the development and application of modern and upcoming technologies in biomedical engineering. Advances in biomedical engineering should be seen in the context of the Fourth Industrial Revolution, especially the biological megatrend highlighted there. The following research, development, and application directions are recognized in this megatrend: (i) robotics with an emphasis on applications in surgery, rehabilitation and therapy of patients; (ii) smart drug technology (Smart Drugs); cloud computing; big data and the Internet of Things; (iv) medical virtual reality; (v) neural technology and development of engineering tools for brain research; (vi) application of disruptive technologies, such as artificial intelligence.

The challenges of biomedical engineering at the beginning of the 21st century and the most important trends in research, development and application of modern technologies in the world at the beginning of the 21st century are: miniaturization of electronic sensors, processors and communication technology, which allows measuring nodes to be installed anywhere on the body; the generation of huge data sets from which, with the help of artificial intelligence, they extract important information about the entire population for prevention, but also an individual approach to each person, including the prediction of adverse health conditions, i.e. individualized treatment and rehabilitation. The aging of the world’s population requires finding a solution for long-term independent living while attempting to preserve quality of life.

For the past 50 years, the University of Zagreb has systematically carried out teaching and research activities in the field of biomedical engineering. This is especially

true for the Faculty of Electrical Engineering and Computing, Faculty of Mechanical Engineering and Naval Architecture, and Faculty of Science, all of the University of Zagreb. The results of the projects implemented by the University of Zagreb provide a major scientific contribution to the development of new medical equipment and clinical services that help the healthcare system in the prevention, diagnosis and treatment of diseases. The results of projects implemented by biomedical engineers are also essential for the development, design, monitoring, maintenance and safety of medical equipment, the selection, installation and integration of medical information systems.



Figure 14. Professor Ratko Magjarević's presentation at the round table "Development trends in biomedical engineering" on the topic of *Challenges of biomedical engineering at the beginning of the 21st century* (October 10, 2018)



Figure 15. Intelligent neurosurgical robotic system RONNA (University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, and Clinical Hospital Dubrava, Zagreb)

Research and development of biomechanics in the Croatian academic community (Faculty of Mechanical Engineering and Naval Architecture) follows development trends in the world and is focused on research and solving technical problems in biology and medicine: (i) numerical algorithms that describe the behaviour of biological tissues and enable the prediction of vascular diseases; (ii) orthodontic therapy in dental biomechanics; (iii) representation of blood flow in the cardiovascular system; (iv) development of various implants, fixators and plates for osteosynthesis; (v) biomaterials research; application of 3D technology in biomedical engineering; (vi) development of medical robotics – neurosurgical robot and exoskeleton systems.

Special mention should be made of the RONNA project, which was launched in 2009 at the Faculty of Mechanical Engineering and Naval Architecture together with



Figure 16. Prototype of an automated system for manufacturing orthopedic insoles (Faculty of Mechanical Engineering and Naval Architecture)

the Dubrava Clinical Hospital (Professor Bojan Jerbić and Professor Darko Chudy). The goal of the project was not only to create a robotic system for unprecedented high-precision stereotactic navigation in neurosurgery, but to create a robotic assistant that should be autonomous and intelligent enough to understand the surgeon's intentions, assisting in the most technically demanding procedures. The development of the 6th generation of RONNA is currently underway, which has great potential for the global market.

CHALLENGES FOR THE FUTURE WORK OF HATZ IN THE FIELD OF DIHs AND EDIHs

HATZ follows the world-leading trends in the development and application of key technologies, especially European research and development programs, such as the framework European programs Horizon 2020 (H2020), Horizon Europe (HE) and the complementary Digital European Program (DEP).

DIHs (Digital Innovation Hubs) were established as part of the Horizon 2020 program. They are based on the European platform of national initiatives for the digitizing industry (Figure 17), which aim to maximize productivity and optimize agility in manufacturing SMEs and Mid-Caps across the European Union.

HE and DEP are key European programs in the period 2021-2027 for research, development and application of technologies and innovations based on them to maintain and increase the competitiveness of European economies. The emphasis in HE is to support the early stages of the innovation chain (scientific research, including preliminary tests, proof of concept and pilot projects), while DEP is focused on the development and dissemination of technologies, which entails testing solutions on larger-scale pilot projects and taking over successful research results (achieved, for example, through HE) and their exploitation for new implementations.



Figure 17. European platform on which DIHs are established

The DEP is built on five pillars: artificial intelligence, high-performance computing, cyber security, advanced digital skills and ensuring widespread use of digital technologies across the economy and society. The key mechanisms for DEP implementation are the European Digital Innovation Hubs (EDIHs) [13], aiming to build technical expertise and experimental infrastructure to enable the digital transformation of industry and the public sector. EDIHs represent the expansion of existing DIHs (financed in the H2020 program) through the building of international corridors and networking of EDIHs; EDIHs do not replace DIHs. To that end, EDIHs assist businesses and SMEs by improving access to digital technologies, technical expertise, and the ability to test tools and technologies before investing in them. Other services provided by EDIHs with a business focus include: financial advice, innovative trainings, technological trainings, skills development, and other resources designed to prepare companies to face and reap the benefits of digital transformation. Operating at national and EU level, EDIHs continue to support national Digital Innovation Hubs, increasing their capacity to deliver projects and results with greater impact and value. Finally, EDIHs also strengthen the overall digital and innovation ecosystem by promoting networking across the various hubs as well as enabling knowledge-building, knowledge-transfer, and expertise. Logical partners of the EDIHs consortia are Research and Technology Organisations (RTOs) and technical universities/faculties in cooperation with economic associations, clusters, the European Enterprise Network (EEN), accelerators/incubators, innovation agencies and professional training institutions.

Serving the economy's digitization and digital transformation, particularly for small and medium-sized enterprises and public administration, is crucial for EDIHs. Local organizations will have access to the European network of EDIHs through EDIHs.

As orchestrators, they will actively network with other innovation centres, sharing best practices and specialist knowledge and bringing companies into contact with other companies in a similar value chain. In addition, EDIHs will act as intermediaries between public administration and companies providing technological services to e-government.

The European Commission awarded Croatia four EDIHs [14] following a competitive process, namely: EDIH CROBOHUB++ (applicant Faculty of Electrical Engineering and Computing, University of Zagreb); AI4HEALTH.Cro (applicant Ruđer Bošković Institute); EDIH Adria (Applicant University of Rijeka) and JURK (applicant Regional Coordinator of Sisak-Moslavina County). The three-year projects mentioned are starting on January 1, 2023.

To illustrate, one of the four approved Croatian EDIHs - CROBOHUB++ (CROatian Industry and Society BOosting - European Digital Innovation HUB) is focused on three key areas of DEP: artificial intelligence, cyber security and high-performance computing (HPC) and in the following technologies: robotics, computer vision, Internet of Things, embedded control and automation systems, smart sensors, blockchain technology and digital simulations. The technologies in which CROBOHUB++ specializes are very widely applicable, but CROBOHUB++ will primarily focus on the following sectors: (i) manufacturing industry, (ii) digitized agriculture, (iii) energy and environment, and (iv) public administration. CROBOHUB++ can directly and strongly contribute to the digital maturity of Croatian industry and society by supporting digital transformation in the above-mentioned areas.

The initiatives and plans of DEP and HE and their implementation mechanisms open the possibility for a significant step forward by Croatian institutions for research and development of technologies in synergy with the business sector and institutions of public administration. Therefore, it is necessary to address the implementation of the National Recovery and Resilience Plan (in Croatian, Nacionalni Plan Oporavka i Otpornosti, NPOO) for the period 2021-2026 wisely, strategically and responsibly, keeping in mind the long-term European Green Deal.

Scientific research on which the development of future technologies in the coming decades will be based, from the current perspective, will largely relate to: information-technology sciences, neurosciences, biotechnology, nanotechnology and energy and energy storage (especially hydrogen technology), energy efficiency with a strong impact on climate change mitigation and materials science.

In January 2021, the European Commission published a text announcing that Industry 5.0 (the Fifth Industrial Revolution) [3] is an evolutionary complement to Industry 4.0. with an emphasis on research and innovation as drivers of sustainable development, a people-centered approach, and the resilience of European industry. The focus

should shift from shareholder values to stakeholder values with tangible and intangible benefits for all parties involved. Therefore, the human factor and integration in inclusive social systems play a greater role.. In addition, there is an increased focus on services and the so-called 3R sustainability strategy: Reduce, Reuse, Recycle. This is undoubtedly the goal of the circular economy as an essential component of the European Green Deal. Technologies and concepts supporting Industry 5.0 include: increasing collaboration between humans and smart systems (cobotics), enabling mass customization in sustainable cyber-physical systems, sensor networks and edge computing for environmental analysis, second-generation digital twins that take into account not only factory processes but also the entire environment, the increased complexity of products as a result of the development and adoption of advanced technologies in products and processes, and the increasing expectations of customers. The result of all of this will be the next generation of the internet, which will connect people, systems, and devices even more strongly in a metaverse environment.

The world is being fundamentally altered by today's Industry 4.0 and its successor, Industry 5.0. There is no doubt that these changes will have many implications, including new wars without conventional weapons. Such wars are already happening: over data, over talent, over digital platforms and ecosystems, and over cyberwarfare.

The question arises - Where is the place of Croatia on the global horizon of technological and economic flows? At this time, it is only possible to answer in principle: it is necessary to build one's own abilities for one's own development. It is the permanent national capital that builds a long-term, sustainable and resilient economy and society. The National Recovery and Resilience Plan is in generally well-structured and provides opportunities for the Croatian economy to take a step towards building smart industries based on advanced technologies and new business models. The Croatian academic and research community, despite its limited capacities, can and should give a respectable development boost in synergy with the business community and with the support of public administration institutions. Croatia urgently needs unity, holistic vision, agility and accountability of decision-makers and implementers. Croatia needs to improve its technological infrastructure, especially the technological-development infrastructure for the building of Croatian RTOs.

Through its committees, centres and councils, HATZ will promote and actively participate in technological and economic development in Croatia and initiate a broad process to bring the academic/research community and the economy together, including the creation of a start-up ecosystem [15].

A good example of the excellent cooperation of the academic community and industry achieved through the cooperation of HATZ and Tehnix Company is the *Bioreactor composting project for biodegradable municipal waste*. The development results obtained in this project have reached commercial application and with good applica-

tion possibilities. The developed composting technology will become more and more widespread.



Figure 18. The project team at work meeting at the Tehnix Company (Donji Kraljevec, June, 2021)

Although the history of the establishment and development of start-ups in Croatia is not long, the development trend is obvious. It is expected that a new wave of digitization in the Croatian industry will accelerate the development of new business models such as start-ups. The emphasis will be on deep-tech start-ups arising from academic scientific research (Figure 19).

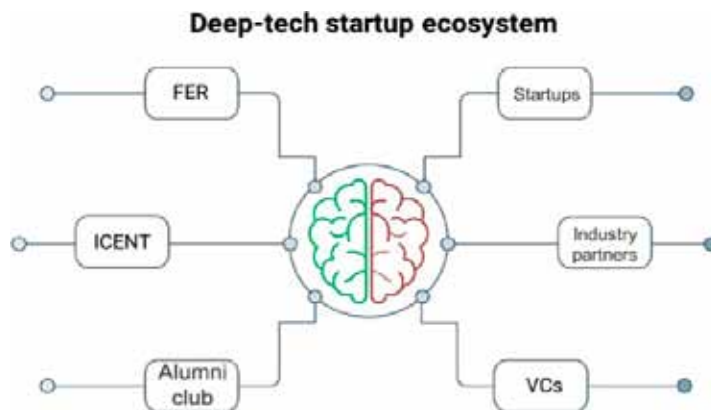


Figure 19. An example of a deep-tech startup ecosystem – deep-tech Venture Builder (Nuqlus)

One of the important challenges that HATZ will deal with through its committees, centres and councils are how to train students of our higher education institutions for future jobs. During the round table discussion entitled “Reforms in higher education - new jobs in the unpredictable future”, it became clear that future jobs will require a combination of traditional and new skills and knowledge, i.e. a formal and informal education system that encourages continuous education and adaptation to new business challenges (Figure 20).



Figure 20. Reforms in higher education - new jobs in the unpredictable future

This will require experts who know how to combine existing and future knowledge, and who can deal with multidisciplinary complex technical and social problems at the same time. It was specifically stated on this occasion too that for the sustainable development of society, which is based on the creation of new products and services, the cooperation between the academic community and the economy is necessary along with stimulating public administration policies [16].

We must have no illusions that HATZ is called upon to implement (structural) reforms in higher education, but we are convinced that it is our duty to responsibly contribute to that process. The lectures and discussions at the above-mentioned round table communicated valuable messages not only to decision-makers at the national level, but also to those of us who are actively involved in certain essential parts of higher education, science, public administration and the economy. We need unity, mutual respect and dialogue.

CONCLUSION

To strengthen the economy through the development of Smart Industries, it is necessary to begin with the facts: the need of the academic community for proactivity

characterizes today's worldwide transition in the Fourth Industrial Revolution, which focuses on industrial transition and social transformation; the pandemic and post-pandemic crisis and technological disruptions, as well as the instabilities caused by the crisis, put new demands on recovery, resilience and self-sufficiency; the Fourth Industrial Revolution, as a result of technological changes and accelerated global development, has given rise to the concept of a new strategic framework for economic development; digital ecosystems with associated virtual communities represent new forms of organization outside the organizations themselves (companies and public institutions), through which new values and common goods are created based on the principles of cooperation.

Bearing in mind the mentioned facts and by creating appropriate operational national mechanisms, it will be easier to achieve national interests and goals and to be more successfully included in the progressive EU and world development trends. This will undoubtedly facilitate and speed up the digital transformation of companies and their networking and develop a cooperative ecosystem with the aim of increasing the productivity and competitiveness of a certain economic sector, which includes the development and application of advanced business models, as well as the development and application of advanced (digital) technologies, as key pillars of smart industries.

To achieve this goal, Croatia needs to invest more in research and development, especially in applied research and development of technologies, where we are significantly below the European average. This means that Croatia as a progressive state should continue to be the main driver of development – a generator of growth and a creator of values, with a clear and bold vision as a guide for building new ecosystems - institutions and mechanisms - that will lead to the realization of that vision in a structured and meritocratic manner.

In this sense, it is very important to understand the “smart symbiosis of digital and green technologies”, which includes the efficient use of resources to stop climate change, protect biodiversity and reduce pollution through the transition to a clean circular economy. Furthermore, the transformative public investment must be made through policies with a mission and a vision that consider the whole innovation chain, from fundamental research to applied research, commercialization, and the spread of start-up funding. Organizations engaged in applied research and technology development (RTOs) play an extremely important role in these transformations. They are “bridges” (systemic intermediaries) between the academic/research community and the economy with an important role in implementing the Smart Specialization Strategy (S3).

The significance of RTOs in supporting development for small and medium-sized enterprises, which typically lack development capabilities and development infrastructure (development laboratories), should be emphasized.

What needs to be emphasized is that behind the RTO institutions within the EU, countries have strongly demonstrated their willingness to support and promote technological development and innovation in various forms. When establishing an RTO, the role of the state as an investor is crucial: the state invests in physical and intellectual infrastructure that individual employees and entrepreneurs could not finance on their own due to high fixed costs and the risks associated with such investments. Nowadays, RTOs have focused their work on the development of technologies that support the Fourth Industrial Revolution and the upcoming Fifth Industrial Revolution, and digital and green transformations.

The Croatian academic and research community, despite its limited capacities, can and should give a respectable development boost in synergy with the business community and with the support of public administration institutions. Croatia urgently needs unity, a holistic vision, agility and accountability of decision-makers and implementers. Croatia needs to improve its technological infrastructure, especially the establishment of research and technology organizations.

The role of HATZ, in the context of development and transfer of knowledge and technology, is continuing to follow global trends in the development and application of key technologies, especially European research and development programs, such as the framework European programs Horizon 2020 and Horizon Europe and the complementary Digital European Program. Through its committees, centres and councils, HATZ will encourage its members to concretely engage in the academic and business community and make proposals to state institutions to improve appropriate legislation and regulations.

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Scientific and Professional Publications of Academy Members in 2022

Prof. **Bruno Zelić**, Ph.D.
Vice-president of the Academy

To show only a part of the scientific and professional activities of the members of the Croatian Academy of Engineering, here is an overview of the scientific and professional publications in journals and congress proceedings, which were co-authored by members, associates and emeritus of the Academy in 2022.¹

1. Ačkar, Đurđica; Babić, Jurislav; Jokić, Stela; Jozinović, Antun; Miličević, Borislav; Šubarić, Drago. Transitioning to Zero Waste in Agro-Food Sector – Novel Solutions for By-Product Valorisation // Engineering power: bulletin of the Croatian Academy of Engineering, 17 (2022), 1; 2-10
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National Awards and Decorations of the Members of the Croatian Academy of Engineering from 1993 to 2022¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

With regard to the scientific, professional and innovative importance of their achievements, members of the Croatian Academy of Engineering received a number of prizes, awards and decorations, some of which are listed in this Annual and previously evaluated by the Editorial Board as the most important:

- National Awards for Scientific and Research Work “Nikola Tesla”,
- National Science Awards,
- Order of the Croatian Danica with the Effigy of Ruđer Bošković,
- Order of the Croatian Danica with the Effigy of Nikola Tesla,
- Award Fran Bošnjaković – University of Zagreb.

Members of the Croatian Academy of Engineering received a number of other major awards at home and abroad, but they are not listed in this Annual because of restrictions to the content. The list of these awards is available on the Academy’s website (www.hatz.hr) and in the section of members.

National Awards for Scientific and Research Work “Nikola Tesla”

- Solarić, Nikola, Prof. Emeritus Ph.D. (1993)

National Science Awards

- Jeren, Branko, Prof. Ph.D. (1996)
- Brnić, Josip, Prof. Emeritus Ph.D. (1997) (2018)
- Sućeska, Muhamed, Prof. Ph.D. (1997)

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

- Božičević, Josip, Academician (1998)
- Granić, Goran, Ph.D. (1998)
- Virag, Zdravko, Prof. Ph.D. (1998)
- Obad Šćitaroci, Mladen, Academician (1998)
- Muftić, Osman, Prof. Ph.D. (1999)
- Mrša, Zoran, Prof. Ph.D. (1999)
- Sorić, Jurica, Prof. Ph.D. (1999)
- Šantić, Ante, Prof. Emeritus Ph.D. (2000)
- Franković, Bernard, Prof. Ph.D. (2000)
- Krakar, Zdravko, Prof. Ph.D. (2000)
- Božičević, Juraj, Prof. Ph.D. (2001)
- Sopta, Luka, Prof. Ph.D. (2001)
- Bašić, Tomislav, Prof. Ph.D. (2002)
- Sladoljev, Želimir, Prof. Ph.D. (2003)
- Lelas, Vesna, Prof. Ph.D. (2003)
- Zentner, Radovan, Prof. Ph.D. (2003)
- Haznadar, Zijad, Prof. Emeritus Ph.D. (2004)
- Radić, Jure, Prof. Ph.D. (2004)
- Šantek, Božidar, Prof. Ph.D. (2004)
- Čorić, Većeslav, Prof. Ph.D. (2005)
- Katović, Drago, Prof. Emeritus Ph.D. (2005)
- Vasić-Rački, Đurđa, Prof. Emerita Ph.D. (2005)
- Karšaj, Igor, Prof. Ph.D. (2005)
- Lovrić, Tomislav, Prof. Emeritus Ph.D. (2006)
- Feretić, Danilo, Prof. Emeritus Ph.D. (2007)
- Perić, Nedjeljko, Prof. Emeritus Ph.D. (2007)
- Marić, Vladimir, Prof. Ph.D. (2007)
- Alfirević, Ivo, Prof. Emeritus Ph.D. (2008)
- Tonković, Zdenko, Prof. Ph.D. (2008)
- Mandić, Milena, Prof. Ph.D. (2008), (2014)
- Marušić, Josip, Prof. Emeritus Ph.D. (2009)
- Senjanović, Ivo, Academician (2009)
- Šušaković, Jagoda, Prof. Emerita Ph.D. (2009) (2020)
- Kralik, Gordana, Prof. Emerita Ph.D., Dr.h.c. (2009), (2010), (2012)
- Pap, Klaudio, Prof. Ph.D. (2010)

- Šubarić, Drago, Prof. Ph.D. (2010), (2011), (2014)
- Žiljak, Vilko, Prof. Emeritus Ph.D. (2010)
- Dragović Uzelac Verica, Prof. Ph.D. (2011), (2015)
- Hranueli, Daslav, Prof. Ph.D. (2011)
- Petrović, Ivan, Academician (2011)
- Barbir, Frano, Prof. Emeritus Ph.D. (2012) (2020)
- Ježek, Damir, Prof. Ph.D. (2012)
- Kelemen, Tomislav, Prof. Ph.D. (2013)
- Ožanić, Nevenka, Prof. Ph.D. (2013)
- Čurković, Lidija, Prof. Ph.D. (2013)
- Lipovac, Nenad, Prof. Ph.D. (2014)
- Frece, Jadranka, Prof. Ph.D. (2014)
- Budin, Leo, Academician (2016)
- Duić, Neven, Prof. Ph.D. (2016)
- Skala, Karolj, Prof. Ph.D. (2016)
- Herceg, Zoran, Prof. Ph.D. (2016)
- Baletić, Bojan, Prof. Ph.D. (2017)
- Kuzle, Igor, Ph.D. (2017)
- Zelić, Bruno, Prof. Ph.D. (2017)
- Kos, Blaženka, Prof. Ph.D. (2017)
- Lončarić, Sven, Academician (2018)
- Grgić, Mislav, Prof. Ph.D. (2018)
- Jokić, Stela, Prof. Ph.D. (2018)
- Kozmar, Hrvoje, Prof. Ph.D. (2019)
- Babić, Jurislav, Prof. Ph.D. (2019)
- Kurajica, Stanislav, Prof. Ph.D. (2020)
- Cifrek, Mario, Prof. Ph.D. (2020)
- Ačkar, Đurđica, Prof. Ph.D. (2020)

Award Fran Bošnjaković – University of Zagreb

- Johanides, Vera, Prof. Emerita Ph.D. (1994)
- Podhorsky, Rikard, Prof. Ph.D. (1994)
- Senjanović, Ivo, Academician (1995)
- Androić, Boris, Prof. Ph.D. (1996)
- Feretić, Danilo, Prof. Emeritus Ph.D. (1996)

- Galović, Antun, Prof. Ph.D. (1999)
- Bogdan, Željko, Prof. Ph.D. (2001)
- Hraste, Marin, Academician (2001)
- Filetin, Tomislav, Prof. Emeritus Ph.D. (2003)
- Haznadar, Zijad, Prof. Emeritus Ph.D. (2003)
- Soljačić, Ivo, Prof. Emeritus Ph.D. (2005)
- Gomzi, Zoran, Prof. Emeritus Ph.D. (2006)
- Radić, Jure, Prof. Ph.D. (2006)
- Glasnović, Antun, Prof. Ph.D. (2007)
- Katović, Drago, Prof. Emeritus Ph.D. (2007)
- Perić, Nedjeljko, Prof. Emeritus Ph.D. (2009)
- Terze, Zdravko, Prof. Ph.D. (2010)
- Rogišić, Marko, Prof. Ph.D. (2011)
- Grancarić, Ana Marija, Prof. Emerita Ph.D. (2012)
- Pegan, Srećko, Prof. Ph.D. (2014)
- Kurajica, Stanislav, Prof. Ph.D. (2014)
- Ćurković, Lidija, Prof. Ph.D. (2015)
- Bogdan, Stjepan, Prof. Ph.D. (2015)
- Lončarić, Sven, Academician (2016)
- Grgić, Mislav, Prof. Ph.D. (2017)
- Obad Šćitaroci, Mladen, Academician (2017)
- Barić, Adrijan, Prof. Ph.D. (2018)
- Sorić, Jurica, Prof. Ph.D. (2018)
- Guzović, Zvonimir, Prof. Ph.D. (2019)
- Mornar, Vedran Prof. Ph.D. (2020)
- Petrović, Ivan, Academician (2021)

Order of the Croatian Danica with the Effigy of Ruđer Bošković – for Science

- Božičević, Josip, Academician (1995)
- Brnić, Josip, Prof. Emeritus Ph.D. (1995)
- Ćosić, Krešimir, Prof. Ph.D. (1995)
- Lovrić, Tomislav, Prof. Emeritus Ph.D. (1995)
- Radić, Jure, Prof. Ph.D. (1995)
- Andročec, Vladimir, Prof. Ph.D. (1996)
- Katavić, Ivan, Prof. Emeritus Ph.D. (1996)

- Majdandžić, Niko, Prof. Ph.D. (1996)
- Mlinarić, Tomislav, Prof. Emeritus Ph.D. (1996)
- Mrša, Zoran, Prof. Ph.D. (1996)
- Ružinski, Nikola, Prof. Ph.D. (1996)
- Sladoljev, Želimir, Prof. Ph.D. (1996)
- Soljačić, Ivo, Prof. Emeritus Ph.D. (1996)
- Tonković, Stanko, Prof. Emeritus Ph.D. (1996)
- Đukan, Petar, Ph.D. (1997)
- Hraste, Marin, Academician (1997)
- Marović, Pavao, Prof. Ph.D. (1997)
- Rogale, Dubravko, Prof. Ph.D. (1997)
- Rožić, Nikola, Prof. Ph.D. (1997)
- Šantić, Ante, Prof. Emeritus Ph.D. (1997)
- Alfirević, Ivo, Prof. Emeritus Ph.D. (1998)
- Auf-Franić, Hildegard, Prof. Emerita Ph.D. (1998)
- Feretić, Danilo, Prof. Emeritus Ph.D. (1998)
- Krumes, Dragomir, Prof. Ph.D. (1998)
- Lelas (maiden name Hegedušić), Vesna, Prof. Ph.D. (1998)
- Ugrinović, Kosta, Prof. Ph.D. (1998)
- Kralik, Gordana, Prof. Emerita Ph.D., Dr.h.c. (2007)
- Milković, Mateo, Prof. Ph.D. (2007)
- Butković, Mirko, Prof. Ph.D. (2008)
- Kovač, Mario, Prof. Ph.D. (2008)
- Primorac, Dragan, Prof. Ph.D., MD (2015)
- Soljačić, Marin, Prof. Ph.D. (2017)
- Grgić, Mislav, Prof. Ph.D. (2019)

Order of the Croatian Danica with the Effigy of Nikola Tesla – for Invention and Innovation

- Golubović, Adrijano, Prof. Emeritus Ph.D. (1997)
- Szavits-Nossan, Antun, Prof. Ph.D. (1997)
- Radić, Jure, Prof. Ph.D. (1998)
- Kniewald, Zlatko, Prof. Emeritus Ph.D. (2006)
- Markotić, Anto, Prof. Ph.D. (2011)
- Car, Stjepan, Prof. Ph.D. (2012)

Recipients of the Awards of the Croatian Academy of Engineering (2002-2022)¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

On the occasion of the 30th anniversary of the Croatian Academy of Engineering we wish to point out the Awards of the Croatian Academy of Engineering, which have been awarded annually since 2002, for contributions to science and profession and the achievement of the objectives and programs of the Academy, as well as the dedicated work that has contributed to social recognition of the Academy.

Awards of the Academy are:

- Lifetime Achievement Award *The Power of Knowledge* (awarded since 2002),
- Annual Award *Rikard Podhorsky* (awarded since 2004),
- Award for Young Scientists *Vera Johanides* (awarded since 2002),
- Award for a Successful Young Scientist from Business Sector *Vera Johanides* (awarded since 2012).

Lifetime Achievement Award “The Power of Knowledge”

- Haznadar, Zijad, Prof. Emeritus Ph.D. (2002)
- Frančula, Nedjeljko, Prof. Emeritus Ph.D. (2003)
- Bošnjak, Marijan, Prof. Ph.D. (2004)
- Alfirević, Ivo, Prof. Ph.D. (2005)
- Janović, Zvonimir, Prof. Ph.D. (2006)

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

- Zovko-Cihlar, Branka, Prof. Emerita Ph.D. (2007)
- Božičević, Juraj, Prof. Ph.D. (2008)
- Ugarčić-Hardi, Žaneta, Prof. Ph.D. (2009)
- Franekić, Jasna, Prof. Ph.D. (2010)
- Aničić, Dražen, Prof. Ph.D. (2011)
- Auf-Franić, Hildegard, Prof. Emerita Ph.D. (2012)
- The 2013 Award was not granted because there had been no applicants
- Soljačić, Ivo, Prof. Emeritus Ph.D. (2014)
- Kniewald, Zlatko, Prof. Emeritus Ph.D. (2015)
- Vasić-Rački, Đurđa, Prof. Emerita Ph.D. (2016)
- Perić, Nedjeljko, Prof. Emeritus Ph.D. (2017)
- Tonković, Stanko, Prof. Emeritus Ph.D. (2018)
- The 2019 Award was not granted because there had been no applicants
- Šušković, Jagoda, Prof. Emerita Ph.D. (2020)
- Rogale, Dubravko, Prof. Ph.D. (2021)
- Skala, Karolj, Prof. Ph.D. (2021)

Annual Award „Rikard Podhorsky“

- Franekić, Jasna, Prof. Ph.D. (2004)
- Nikolić, Gojko, Prof. Ph.D. (2004)
- Perić, Nedjeljko, Prof. Emeritus Ph.D. (2004)
- Sever, Stanislav, Prof. Ph.D. (2004)
- Auf-Franić, Hildegard, Prof. Emerita Ph.D. (2005)
- Majdandžić, Niko, Prof. Ph.D. (2005)
- Radošević, Jagoda, Prof. Ph.D. (2005)
- Sorić, Zorislav, Prof. Ph.D. (2005)
- Grgić, Sonja, Prof. Ph.D. (2006)
- Šušković, Jagoda, Prof. Emerita Ph.D. (2006)
- Tomas, Srećko, Prof. Ph.D. (2006)
- Višković, Alfredo, Prof. Ph.D. (2006)
- Wolf, Hinko, Ph.D. (2006)
- Franković, Bernard, Prof. Ph.D. (2007)
- Petrović, Ivan, Academician (2007)
- Ujević, Darko, Prof. Emeritus Ph.D. (2007)

- Zrnčević, Stanka, Prof. Ph.D. (2007)
- Bonefačić, Davor, Prof. Ph.D. (2008)
- Dragčević, Zvonko, Prof. Emeritus Ph.D. (2008)
- Filetin, Tomislav, Prof. Emeritus Ph.D. (2008)
- Medved-Rogina, Branka, Prof. Ph.D. (2008)
- Mikulić, Dinko, Assist. Prof. Ph.D. (2008)
- Galović, Antun, Prof. Ph.D. (2009)
- Jurković, Sonja, Prof. Ph.D. (2009)
- Salopek, Branko, Prof. Ph.D. (2009)
- Marušić, Josip, Prof. Ph.D. (2010)
- Pap, Klaudio, Prof. Ph.D. (2010)
- Kurtanjek, Želimir, Prof. Ph.D. (2011)
- Lelas, Vesna, Prof. Ph.D. (2011)
- Medved, Vladimir, Prof. Ph.D. (2011)
- Šubarić, Drago, Prof. Ph.D. (2012)
- Cifrek, Mario, Prof. Ph.D. (2013)
- Tonković, Zdenko, Prof. Ph.D. (2013)
- Lončarić, Sven, Academician (2014)
- Herceg, Zoran, Prof. Ph.D. (2014)
- Šantek, Božidar, Prof. Ph.D. (2014)
- Jerbić, Bojan, Academician (2015)
- Ježek, Damir, Prof. Ph.D. (2015)
- Babić, Jurislav, Prof. Ph.D. (2016)
- The 2017 Awards were not granted because there had been no applicants
- Pribanić, Tomislav, Prof. Ph.D. (2018)
- Bolf, Nenad, Prof. Ph.D. (2018)
- Kos, Blaženka, Prof. Ph.D. (2018)
- Baotić, Mato, Prof. Ph.D. (2019)
- Jokić, Stela, Prof. Ph.D. (2019)
- Kuzle, Igor, Prof. Ph.D. (2020)
- Martinović, Goran, Prof. Ph.D. (2020)
- Zelić, Bruno, Prof. Ph.D. (2020)
- Frece, Jadranka, Prof. Ph.D. (2021)
- Jakobović, Domagoj, Prof. Ph.D. (2021)
- Žagar, Drago, Prof. Ph.D. (2021)

Award for Young Scientist „Vera Johanides“

- Perl, Antonija, Ph.D. (2002)
- Gaurina Srček, Višnja, Ph.D. (2003)
- Velić, Darko, B.Sc. (2003)
- Durgo, Ksenija, M.Sc. (2004)
- Garašić, Ivica, B.Sc. (2004)
- Grgić, Mislav, Ph.D. (2004)
- Jukić, Ante, Ph.D. (2004)
- Slaćanac, Vedran, Ph.D. (2004)
- Budžaki, Sandra, M.Sc. (2005)
- Halassy-Špoljar, Beata, Ph.D. (2005)
- Lacković, Igor, Ph.D. (2005)
- Pavlović, Hrvoje, M.Sc. (2005)
- Trgo, Marina, Ph.D. (2005)
- Ambruš, Davorin, M.Sc. (2006)
- Komes, Draženka, Assist. Prof. Ph.D. (2006)
- Pribanić, Tomislav, Assist. Prof. Ph.D. (2006)
- Suligoj, Tomislav, Assist. Prof. Ph.D. (2006)
- Zelić, Bruno, Assist. Prof. Ph.D. (2006)
- Babić, Jurislav, Assoc. Prof. Ph.D. (2007)
- Baotić, Mato, Ph.D. (2007)
- Rezić, Iva, Ph.D. (2007)
- Tarbuk, Anita, M.Sc. (2007)
- Vasić, Darko, M.Sc. (2007)
- Čačić-Kenjeric, Daniela, Ph.D. (2008)
- Hursa, Anica, Ph.D. (2008)
- Krešić, Greta, Ph.D. (2008)
- Vašak, Mario, Ph.D. (2008)
- Vrsalović-Presečki, Ana, Ph.D. (2008)
- Bucić-Kojić, Ana, Ph.D. (2009)
- Findrik, Zvezdana, Ph.D. (2009)
- Kopjar, Mirela, Ph.D. (2009)
- Otmačić Ćurković, Helena, Ph.D. (2009)
- Petošić, Antonio, Ph.D. (2009)
- Karšaj, Igor, Ph.D. (2010)

- Mužić, Marko, Ph.D. (2010)
- Molnar, Goran, Ph.D. (2010)
- Režek Jambrak, Anet, Ph.D. (2010)
- Jelavić, Mate, Ph.D. (2011)
- Dejanović, Igor, Ph.D. (2011)
- Đakulović, Marija, Ph.D. (2011)
- Skorin-Kapov, Nina, Assist. Prof. Ph.D. (2011)
- Beganović, Jasna, Ph.D. (2011)
- Jokić, Stela, Assist. Prof. Ph.D. (2012)
- Lerga, Jonatan, Ph.D. (2012)
- Lörincz, Josip, Assist. Prof. Ph.D. (2012)
- Žagar, Martin, Ph.D. (2012)
- Ačkar, Đurđica, Assist. Prof. Ph.D. (2013)
- Poljak, Mirko, Ph.D. (2013)
- Marčić (née Jurić-Kačunić), Danijela, Ph.D. (2013)
- Mišković, Nikola, Ph.D. (2013)
- Serdar, Marijana, Ph.D. (2014)
- Pandžić, Hrvoje, Assist. Prof. Ph.D. (2014)
- Kininčić, Vedran, Ph.D. (2014)
- Pilipović, Ana, Ph.D. (2014)
- Capuder, Tomislav, Ph.D. (2015)
- Pukšec, Tomislav, Ph.D. (2015)
- Belščak-Cvitanović, Ana, Ph.D. (2015)
- Marović, Ivan, Ph.D. (2015)
- Banjuri, Ines, Assist. Prof. Ph.D. (2016)
- Jović, Alan, Assist. Prof. Ph.D. (2016)
- Hofman, Daniel, Assist. Prof. Ph.D. (2016)
- Mikulčić, Hrvoje, Ph.D. (2017)
- Marković, Ivan, Assist. Prof. Ph.D. (2017)
- Jozinoić, Antun, Assist. Prof. Ph.D. (2017)
- Picek, Stjepan, Ph.D. (2017)
- Orsag, Marko, Assist. Prof. Ph.D. (2018)
- Stipetić, Stjepan, Assist. Prof. Ph.D. (2018)
- Vasilj, Josip, Assist. Prof. Ph.D. (2018)
- Žunić, Alen, Assist. Prof. Ph.D. (2018)

- Feraguna, Fabio, Assist. Prof. Ph.D. (2019)
- Lončarić, Ante, Assist. Prof. Ph.D. (2019)
- Šolić, Petar, Assist. Prof. Ph.D. (2019)
- Švaco, Marko, Assist. Prof. Ph.D. (2019)
- Čanak, Iva, Ph.D. (2020)
- Đurasević, Marko, Assist. Prof. Ph.D. (2020)
- Kovač, Tihomir, Assist. Prof. Ph.D. (2020)
- Vidović, Ivan, Assist. Prof. Ph.D. (2020)
- Leventić, Hrvoje, Ph.D. (2021)
- Pavić, Ivan, Ph.D. (2021)
- Virag, Lana, Assist. Prof. Ph.D. (2021)
- Vukušić Pavičić, Tomislava, Assist. Prof. Ph.D. (2021)

Award for Successful Young Scientist from the Business Sector „Vera Johanides“

- Elez, Ante, Ph.D. (2012)
- Filipović-Grčić, Dalibor, Ph.D. (2013)
- Sučić, Stjepan, Ph.D. (2014)
- *The 2015 Award was not granted because there had been no applicants*
- Hrkovac, Martina, Ph.D. (2016)
- Penović, Tomislav, Ph.D. (2017)
- Antonijević, Miro, Ph.D. (2018)
- Plavec, Edouard, Ph.D. (2019)
- *The 2020 Award was not granted because there had been no applicants*
- *The 2021 Award was not granted because there had been no applicants*

Full Members of the Academy, Emeriti of the Academy and Associates of the Academy¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

For Full Members of the Academy, Emeriti of the Academy and Associates of the Academy may be elected persons who meet conditions according to the Statute and the Bylaw on Membership of the Academy.

Full Member of the Academy may be a Croatian citizen with generally acknowledged scientific results and/or patents in the field of technical and biotechnical sciences, who has the status of a scientific advisor or Full Professor of a university, who is elected by the Presidency and who, on the occasion of submitting the candidature for a member according to the Statute commits himself/herself that after the election he/she will actively participate in the work of the Academy, take part in projects and activities of the Academy, contribute to its reputation and honor the Code of Ethics of the Academy.

Emeritus of the Academy becomes every Full Member of the Academy in the year in which he/she turns seventy five. Full Member of the Academy can become Emeritus of the Academy after turning seventy on personal request. Emeriti of the Academy are elected by the Presidency of the Academy.

Associate of the Academy may be a citizen of the Republic of Croatia with the title of research associate or some higher title in the field of engineering and/or biotechnical sciences, who is elected by the Assembly and who, when submitting the candidature for a member according to the Statute commits himself/herself that after the election he/she will actively participate in the work of the Academy. Membership in the Academy of the Associate Member ceases in the year when he/she turns seventy years of age.

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

Hereinafter is the list of members in the three categories of the elected members of the Academy (state in May 2023).

Full Members of the Academy

1. Babić, Jurislav, Prof. Ph.D.
2. Baletić, Bojan, Prof. Ph.D.
3. Barbir, Frano, Prof. Emeritus Ph.D.
4. Barić, Adrijan, Prof. Ph.D.
5. Bedeković, Gordan, Prof. Ph.D.
6. Begušić, Dinko, Prof. Ph.D.
7. Bonefačić, Davor, Prof. Ph.D.
8. Cifrek, Mario, Prof. Ph.D.
9. Čavlina, Nikola, Prof. Ph.D.
10. Čišić, Dragan, Prof. Ph.D.
11. Dalbelo Bašić, Bojana, Prof. Ph.D.
12. Debrecin, Nenad, Prof. Ph.D.
13. Domazet, Željko, Prof. Ph.D.
14. Duić, Neven, Prof. Ph.D.
15. Dujmović, Darko, Prof. Ph.D.
16. Fajt, Siniša, Prof. Ph.D.
17. Fertalj, Krešimir, Prof. Ph.D.
18. Firšt Rogale, Snježana, Prof. Ph.D.
19. Gaurina-Međimurec, Nediljka, Prof. Emerita Ph.D.
20. Gold, Hrvoje, Prof. Ph.D.
21. Grbac, Ivica, Prof. Emeritus Ph.D.
22. Grbavac, Vitomir, Prof. Ph.D.
23. Grgić, Mislav, Prof. Ph.D.
24. Grgić, Sonja, Prof. Ph.D.
25. Guzović, Zvonimir, Prof. Ph.D.
26. Herceg, Zoran, Prof. Ph.D.
27. Horvat, Predrag, Prof. Ph.D.
28. Jambreković, Vladimir, Prof. Ph.D.
29. Jerbić, Bojan, Academician
30. Ježek, Damir, Prof. Ph.D.
31. Jirouš-Rajković, Vlatka, Prof. Ph.D.
32. Jukić Tihomir, Prof. Emeritus Ph.D.

33. Karšaj, Igor, Prof. Ph.D.
34. Komen, Vitomir, Prof. Ph.D.
35. Kos, Blaženka, Prof. Ph.D.
36. Kos, Serdo, Prof. Ph.D.
37. Kovačević, Meho Saša, Prof. Ph.D.
38. Kovačević Zelić, Biljana, Prof. Ph.D.
39. Kralj, Damir, Prof. Ph.D.
40. Kujundžić, Trpimir, Prof. Ph.D.
41. Kurajica, Stanislav, Prof. Ph.D.
42. Kuzle, Igor, Prof. Ph.D.
43. Lipovac, Vladimir, Prof. Ph.D.
44. Lončarić, Sven, Academician
45. Mandić, Milena, Prof. Ph.D.
46. Marović, Pavao, Prof. Emeritus Ph.D.
47. Martinović, Goran, Prof. Ph.D.
48. Medak, Damir, Prof. Ph.D.
49. Medved, Vladimir, Prof. Ph.D.
50. Medved-Rogina, Branka, Prof. Ph.D.
51. Mihanović, Ante, Prof. Emeritus Ph.D.
52. Mikac, Tonči, Prof. Ph.D.
53. Milković, Marin, Prof. Ph.D.
54. Moguš-Milanković, Andrea, Prof. Ph.D.
55. Mornar, Vedran, Prof. Ph.D.
56. Mrnjavac, Edna, Prof. Ph.D.
57. Mrša, Vladimir, Prof. Ph.D.
58. Mrvac, Nikola, Prof. Ph.D.
59. Obad Šćitaroci, Mladen, Academician
60. Ožanić, Nevenka, Prof. Ph.D.
61. Pap, Klaudio, Prof. Ph.D.
62. Pavić, Ivica, Prof. Ph.D.
63. Pavković, Branimir, Prof. Ph.D.
64. Penava, Željko, Prof. Ph.D.
65. Perić, Nedjeljko, Prof. Emeritus Ph.D.
66. Petrović, Ivan, Academician
67. Pribičević, Boško, Prof. Ph.D.
68. Pušić, Tanja, Prof. Ph.D.

69. Rimac-Drlje, Snježana, Prof. Ph.D.
70. Rogale, Dubravko, Prof. Ph.D.
71. Rogošić, Marko, Prof. Ph.D.
72. Skala, Karolj, Prof. Ph.D.
73. Sorić, Jurica, Prof. Emeritus Ph.D.
74. Sribljic, Siniša, Prof. Ph.D.
75. Stipaničev, Darko, Prof. Ph.D.
76. Sučić, Viktor, Prof. Ph.D.
77. Sućeska, Muhamed, Prof. Ph.D.
78. Šantek, Božidar, Prof. Ph.D.
79. Šercer, Mladen, Prof. Ph.D.
80. Šubarić, Drago, Prof. Ph.D.
81. Šušković, Jagoda, Prof. Emerita Ph.D.
82. Terze, Zdravko, Prof. Ph.D.
83. Tomas, Srećko, Prof. Ph.D.
84. Tomašić, Vesna, Prof. Ph.D.
85. Tomšić, Željko, Prof. Ph.D.
86. Tonković, Zdenko, Prof. Ph.D.
87. Tušek, Darovan, Prof. Ph.D.
88. Ujević, Darko, Prof. Emeritus Ph.D.
89. Virag, Zdravko, Prof. Ph.D.
90. Višković, Alfredo, Prof. Ph.D.
91. Vražić, Mario, Prof. Ph.D.
92. Vrkljan, Darko, Prof. Ph.D.
93. Vujasinović, Edita, Prof. Ph.D.
94. Vujević, Slavko, Prof. Ph.D.
95. Zelenika, Saša, Prof. Ph.D.
96. Zelić, Bruno, Prof. Ph.D.
97. Žagar, Drago, Prof. Ph.D.
98. Žarko, Damir, Prof. Ph.D.

Emeriti of the Academy

1. Agić, Darko, Prof. Ph.D.
2. Alfirević, Ivo, Prof. Ph.D.
3. Andrassy, Maja, Prof. Ph.D.

4. Andročec, Vladimir, Prof. Ph.D.
5. Androić, Boris, Prof. Ph.D.
6. Aničić, Dražen, Prof. Ph.D.
7. Anžek, Mario, Prof. Ph.D.
8. Auf-Franić, Hildegard, Prof. Emerita Ph.D.
9. Babić, Darko, Prof. Ph.D.
10. Ban, Drago, Prof. Ph.D.
11. Beslać, Jovo, Prof. Ph.D.
12. Biondić, Božidar, Prof. Emeritus Ph.D.
13. Bogdan, Željko, Prof. Ph.D.
14. Bogunović, Nikola, Prof. Ph.D.
15. Bolanča, Stanislav, Prof. Emeritus Ph.D.
16. Bolanča, Zdenka, Prof. Ph.D.
17. Brnić, Josip, Prof. Emeritus Ph.D.
18. Butković, Mirko, Prof. Emeritus Ph.D.
19. Cerovac, Vesna, Prof. Ph.D.
20. Čaušević, Mehmed, Prof. Emeritus Ph.D.
21. Črnko, Josip, Prof. Ph.D.
22. Čunko, Ružica, Prof. Ph.D.
23. Ćosić, Krešimir, Prof. Ph.D.
24. Damić, Vjekoslav, Prof. Ph.D.
25. Dragčević, Zvonko, Prof. Emeritus Ph.D.
26. Ferić, Miljenko, Prof. Ph.D.
27. Filetin, Tomislav, Prof. Emeritus Ph.D.
28. Frančula, Nedjeljko, Prof. Emeritus Ph.D.
29. Franekić, Jasna, Prof. Ph.D.
30. Franković, Bernard, Prof. Ph.D.
31. Galović, Antun, Prof. Ph.D.
32. Glasnović, Antun, Prof. Ph.D.
33. Gomzi, Zoran, Prof. Emeritus Ph.D.
34. Grncarić, Ana Marija, Prof. Emerita Ph.D.
35. Granić Goran, Ph.D.
36. Hnatko, Emil, Prof. Ph.D.
37. Hraste, Marin, Academician
38. Ilić, Ivan, Prof. Emeritus, Ph.D.

39. Janović, Zvonimir, Prof. Ph.D.
40. Jelaska, Damir, Prof. Ph.D.
41. Jović, Franjo, Prof. Ph.D.
42. Jurković, Sonja, Prof. Ph.D.
43. Kalpić, Damir, Prof. Emeritus Ph.D.
44. Kelemen, Tomislav, Prof. Ph.D.
45. Kniewald, Zlatko, Prof. Emeritus Ph.D.
46. Komadina, Pavao, Prof. Emeritus Ph.D.
47. Koroman, Vladimir, Prof. Ph.D.
48. Krakar, Zdravko, Prof. Ph.D.
49. Kralik, Gordana, Prof. Emerita Ph.D., Dr.h.c.
50. Križan, Božidar, Prof. Emeritus Ph.D.
51. Krumes, Dragomir, Prof. Ph.D.
52. Kurtanjek, Želimir, Prof. Ph.D.
53. Kviz, Boris, Prof. Ph.D.
54. Lapaine, Miljenko, Prof. Emeritus Ph.D.
55. Ljuljka, Boris, Prof. Emeritus Ph.D.
56. Majdandžić, Niko, Prof. Ph.D.
57. Margeta, Jure, Prof. Emeritus Ph.D.
58. Markotić, Anto, Prof. Ph.D.
59. Marušić, Josip, Prof. Ph.D.
60. Matejiček, Franjo, Prof. Ph.D.
61. Matijašević, Ljubica, Prof. Ph.D.
62. Mikuličić, Vladimir, Prof. Ph.D.
63. Milković, Mateo, Prof. Emeritus Ph.D.
64. Parac-Osterman, Đurđica, Prof. Emerita Ph.D.
65. Pegan, Srećko, Prof. Emeritus Ph.D.
66. Roje, Vesna, Prof. Ph.D.
67. Rožić, Nikola, Prof. Ph.D.
68. Salopek, Branko, Prof. Ph.D.
69. Sečen, Josip, Prof. Ph.D.
70. Senjanović, Ivo, Academician
71. Solarić, Nikola, Prof. Emeritus Ph.D.
72. Soljačić, Ivo, Prof. Emeritus Ph.D.
73. Somek, Branko, Prof. Ph.D.

74. Sorić, Zorislav, Prof. Ph.D.
75. Sršen, Mate, Prof. Emeritus Ph.D.
76. Ugarčić-Hardi, Žaneta, Prof. Ph.D.
77. Vasić-Rački, Đurđa, Prof. Emerita Ph.D.
78. Veža, Ivica, Prof. Emeritus Ph.D.
79. Zrnčević, Stanka, Prof. Ph.D.
80. Žagar, Zvonimir, Prof. Ph.D.
81. Žiljak, Vilko, Prof. Emeritus Ph.D.

Associates of the Academy

1. Ačkar, Đurđica, Prof. Ph.D.
2. Afrić, Winton, Prof. Ph.D.
3. Arbanas, Željko, Prof. Ph.D.
4. Baotić, Mato, Prof. Ph.D.
5. Baranović, Mirta, Prof. Ph.D.
6. Biondić, Ranko, Prof. Ph.D.
7. Bogdan, Stjepan, Prof. Ph.D.
8. Bolanča Mirković, Ivana, Prof. Ph.D.
9. Bolf, Nenad, Prof. Ph.D.
10. Božanić, Rajka, Prof. Ph.D.
11. Brkić, Vladislav, Assoc. Prof. Ph.D.
12. Burum, Nikša, Prof. Ph.D.
13. Čanađija, Marko, Prof. Ph.D.
14. Ćurković, Lidija, Prof. Ph.D.
15. Dobrilović, Mario, Prof. Ph.D.
16. Dragović-Uzelac, Verica, Prof. Ph.D.
17. Đapo, Almin, Prof. Ph.D.
18. Frece, Jadranka, Prof. Ph.D.
19. Galić, Irena, Prof. Ph.D.
20. Goić, Ranko, Prof. Ph.D.
21. Grgić, Davor, Prof. Ph.D.
22. Hocenski, Željko, Prof. Ph.D.
23. Hruškar, Mirjana, Prof. Ph.D.
24. Ivanjko, Edouard, Prof. Ph.D.
25. Jakobović, Domagoj, Prof. Ph.D.

26. Jokić, Andrej, Prof. Ph.D.
27. Jokić, Stela, Prof. Ph.D.
28. Joler, Miroslav, Prof. Ph.D.
29. Jugović, Alen, Prof. Ph.D.
30. Jukić, Ante, Prof. Ph.D.
31. Kasum, Josip, Prof. Ph.D.
32. Kliček, Božidar, Prof. Ph.D.
33. Knezić, Željko, Assoc. Prof. Ph.D.
34. Kozmar, Hrvoje, Prof. Ph.D.
35. Krstulović-Opara, Lovre, Prof. Ph.D.
36. Lakušić, Stjepan, Prof. Ph.D.
37. Lipovac, Nenad, Prof. Ph.D.
38. Lončar, Dražen, Prof. Ph.D.
39. Lulić, Zoran, Prof. Ph.D.
40. Mandžuka, Sadko, Prof. Ph.D.
41. Marasović, Katja, Prof. Ph.D.
42. Matijašić, Gordana, Prof. Ph.D.
43. Matijević, Božidar, Prof. Ph.D.
44. Meštrović, Krešimir, Prof. Ph.D.
45. Mikota Miroslav, Assoc. Prof. Ph.D.
46. Dr. sc. Mikulić Dinko, College Prof.
47. Miličević, Kruno, Prof. Ph.D.
48. Mlinarić, Hrvoje, Prof. Ph.D.
49. Mlinarić, Tomislav Josip, Prof. Ph.D.
50. Modrić, Damir, Prof. Ph.D.
51. Muštra Mario, Assoc. Prof. Ph.D.
52. Novak, Doris, Prof. Ph.D.
53. Petrak, Slavenka, Prof. Ph.D.
54. Picek, Stjepan, Assoc. Prof. Ph.D.
55. Pribanić, Tomislav, Prof. Ph.D.
56. Sander, Aleksandra, Prof. Ph.D.
57. Slavica, Anita, Prof. Ph.D.
58. Sumina, Damir, Prof. Ph.D.
59. Šarolić, Antonio, Prof. Ph.D.
60. Šerman, Karin, Prof. Ph.D.

61. Šikić, Mile, Prof. Ph.D.
62. Šimić, Zdenko, Prof. Ph.D.
63. Šljivac, Damir Prof. Ph.D.
64. Tarbuk, Anita, Assoc. Prof. Ph.D.
65. Trkulja, Bojan, Prof. Ph.D.
66. Udiljak, Toma, Prof. Ph.D.
67. Veršić, Zoran, Prof. Ph.D.
68. Vusić, Damir, Prof. Ph.D.
69. Zeljko, Mladen, Assoc. Prof. Ph.D.
70. Zentner, Radovan, Prof. Ph.D.
71. Zovko Brodarac, Zdenka, Prof. Ph.D.
72. Zrinjski, Mladen, Prof. Ph.D.
73. Žagar, Martin, Assist. Prof. Ph.D.
74. Žiljak Gršić, Jana, Prof. Ph.D.

Honorary Members of the Academy¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

Honorary Member of the Academy may be a distinguished Croatian or foreign scientist, who meets the criteria for membership in the Academy and who, by his or her lifelong activity, has made considerable contribution to the affirmation, recognition and reputation of engineering sciences in Croatia and abroad. Honorary Members of the Academy are elected by the Presidency of the Academy.

Hereinafter is the list of Honorary Members of the Academy in May 2023

1. Boras, Damir, Prof. Ph.D.
2. Gajski, Daniel D., Prof. Ph.D.
3. Pejovnik, Stane, Prof. Emeritus Ph.D.
4. Primorac, Dragan, Prof. Ph.D., MD
5. Richter, Kurt R., Prof. Ph.D.
6. Turk, Vito, Prof. Ph.D.

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Monograph „25 Years of the Croatian Academy of Engineering (HATZ) 1993 -2018“, on the occasion of the 25th Anniversary of the Croatian Academy of Engineering.

International Members of the Academy¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

International Members of the Academy may be distinguished Croatian or foreign scientists in the field of engineering sciences, with international reputation, living abroad, who meet the criteria for membership in the Academy. When submitting the candidature for a member according to the Statute, they commit themselves that after the election they will participate in the work of the Academy according to their best abilities. International Members of the Academy are elected by the Presidency of the Academy.

Hereinafter is the overview of the international members of the Academy in May 2023.

1. Ahić-Đokić, Melita, Prof. Ph.D.
2. Gavin, Kenneth George, Prof. Ph. D.
3. Gucunski, Nenad, Prof. Ph.D.
4. Geršak, Jelka, Prof. Ph.D.
5. Holzer, Clemens, Prof. Ph.D.
6. Lipičnik, Martin, Prof. Ph.D.
7. Kipphan, Helmut, Prof. Ph.D.
8. Knez, Željko, Prof. Ph.D.
9. Mitra Sanjit, Kumar, Prof. Ph.D.
10. Omanović, Saša, prof. Ph.D.
11. Palik, František, Prof. Ph.D.
12. Petrović, Bojan, Prof. Ph.D.
13. Podhradsky, Pavol, Prof. Ph.D.
14. Rajendrakumar, Anayath, Prof. Ph.D.
15. Raspor Peter, Prof. Ph.D.
16. Skov, Iva Ridjan, Assoc. Prof. Ph.D.
17. Soljačić, Marin, Prof. Ph.D.
18. Vranešić, Zvonko George, Prof. Ph.D.
19. Zagorščak, Renato, Prof. Ph.D.

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

Supporting Members of the Academy as stated by May 2023¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

Like all non-profit organizations, the Croatian Academy of Engineering has exceptionally limited financial resources. Regular costs of the Secretariat, maintenance of the building, computer and communication systems, web sites, membership fees in CAETS and Euro-CASE, etc. are unfortunately inevitable. The Supporting Members of the Academy mostly ensure the existence of the Academy, since membership fees, help of the Ministry of Science, Education and Sports as well as of sponsors of individual events are not sufficient. Each Supporting Member, a legal entity or private donor, is especially appreciated and registered in the Academy Archives. The person authorized to represent the Supporting Members of the Academy or private donor has a right to participate in the activities of the Academy and receives regular information about news from the work of the Academy. All suggestions are welcome in hope and desire that they will improve the work of the Academy.

Supporting Member of the Academy may only be a legal entity. Decision about its admission is made by the Presidency of the Academy. Representative of the legal entity for cooperation with the Academy is appointed by the person authorized to represent the legal person, and the Academy may elect him/her as an Entrepreneur Member of the Academy.

Supporting Members of the Academy (admitted January 1993 – May 2023)

1. Aircash d.o.o., Zagreb, www.aircash.eu
2. ALTPRO d.o.o., Zagreb, www.altpro.hr

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

3. Arhitektonski fakultet, Zagreb, www.arhitekt.hr
4. CARNet – Hrvatska akademska i istraživačka mreža, www.carnet.hr
5. Centar za vozila Hrvatske d.o.o., www.cvh.hr
6. ENCRO d.o.o., Zagreb
7. Elektroprojekt d.d., Zagreb, www.elektroprojekt.hr
8. Energetski institut Hrvoje Požar, Zagreb, www.eihp.hr
9. Fakultet elektrotehnike i računarstva, Zagreb, www.fer.unizg.hr
10. Fakultet elektrotehnike, računarstva i informacijskih tehnologija, Osijek, www.ferit.unios.hr
11. Fakultet elektrotehnike, strojarstva i brodogradnje, Split, www.fesb.unist.hr
12. Fakultet kemijskog inženjerstva i tehnologije, Zagreb, www.fkit.unizg.hr
13. Fakultet organizacije i informatike, Varaždin, www.foi.unizg.hr
14. Fakultet prometnih znanosti, Zagreb, www.fpz.unizg.hr
15. Fakultet strojarstva i brodogradnje, Zagreb, www.fsb.unizg.hr
16. Fakultet šumarstva i drvne tehnologije, Zagreb, www.sumfak.unizg.hr
17. Geodetski fakultet, Zagreb, www.geof.unizg.hr
18. Građevinski fakultet, Osijek, www.gfos.unios.hr
19. Građevinski fakultet, Rijeka, www.gradri.uniri.hr
20. Fakultet građevinarstva, arhitekture i geodezije, Split, www.gradst.unist.hr
21. Građevinski fakultet, Zagreb, www.grad.unizg.hr
22. Grafički fakultet, Zagreb, www.grf.unizg.hr
23. Hrvatska elektroprivreda d.d., Zagreb, www.hep.hr
24. Hrvatska gospodarska komora, www.hgk.hr
25. Hrvatska komora inženjera građevinarstva, Zagreb, www.hkig.hr
26. Hrvatska komora inženjera strojarstva, Zagreb, www.hkis.hr
27. Hrvatske šume d.o.o., Zagreb, www.hrsume.hr
28. HYDROMAT d.o.o., www.hydromat.hr
29. INA d.d., Zagreb, www.ina.hr
30. InfoDom d.o.o., Zagreb, www.infodom.hr
31. JADROLINIJA, Rijeka, www.jadrolinija.hr
32. Kemijsko-tehnološki fakultet, Split, www.ktf.unist.hr
33. KONČAR – Elektroindustrija d.d., Zagreb, www.koncar.hr
34. KONČAR – Institut za elektrotehniku d.o.o. za istraživanje, razvoj i usluge, www.koncar-institut.hr
35. Metalurški fakultet, Sisak, www.simet.unizg.hr

36. MIPRO – Hrvatska udruga za informacijsku i komunikacijsku tehnologiju, elektroniku i mikroelektroniku, Rijeka, www.mipro.hr
37. Petrokemija d.d., Kutina, www.petrokemija.hr
38. Pomorski fakultet, Rijeka, www.pfri.uniri.hr
39. Prehrambeno-biotehnološki fakultet, Zagreb, www.pbf.unizg.hr
40. Prehrambeno-tehnološki fakultet, Osijek, www.ptfos.hr
41. Pučko otvoreno učilište Zagreb, www.pou.hr
42. Rudarsko-geološko-naftni fakultet, Zagreb, www.rgn.unizg.hr
43. SOLVIS d.o.o., www.solvis.hr
44. SRCE – Sveučilišni računski centar Sveučilišta u Zagrebu, Zagreb, www.srce.unizg.hr
45. Sveučilište Josipa Jurja Strossmayera u Osijeku, www.unios.hr
46. Sveučilište Jurja Dobrile u Puli, www.unipu.hr
47. Sveučilište Sjever, Varaždin, www.unin.hr
48. Sveučilište u Dubrovniku, www.unidu.hr
49. Sveučilište u Splitu, www.unist.hr
50. Sveučilište u Zagrebu, www.unizg.hr
51. Tehnički fakultet, Rijeka, www.riteh.hr
52. Tehnički muzej Nikola Tesla, Zagreb, www.tmnt.hr
53. Tehničko veleučilište u Zagrebu, www.tvz.hr
54. Tekstilno-tehnološki fakultet, Zagreb, www.ttf.unizg.hr
55. TEHNIX d.o.o., Donji Kraljevec, www.tehnix.hr
56. Tehnomont d.d., Pula, www.tehnomont.hr
57. Zagreb-Montaža-Gruppe, Düsseldorf, Njemačka, www.zagreb-montaza.hr
58. Zagrebačke otpadne vode d.o.o., Zagreb, www.zov-zagreb.hr
59. XELLIA d.o.o., Zagreb, www.xellia.com

More detailed information and facts about Supporting Members of the Academy can be found either on the Academy web page (www.hatz.hr) or at their respective web pages.

Deceased Members of the Croatian Academy of Engineering (1993 – 2023)¹

Tanja Miškić Rogić, univ. spec. oec
Adrijana Pavičić

On the occasion of the 30th anniversary of our Academy, with respect and gratitude we remember our members who died during this period and their contribution to the Academy, as well as the Croatian science and economy.

For certain deceased members we could not find certain data, although we did our best and searched our database and Archives, and therefore we apologize to the readers.

Ban, Siniša, Prof. Emeritus Ph.D.

Born: 1914

Died: 2007

Department of Bioprocess Engineering

Honorary Member of the Academy (admitted 2000)

Bjegović, Dubravka, Prof. Emerita Ph.D.

Born: 1945

Died: 2023

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 1994)

Bonefačić, Branko, Prof. Ph.D.

Born: 1923

Died: 1995

Department of Traffic and Transportation (admitted 1994)

¹ This article is an updated and amended version of the article of the same title, which was published in 2018 in the Jubilee Annual 2017-2018 of the Croatian Academy of Engineering, on the occasion of the 25th Anniversary of the Academy (1993-2018).

Bošnjak, Marijan, Prof. Ph.D.

Born: 1934

Died: 2020

Department of Chemical Engineering

Emeritus of the Academy (admitted 1994)

Božićević, Josip, Academician

Born: 1929

Died: 2021

Department of Traffic and Transportation

Emeritus of the Academy (admitted 1993)

Božićević, Juraj, Prof. Ph.D.

Born: 1935

Died: 2016

Department of Systems and Cybernetics

Emeritus of the Academy (admitted 1993)

Brić, Vladimir, Ph.D.

Born: 1949

Died: 2011

Department of Communication Systems

Associate of the Academy

Damjanić, Frano, Prof. Ph.D.

Born: 1944

Died: 1998

Department of Civil Engineering and Geodesy

Associate Member of the Academy (admitted 1994)

Domitrović, Hrvoje, Prof. Ph.D.

Born: 1959

Died: 2018

Department of Electrical Engineering and Electronics

Full Member of the Academy (admitted 2002)

Dujmović, Nenad, Prof. Ph.D.

Born: 1942

Died: 2013

Department of Transport

Member of the Academy (admitted 2009)

Duraković, Senadin, Prof. Ph.D.

Born: 1937

Died: 2017

Department of Bioprocess Engineering

Emeritus of the Academy

Dvornik, Josip, Prof. Emeritus Ph.D.

Born: 1938

Died: 2023

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 2000)

Džanić, Husein, Prof. Ph.D.

Born: 1933

Died: 1994

Department of Chemical Engineering

Full Member of the Academy (admitted 1993)

Feretić, Danilo, Prof. Emeritus Ph.D.

Born: 1930

Died: 2019

Department of Power Systems

Emeritus of Academy (admitted 1994)

Filajdić, Mirko, Prof. Ph.D.

Born: 1920

Died: 1998

Department of Bioprocess Engineering

Honorary Member of the Academy (admitted 1994)

Fleš, Dragutin, Prof. Emeritus Ph.D.

Born: 1921

Died: 2005

Honorary Member of the Academy (admitted 1998)

Fritz, Franjo, Prof. Ph.D.

Born: 1932

Died: 1996

Department of Civil Engineering and Mining

Associate Member of the Academy (admitted 1994)

Gamulin, Antun, Prof. Ph.D.

Born: 1931

Died: 1998

Department of Mechanical Engineering and Naval Architecture
Associate Member of the Academy (admitted 1994)**Glancer Šoljan, Margareta**, Prof. Ph.D.

Born: 1944

Died: 2008

Department of Bioprocess Engineering
Associate Member of the Academy (admitted 2000)**Haznadar, Zijad**, Prof. Emeritus Ph.D.

Born: 1935

Died: 2021

Department of Electrical Engineering and Electronics
Member Emeritus of the Academy (admitted 1993)**Hebel, Zdravko**, Prof. Ph.D.

Born: 1943

Died: 2017

Department of Electrical Engineering and Electronics
Member Emeritus of the Academy (admitted)**Hrs, Ivo**, Assist. Prof. Ph.D.

Born: 1937

Died: 1999

Department of Electrical Engineering and Electronics
Collaborating Member of the Academy (admitted 1994)**Janjanin, Simo**, Prof. Ph.D.

Born: 1933

Died: 2017

Department of Systems and Cybernetics
Emeritus of the Academy (admitted 1998)**Jerič, Viljem**, Prof. Ph.D.

Born: 1936

Died: 2015

Department of Communication Systems
Emeritus of the Academy (admitted 1994)

Johanides, Vera, Prof. Emerita Ph.D.

Born: 1917

Died: 2000

Department of Bioprocess Engineering

Honorary Member of the Academy (admitted 1994)

Karlović, Damir, Prof. Ph.D.

Born: 1938

Died: 2017

Department of Bioprocess Engineering

Emeritus of the Academy (admitted 2002)

Katović, Drago, Prof. Emeritus Ph.D.

Born: 1941

Died: 2020

Department of Textile Technologies

Emeritus of the Academy (admitted 1994)

Kirinčić, Josip, Prof. Ph.D.

Born: 1924

Died: 2019

Honorary Member of the Academy (admitted 1998)

Kniewald, Jasna, Prof. Ph.D.

Born: 1938

Died: 2018

Department of Bioprocess Engineering

Emeritus of the Academy (admitted 1994)

Kolombo, Marijan, Ph.D.

Born: 1925

Died: 2009

Member Amicus of the Academy (admitted 2002)

Konja, Gordana, Prof. Ph.D.

Born: 1944

Died: 1998

Department of Bioprocess Engineering

Associate Member of the Academy (admitted 1994)

Kordić, Zdenko, Prof. Ph.D.

Born: 1949

Died: 2004

Department of Mechanical Engineering and Naval Architecture
Associate Member of the Academy (admitted 1994)**Krajcar, Slavko**, Prof. Ph.D.

Born: 1951

Died: 2021

Department of Power Systems
Full Member of the Academy (admitted 1995)**Kos, Vesna**, Prof. Ph.D.

Born: 1930

Died: 2015

Department of Electrical Engineering and Electronics
Emeritus of the Academy**Kos, Zorko**, Prof. Ph.D.

Born: 1930

Died: 2018

Department of Civil Engineering and Geodesy
Emeritus of the Academy (admitted 1994)**Kostelić, Aurel**, Prof. Ph.D.

Born: 1933

Died: 1997

Department of Mechanical Engineering and Naval Architecture
Associate Member of the Academy (admitted 1994)**Kovačić, Davorin**, Prof. Ph.D.

Born: 1945

Died: 2019

Department of Civil Engineering and Geodesy
Associate Member of the Academy (admitted 2005)**Krpan, Mirko**, Prof. Emeritus Ph.D.

Born: 1924

Died: 2006

Department of Mechanical Engineering and Naval Architecture
Member Emeritus of the Academy (admitted 1993)

Ladanyi, Branko, Prof. Emeritus Ph.D.

Born: 1922

Died: 2022

Honorary Member of the Academy (admitted 2005)

Liščić, Božidar, Academician

Born: 1929

Died: 2020

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1998)

Lončarić, Rudolf, Prof. Ph.D.

Born: 1932

Died: 2020

Honorary Member of the Academy (admitted 1994)

Lopašić, Vatroslav, Prof. Ph.D.

Born: 1911

Died: 2003

Honorary Member of the Academy (admitted 1994)

Lovrić, Josip, Prof. Ph.D.

Born: 1928

Died: 2012

Department of Transport

Emeritus of the Academy (admitted 1993)

Lovrić, Paško, Prof. Ph.D.

Born: 1931

Died: 1997

Department of Civil Engineering and Geodesy

Full Member of the Academy (admitted 1994)

Lovrić, Tomislav, Prof. Emeritus Ph.D.

Born: 1925

Died: 2020

Department of Bioprocess Engineering

Emeritus of the Academy (admitted 1993)

Lukačević, Zvonimir, Prof. Ph.D.

Born: 1935

Died: 1998

Department of Mechanical Engineering and Naval Architecture

Associate Member of the Academy

Malbaša, Niko, Prof. Ph.D.

Born: 1948

Died: 2019

Department of Power Systems

Associate Member of the Academy

Maljković, Darko, Prof. Ph.D.

Born: 1935

Died: 2003

Department of Chemical Engineering

Full Member of the Academy (admitted 1993)

Marić, Vladimir, Prof. Ph.D.

Born: 1939

Died: 2009

Department of Bioprocess Engineering

Full Member of the Academy (admitted 1994)

Marković, Ivan, Prof. Ph.D.

Born:

Died: 2005

Department of Traffic and Transportation

Associate Member of the Academy (admitted 1993)

Mikula Miroslav, Prof. Ph.D.

Born: 1933

Died: 2023

Department of Transport

Emeritus of the Academy (admitted 2005)

Miliša, Ante, Prof. Ph.D.

Born: 1937

Died: 2006

Department of Electrical Engineering and Electronics

Collaborating Member of the Academy (admitted 1994)

Miloš, Ivan, Prof. Ph.D.

Born: 1948

Died: 2021

Department of Traffic

Full Member of the Academy (admitted 2009)

Mlinarić, Tomislav, Prof. Emeritus Ph.D.

Born: 1932

Died:

Department of Transport

Member Emeritus of the Academy (admitted 1993)

Muftić, Osman, Prof. Emeritus Ph.D.

Born: 1934

Died: 2010

Department of Systems and Cybernetics

Member Emeritus of the Academy (admitted 1993)

Muljević, Vladimir, Prof. Emeritus Ph.D.

Born: 1913

Died: 2007

Honorary Member of the Academy (admitted 1993)

Orešković, Vladimir, Prof. Ph.D.

Born: 1928

Died: 2016

Department of Textile Technologies

Member Emeritus of the Academy (admitted 1995)

Peran, Zdravko, Prof. Ph.D.

Born: 1955

Died: 2019

Department of Transport

Associate Member of the Academy (admitted 2013)

Pilić-Rabadan, Ljiljana, Prof. Ph.D.

Born: 1930

Died: 2017

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1994)

Plenković, Zlatko, Prof. Ph.D.

Born: 1917

Died: 2003

Honorary Member of the Academy (admitted 1994)

Podhorsky, Rikard, Prof. Ph.D.

Born: 1902

Died: 1994

Honorary Member of the Academy (admitted 1994)

Popović, Krešimir, Prof. Ph.D.

Born: 1940

Died: 2003

Department of Chemical Engineering and the Related Fields

Associate Member of the Academy (admitted 1994)

Prikrič, Boris, Prof. Ph.D.

Born: 1915

Died: 1995

Honorary Member of the Academy (admitted 1994)

Radić, Jure, Prof. Ph.D.

Born: 1953

Died: 2016

Department of Civil engineering and Geodesy

Member of the Academy (admitted 1993)

Richter, Branimir, Prof. Ph.D.

Born: 1920

Died: 2012

Honorary Member of the Academy (admitted 2001)

Rotim, Franko, Prof. Ph.D.

Born: 1939

Died: 2021

Department of Traffic

Emeritus of the Academy (admitted 1994)

Rožanić, Igor, Prof. Ph.D.

Born: 1927

Died: 2022

Honorary Member of the Academy (admitted)

Sertić, Vladimir, Prof. Ph.D.

Born: 1935

Died: 2002

Department of Chemical Engineering

Full Member of the Academy (admitted 1994)

Sever, Stanislav, Prof. Ph.D.

Born: 1935

Died: 2020

Department of Bioprocess Engineering

Emeritus of the Academy (admitted 1998)

Sladoljev, Želimir, Prof. Emeritus Ph.D.

Born: 1932

Died: 2012

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1993)

Smrkić, Zlatko, Prof. Ph.D.

Born: 1924

Died: 1995

Honorary Member of the Academy (admitted 1994)

Staniša, Branko, Prof. Ph.D.

Born: 1941

Died: 2013

Department of Power Systems

Emeritus of the Academy (admitted 1998)

Šantić, Ante, Prof. Emeritus Ph.D.

Born: 1928

Died: 2008

Department of Electrical Engineering and Electronics

Full Member of the Academy (admitted 1994)

Štefanko, Stjepan, Prof. Ph.D.

Born: 1944

Died: 2013

Department of Electrical Engineering and Electronics

Associate Member of the Academy (admitted 1994)

Štern, Ivica, Assoc. Prof. Ph.D.

Born: 1933

Died: 2021

Department of Chemical Engineering

Emeritus of the Academy (admitted 1994)

Štulhofer, Mladen, Ph.D.

Born: 1924

Died: 2010

Honorary Member of the Academy (admitted 2001)

Tonković, Stanko, Prof. Emeritus, Ph.D.

Born: 1942

Died: 2023

Department of Systems and Cybernetics Emeritus of the Academy (admitted 1994)

Topolnik, Dražen, Prof. Ph.D.

Born: 1927

Died: 2014

Department of Transport

Emeritus of the Academy (admitted 2001)

Valter, Zdravko, Prof. Ph.D.

Born: 1940

Died: 2016

Department of Electrical Engineering and Electronics

Emeritus of the Academy (admitted 1994)

Wolf, Radenko, Prof. Ph.D.

Born: 1919

Died: 1997

Honorary Member of the Academy (admitted 1994)

Zenter, Ervin, Prof. Ph.D.

Born: 1931

Died: 2014

Department of Communication Systems

Emeritus of the Academy (admitted 1998)

Zgaga, Zoran, Prof. Ph.D.

Born: 1956

Died: 2011

Department of Bioprocess Engineering

Associate of the Academy (admitted 2000)

Zovko-Cihlar, Zdenka, Prof. Emerita Ph.D.

Born: 1933

Died: 2023

Department of Communication Systems

Emerita of the Academy (admitted 2009)

Žanetić, Ratimir, Prof. Ph.D.

Born: 1939

Died: 2018

Department of Chemical Engineering

Emeritus of the Academy (admitted 1998)

Županović, Ivan, Prof. Ph.D.

Born: 1940

Died: 2017

Department of Transport

Emeritus of the Academy (admitted 2005)

Work Programme of the Governing Board of the Croatian Academy of Engineering for the Mandate Period 2022 to 2026

Prof. **Vedran Mornar**, Ph.D.¹

Prof. **Neven Duić**, Ph.D.²

Prof. **Bruno Zelić**, Ph.D.²

Prof. **Vladimir Mrša**, Ph.D.³

Prof. **Vladimir Andročec**, Ph.D.⁴

¹ president of the Croatian Academy of Engineering

² vice-presidents of the Croatian Academy of Engineering

³ secretary general of the Croatian Academy of Engineering

⁴ member of the Governing Board of the Croatian Academy of Engineering

Introduction

This year marks the 30th anniversary of Croatian Academy of Engineering. Established on January 19th, 1993 as a Non-Governmental, Independent, Non-Partisan and Non-Profit Organization, the Academy was granted the status of a Scientific Organization in 2009. In total, 14 departments include 81 full members, 91 associate members, 86 emeritus members, 19 international members, and 9 honorary members. These scientists are outstanding researchers and engineers who play a vital role in the development of Croatian society. There are also 9 entrepreneurial members and 64 supporting members, important economic enterprises and scientific and educational institutions.

The Academy has gained a strong social reputation because of the hard work of prior governing boards and five former presidents. It is, however, our opinion that there is ample scope for improvement. After decades of disregarding the significance of manufacturing and industry, we believe that the future of the Republic of Croatia cannot be solely dependent on tourism and trade. We are of the opinion that the only way to achieve betterment is to invest more in manufacturing and reindustrialization. Production and reindustrialization are essentially high-tech activities in which a product

is no longer produced. The COVID-19 pandemic, which has yet to end, highlighted the resilience of high-tech companies and demonstrated that they were able to sustain growth even during the most challenging economic times.

It is in this context that the importance of this academy becomes apparent. In the final analysis, politicians are the gatekeepers of society, among whom, regrettably, there are few engineers. We have had the chance to observe that politicians tend to think in terms of ‘populism’, often with the objective of obtaining a second term in office, disregarding initiatives or legislation that may not generate immediate electoral support but could lead to sustainable economic development and job creation in the long term. First and foremost, the Academy should be the voice of reason. Gradually but consistently, it should promote the idea that without manufacturing, it is irrational to expect prosperity in the short or long term, and that investing in innovation and science is essential for any manufacturing in the 21st century. This will not be a simple task, but it is essential to begin working on it as soon as possible.

Following this, we will outline the most significant initiatives that we would undertake in the upcoming mandate, initiatives that we deem to be fully in line with the Academy’s vision and mission, and we will quote them below without alteration from our site:

- to be a leading creative and multidisciplinary scientific organization of the scientists of engineering and technological professions
- to competently and actively contribute to the development of engineering sciences and the transfer of knowledge vital to the progress of Croatian economy and welfare of its people
- to advocate a safe and useful application of technology, protection of environment and people from its inappropriate use
- to promote professionalism and responsible behaviour with high ethical standards.

Creating a financial plan and sustainable development

Analysing financial indicators over the last 5 years

The stability of the Croatian Academy of Engineering in recent years has allowed the Academy to play its part in the scientific system of Republic of Croatia, and in particular all the planned activities of the work plan. The main financial indicators showed that the Academy’s total assets were between HRK 800,000 and HRK 1,000,000k, with a step up to HRK 1,200,000 in 2020. This was mainly due to an increase in revenue in the financial assets section due to payments from the *IRI project*

Development of Tehnix’s Plant for Bioreactor Composting of Biodegradable Municipal Waste, which was done through the Centre for development studies and projects. Non-financial assets have a fixed value and fluctuate around HRK 200,000.



Fig. 1. Main financial indicators of business results of the Academy over the last five years

The total revenue of the Academy rose in 2019 and 2020 as a result of the revenue generated from the above-mentioned project, while the total expenditure has remained relatively stable in recent years.

Figure 2 shows the main revenue items. It is evident that the Academy generates the majority of its revenue from membership dues and revenue from projects conducted through the Academy centres, while other sources contribute only marginally to the total revenue.

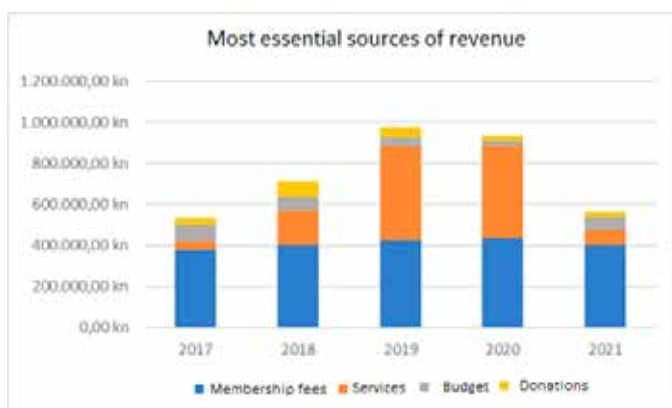


Fig. 2. The Academy’s most significant sources of revenue over the past five years.

The most significant components of the Academy's expenditure are outlined in Figure 3. It can be observed that the expenditure on the salaries of the Academy's staff is the most significant component, followed by the expenditure on services, which includes expenditure on the publication of magazines, printing, Academy awards, the maintenance of the Academy's website, and the provision of educational and other services.

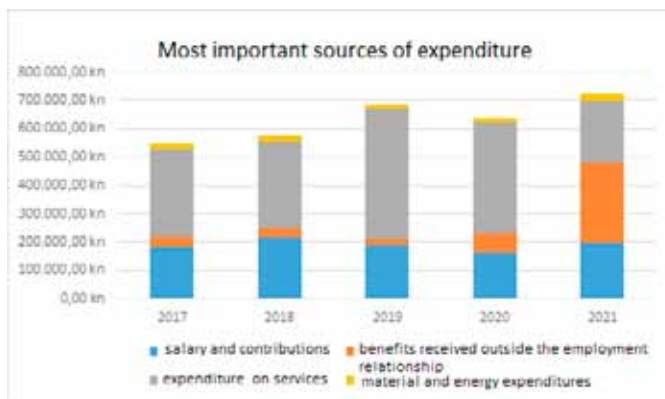


Fig. 3. The Academy's most important sources of expenditure over the last five years

Projection of the Academy's finances during the mandate of the new Governing Board

The revenue generated by the Academy's projects over the past five years was primarily attributed to the project *Development of Tehnix's Plant for Bioreactor Composting of Biodegradable Municipal Waste*, while the revenue from membership fees remained relatively stable. Since these two items are HATZ's primary revenue sources, the new governing board will be focused on growing the number of supporting members and thus the revenue from membership fees. The increase is expected to be between 5% and 10% per year, taking the total revenue from HRK membership fees from \$15.00 to \$30.00. The increased revenue can be attributed to the increased involvement of centres in the execution of projects, which will also be reflected in the work of the new Governing Board.

With the exception of expenditure on staff, the Academy's expenditure was constant and came from the Academy's activities, such as publication activities, honouring the most successful members and organising conferences. The functioning of the Academy's office may be rated favourably, therefore a major restructuring is not required. As a result, expenditure on employees will remain stable in the coming years. The

Academy's activities, both those that will continue under the mandate of the new Governing Board and those that are integral to the work plan, along with annual inflation, are projected to result in a smaller expenditure increase of 3% – 5% annually, which not only ensures stable business operations but also increases the Academy's overall financial assets.

Planned activities

Increasing the scientific and technical standing and reputation of the Academy in Croatia, and visibility of the Academy in the business world and key Croatian institutions

- Although the Academy is a national leader among entrepreneurs, scientists and engineers through the work of its committees, we think that these efforts should be more actively supported through social media, as it is one of the simplest ways to reach a wider audience of outside stakeholders as well as members. At the same time, more emphasis should be placed on making statements and taking an unambiguous position on current technical issues, such as the current (long-term) problems of supplying the market with gas from alternative sources, the price of oil derivatives, the price of food, supply chain interruptions, and so on.
- One of the primary objectives of the Academy should be to expand the visibility of the Engineering Power Bulletin, which will lead to higher awareness of the Academy. In addition to improving the working methods of the editorial board to ensure publication continuity, the focus for the following period should be on the integration of the bulletin into relevant databases, initially with DOAJ and subsequently with SCOPUS. One of the ways to make works more accessible to a broader audience is to consider the introduction of a Digital Object Identifier (DOI) for each work published.
- The members and associates of the Academy should be encouraged to continue working on the third and fourth volumes of the Technical Encyclopaedia in collaboration with the Miroslav Krleža Institute of Lexicography and Croatian Academy of Sciences and Arts. Members and associates should actively participate in the publication of the Technical Encyclopaedia, as it is the most significant publishing activity of the Academy, not only in terms of deadlines but also in terms of the quality of articles produced.
- The Statute of the Academy and other related documents that regulate the Academy's activities should be updated regularly in order to respond to alterations in existing regulations while also enhancing the legal basis for day-to-day activities.

- The Academy, as an institution that assembles the most prominent Croatian researchers in the areas of engineering and biotechnology, must play a significant role in the creation of national policy documents that are essential for the development of the engineering field and the economic and social progress of Croatia. This will make sure that when writing these papers, the outcomes and significance of the engineering field and STEM fields are not overlooked.
- The Academy should be more actively involved in the development of the national legislative framework that will govern the Academy's activities, and members of the Academy should be involved in public discussions when new laws are passed. At the same time, the Academy's standpoint as an institution should be laid out clearly.
- The Academy's 30th anniversary will get special attention, with a variety of events scheduled to mark the occasion, in addition to the major event, the Solemn Assembly. The solemn anniversary should undoubtedly be accompanied by a suitable theme, which will be covered in the Academy's Annual and conferences and round tables will be organized during which the role and importance of the Academy will be better known to scientists and entrepreneurs, whose field of activity is primarily focused on technical and biotechnological sciences. The central activity that will further advance the 30th anniversary of the Academy in the international context is certainly the organization of the CAETS Annual Conference 2023.
- In addition to the initiatives indicated above, collaboration with HAZU and other national academies should undoubtedly be continued. Along with already-existing initiatives like the Croatian Technical Encyclopaedia, on which a substantial number of Academy members are engaged, cooperation with Croatian Academy of Sciences and Arts should continue through new initiatives of a similar kind and the preparation of joint events. The coordination of the national academies, the Croatian Academy of Medical Sciences, the Croatian Academy of Legal Sciences, and the Croatian Academy of Forestry Sciences, as well as the work of the Council, which our Academy initiated, should be strengthened further, primarily for the purpose of resolving common status issues, but also through the implementation of various joint dissemination activities.

Increasing the Academy's international recognition and influence

- The Academy's impact and worldwide reputation will definitely grow as a result of continued and supported cooperation with regional technical academies through combined working sessions, events, or joint statements on

current technical profession concerns. In accordance with the strategy started and maintained by CAETS, special emphasis should be made to ongoing initiatives to investigate the feasibility of establishing academies of technical sciences in the nations of South Eastern Europe.

- The Academy's strength lies in its international membership. In addition to increasing the Academy's worldwide membership, a greater focus will be placed on their more active participation in Academy activities, such as writing articles in the Academy's bulletins or hosting (virtual) lectures and workshops.
- The strong involvement of the Academy in international organizations will undoubtedly continue, notably through Euro-CASE and CAETS, but also through bilateral collaborations with other academies. The Academy should encourage the integration of its eminent members in the international committees of Euro-CASE and CAETS, but also in the technical and scientific activities coordinated by the international partners of the Academy. Members of the Academy should actively engage in the creation of priority subjects that should be promoted and brought to the attention of the general public through their work in the Euro-CASE and CAETS committees. The main activity, which will further strengthen the role of the Academy in the international association, is mainly the organization of the already started CAETS 2023 annual conference.
- It is worth noting that the candidate for the Academy's Vice-President Position, Prof. Neven Duić Ph.D., was elected the Chairperson of the COATS 2023 Organising and Planning Committee. Organising the conference will help Academy get a better foothold in the world by connecting with others during the planning and execution of the conference.
- Academy members should be encouraged to participate in Euro-CASE and SAPEA working groups. Over the last two years, Academy members have engaged in two working groups to establish guidelines and recommendations, one for food production and agriculture and the other for higher engineering education.
- Participation in working groups strengthens, among other things, the Academy's reputation on the international scene.

Strengthening staff and mobilization of members

- The Academy could facilitate the mobilization of members by organizing meetings of the governing board and the presidency in regional university centres across the country, such as in Osijek (3), Rijeka (2), and Split (1).

Informal discussions with members revealed that they would like to get more involved, but that travelling to Zagreb was an obstacle for them. Therefore, the geographical distribution of the activities of the Academy related to the organization of round tables, workshops and conferences should be encouraged. More members should also be involved in the work of the Academy, for example by changing the terms and conditions for promotion from associate to member status, making an Academy-related activity a requirement for promotion (e.g., publication of a paper in the Annual or the Engineering Power Bulletin), or actively participating in the organization of an Academy-related round table or workshop on behalf of and in association with the Academy.

Increased cooperation with economists and engineers

- Scientists from business sector are highly motivated to become members of the Academy. Due to the nature of their work, they do not have much time to write scientific papers, however, we do not view significant accomplishments in industry as being of lesser value than journal articles. Their involvement in the Academy would make it more likely that they' will work together on projects, amongst other things. As a result, we would review the criteria for electing members to take greater account of key industry achievements.
- The membership fees of the supporting members make up a significant part of the Academy's revenue. Attracting additional supporting members will not only enhance funds for the Academy's normal operations but would also open up fresh possibilities for joint projects. It is also necessary to provide a model in which potential group members can see their interest, because without this it is unlikely that a company will make a significant contribution today.
- The Engineer's Day celebration is definitely an activity that should be continued in the future. This type of long-term partnership with Croatian Engineering Association will provide the Academy with access to a wider network of scientists, engineers, and Croatian Engineering Association members from the business world. This will enable the Academy to better inform the public about current developments in the technical field.

Strengthening the influence of the Academy on the engineering education process

- Because it is the basis of education in all engineering fields, the fundamental form of formal education of engineers within the study programs of higher education institutions should unquestionably be regularly supported. It is

important to note, however, that there are also other forms of informal and non-formal education to which the Academy can make an important contribution through its members. One of the ways the Academy can help with engineering education is by creating a Croatian technical dictionary. This should be done as a joint effort between the Academy and the other institutes, just like the Croatian technical encyclopaedia. This project will almost certainly be acknowledged by all engineering professions.

- Promoting the Croatian Qualification Framework as a fundamental link between labour market needs and higher education is one of the tools by which the Academy can further position itself between science and business. In doing so, the Academy can contribute to a stronger link between occupational standards, qualification standards and study programmes by conducting occupational surveys or developing proposals for key occupations, knowledge and skills whose core competences are recognised by the economy - a specific specialised occupation. Not only that, but also in the light of the recommendations of the European engineering umbrella organizations (e.g., FEANI) concerning the competences needed for the training of engineers in educational institutions, the Academy can have a significant impact on the organisation and content of the study programmes and, in the long run, help the higher education institutions to align the study programmes with Croatian Qualifications Framework. For example, positive experiences in adapting study programmes to the Croatian Qualifications Framework can be presented in one of the Academy's Annuals, and an overview of the positions of the European engineering umbrella organisations on engineering education can also be provided.

Strengthening the influence of the Academy as a cohesive factor between the institutions of the Croatian academic community and the stakeholders from the business community

- One of the Academy's strengths is its multi-disciplinary membership. This allows us to keep going with activities that involve members and associates of the Academy working on projects with businesses that are funded by European funds and where the Academy supports activities through its centres. The successful implementation of such initiatives ensures the smooth financial functioning of the Academy and is the most important source of income along with membership fees. Efforts to implement these measures must therefore be intensified. As previously mentioned, collaboration initiatives with the business sector should continue to be pursued through the Academy's planned Technology Transfer Centre whose work should be given special emphasis and special attention in the upcoming period.

Conclusion

By focusing our efforts on the aforementioned challenges and continuing to work on the Academy's ongoing activities, we can not only sustain but significantly enhance its public perception. This Academy must above all be a factor of cohesion between the institutions from which our members come and a powerful promoter of technology transfer between Croatian science and the Croatian and world economy.

Finally, the translation of the name of our Academy into English is Croatian Academy of Engineering. In the neighbouring country there is the Slovenian Academy of Engineering. We are a member of the International Council of Academies of Engineering and Technological Sciences and the European Council of Applied Sciences and Engineering. We do not underestimate the importance of science; on the contrary, we will continue to support basic research; however, we believe that science should primarily serve technology and technology should serve the economy, that we should be the engineers mentioned by Theodore von Kármán, not only describing what exists but also creating what never existed.

Part II - Caets Energy Report 2022

Chapter 0. To set the scene¹

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1. Context, scope and methodology of the report

The reports of the Intergovernmental Panel on Climate Change (IPCC) issued during the 2021-2022 period show that it is becoming ever more urgent to act in order to contain climate change and other related global issues. Despite the COP26 conference, numerous announcements from governments, trillions of investments in efficiency and renewable sources, the major greenhouse gases (GHGs), especially CO₂, CH₄, N₂O, and SF₆, keep increasing as shown in Fig. 0.1. (in this figure, data for 2020 is only available for fossil CO₂ and Land Use, Land Use Change and Forestry (LULUCF), but not for Fluorinated Gases (F-gases), CH₄ or N₂O). The result is that in 2019, the annual average concentration of CO₂ in the atmosphere reach 410 ppm, compared to 280 before the industrial age (See IPCC - Climate change 2021 - The physical science basis - Summary for policymakers).

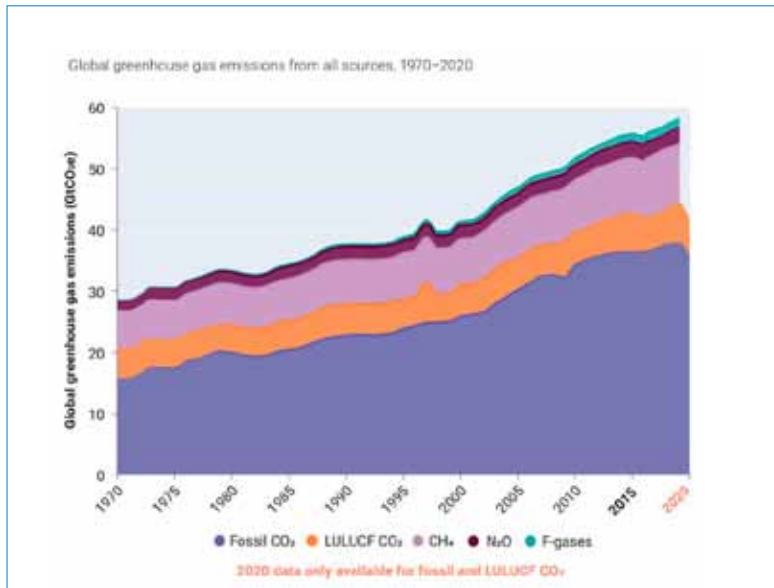


Fig. 0.1. Global GHG emissions from all sources

Source: Emissions Gap Report 2021: The Heat Is On, page XVII
<https://www.unep.org/resources/emissions-gap-report-2021>

The CAETS¹ are committed to addressing these highly complex and systemic issues, to which technology is only one of the key elements, although an essential one. This is why we have endeavoured to write this report. The reader will see that many of the technologies that can mitigate present global climate change are already available and affordable, or could be made so, and may be deployed immediately as soon as the political, economic, and societal contexts are sufficiently aligned and stable.

For this reason, our report is focused on the time period 2020-2040 to illustrate what may be possible right now.

However, some considerations in our report extend to beyond 2040 and some even extrapolate beyond existing technologies since the development and implementation of new technologies will open new possibilities to help the world meet the net-zero goals. Continuous support and funding for Research and Development (R&D) are thus critical.

The Council of Academies of Engineering and Technological Sciences (CAETS) provides its more than 30 worldwide Member Academies and their individual Fellows with the opportunity to enrich their approaches

¹ <https://www.newcaets.org/>

beyond their respective national contexts. CAETS enables comparing solutions, sharing best practices and making suggestions to the respective public authorities of the Member Academies. The Academies do not lobby for any specific technology or special interest but aim to make recommendations based on evidence rather than self-interest, ideology, or philosophical motivations. The composition of the Academies and the diversity of their Members, some coming from the Industry, some other from the academic world or other sectors, help us elaborate evidence-based reports, which is of utmost importance for policy-makers, industrial leaders, and the general public in an area where ‘wishful thinking’ and ‘fake news’ are often present.

In its past reports², the CAETS Energy committee first analysed aspects of energy generation (2018), then the integration of intermittent sources (2020). As the other side of the energy equation: how is it used, had not been addressed so far, this topic has been chosen for this 2022 report.

Many international reports produce ‘scenarios’ or present ‘roadmaps’³ to net-zero GHG emissions by 2030, 2050 or 2060, for example, one reference being the well-known 2021 Net-Zero IEA Roadmap . International sectorial associations are also describing how their respective sector will reduce GHG emissions. At the national level, in particular in connection with the Paris Agreement, many countries have also presented national ‘roadmaps’.

We have chosen to highlight some of the most GHG-intensive sectors of the global economy in this report and to explore feasible approaches to GHG emissions reduction. Our report is not strictly limited to the technical dimensions of the issue since other dimensions as well as holistic approaches are required to move on from discussing to acting.

We have opted to focus on sectors that are energy and capital intensive, with presently high GHG emissions, and for which the diversity of member Academies is an asset to provide relevant answers, comments and recommendations.

We did not include some important sectors in this study, as we had to choose those in which our limited resources could be put to the best use. Therefore, we decided not to consider the sectors of transport, aluminium and paper. Along these lines, the chapters included in this report are the following:

- Chapter 0.* To set the scene
- Chapter 1.* Food and agriculture
- Chapter 2.* Buildings and Smart Cities
- Chapter 3.* Oil and gas industry
- Chapter 4.* Chemical industry
- Chapter 5.* Cement industry
- Chapter 6.* Iron and Steel industry
- Chapter 7.* Information and Communications Technologies
- Chapter 8.* Conclusions
- Annexes* Country analysis questionnaires

² <https://www.newcaets.org/statements-reports/caets-reports>

³ <https://www.iea.org>

Fig. 0.2. below shows the 2019 GHG emissions produced by the major sectors, in particular by the sectors covered in this report (McKinsey Sustainability Insights 2021).

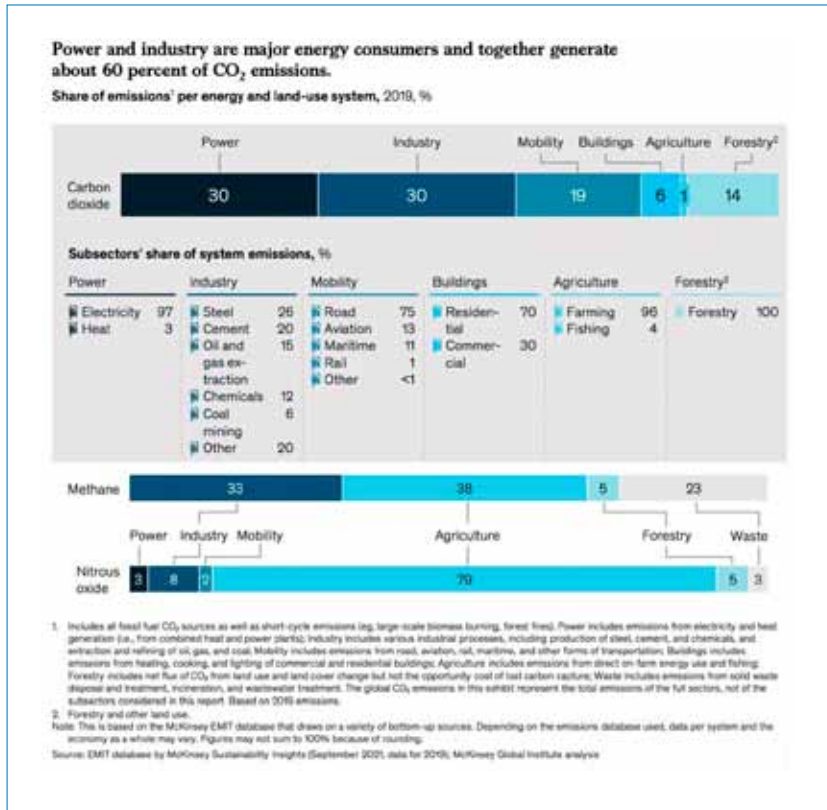


Fig. 0.2. Percentage of CO₂ emissions by sector, 2019

Exhibit from "The net-zero transition. What it would cost, what it could bring", January 2022, McKinsey & Company, www.mckinsey.com.

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<https://www.mckinsey.com/-/media/mckinsey/business%20functions/sustainability/our%20insights/the%20net%20zero%20transition%20what%20it%20would%20cost%20what%20it%20could%20bring/the-net-zero-transition-what-it-would-cost-and-what-it-could-bring-final.pdf>

The report is organised as indicated below.

- This introductory chapter (*Chapter 0.*) is focused on the increasing role of electricity and provides common comments concerning most sectors to facilitate decisions and actions by policy-makers, industrial and academic leaders.
- Each of the seven chapters in this report describes one sector. The chapters are not exhaustive monographs on their subject. They do not examine the potential for growth or contraction of their sector. Their focus is on scope 1 and scope 2⁴, as defined in the studies on Climate Change⁵. They highlight the main elements on the potential pathways to reduce GHG emissions as seen by the Members of our Committee, using *currently available* technologies and existing ‘low-hanging fruit’ for ‘non-regret’ strategies, some lessons learned or case studies and, where appropriate, potentially disruptive technologies.
- Finally, *Chapter 8.* draws conclusions and summarises our key findings.
- The annexes contain country specific data on energy use, GHG emissions, information on decarbonisation strategies, and further elements for some selected sectors.

How was this report prepared?

After the validation of a scoping paper and a working process suggested by the Committee Chairman, the CAETS Member Academies were invited to propose participants to the Committee and to its Working Groups. The list of the more than 60 authors from 20 countries is given at the end of the report.

The working process was organised along the following two parallel lines.

1. Seven Working Groups, generally led by two co-chairs from different continents, were organised and responsible for the drafting of one chapter each. Sometimes they have invited external experts (the list of these experts can be found at the end of the report). The Working Groups also presented the progress of their work in seminars organised by the Energy Committee.
2. In total, the chairman organised such Energy Committee Seminars from February 2021 to June 2022, where transversal issues were presented, proposals by the Working Groups discussed and suggestions for achieving further progress made. All members of the Working Groups were invited to the seminars, held in two-hour sessions, twice a day (morning and afternoon, Central European Time) to facilitate the participation of members in different time zones, on two consecutive days.

A complete version of each chapter was produced by the end of May 2022 and then sent to internal reviewers (members from one Working Group (WG) reviewing the chapter of another WG) and external reviewers (list at the end). The reviewers’ comments and suggestions were discussed and taken into account by the WGs from 20 June to 10 July 2022, under the leadership of the WG’s Co-chairs, before validation by the participants. The revised version of the whole text was sent for editing to ensure as much consistency as possible for a text written by many hands! The text was then sent to the Academies for endorsement.

The process was supported by NATF’s team lead by the Committee Chairman Pr. Yves Bamberger (Academician) supported by Dr. Wolf Gehrisch and Dr. Gaël-Georges Moullec.

⁴ Scope 1, Scope 2, emissions: Emissions responsibility as defined by the GHG Protocol, a private sector initiative. ‘Scope 1’ indicates direct greenhouse gas (GHG) emissions that are from sources owned or controlled by the reporting entity. ‘Scope 2’ indicates indirect GHG emissions associated with the production of electricity, heat, or steam purchased by the reporting entity.

⁵ See for example: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-i.pdf and <https://ghgprotocol.org/standards>

2. The central role of low-carbon electrification

The focus of the report is the reduction, as soon as feasible, of GHG emissions from energy uses in the seven sectors it covers. This includes all types of energy uses in the sectors including: heating, cooling, manufacturing, processing, data handling, etc.

Today, fossil energy sources are largely used in industry and remain the main source for electricity generation: thus, *energy efficiency improvements*, i.e. the use of technologies that contribute to lowering energy/electricity consumption, directly reduce GHG emissions. When electricity has a low-carbon content, i.e. is quite entirely produced via renewable energy or nuclear power, increasing or decreasing its consumption will have less impact on CO₂ emissions. This is likely to happen at a different pace in each country.

What is low-carbon electricity?

The CO₂ content of electricity, also known as the CO₂ intensity of electricity, is usually characterised by the number of grams of CO₂ produced to obtain 1 kWh of electricity. See for example <https://www.iea.org/data-and-statistics/data-product/emissions-factors-2021>.

With electricity produced through hydropower, wind, solar or nuclear energy, CO₂ content is equal to zero if only emissions for operation are considered, and not the complete cycle for the plant and the fuel: (a) upstream (e.g., material acquisition and plant construction), (b) combustion (where applicable), (c) operation and maintenance, (d) plant decommissioning and fuel disposal/recycling. Taking these phases into consideration, CO₂ content is generally estimated to be between 10 gCO₂/kW and 50 gCO₂/kWh. See for example analysis by the US National Renewable Energy Laboratory (NREL) [<https://www.nrel.gov/analysis/life-cycle-assessment>].

According to IEA, <https://www.iea.org/data-and-statistics/data-product/emissions-factors-2021>, the average CO₂ content of electricity worldwide was:

- 950 gCO₂/kWh for coal, with plants below 900 gCO₂/kW and others at 1 100 gCO₂/kWh,
- 430 gCO₂/kWh for natural gas, with plants around 350 gCO₂/kW and others at 550 gCO₂/kWh.

Taking into account the complete cycle, some 10 g have to be added for natural gas plant, some 20 g for coal plants.

In this report, the term low-carbon energy implies emitting less than 50 gCO₂/kWh for electricity as well as for heat.

While energy efficiency is often among the ‘low-hanging fruit’, it does not lead to “zero emissions”. Comparing the decrease of GHG emissions resulting from the introduction of specific energy-efficient technology (with its associated cost) with other available solutions, such as replacing the energy vector (gas with electricity for example), reveals key variables for each outcome.

Four principal options, which may possibly be combined, are currently available to achieve as soon as practicable low GHG emissions:

1. When feasible, replace fossil sources by *directly* using low-carbon sources: direct use of solar energy to heat water for example;
2. If 1 is not feasible, replace fossil sources with low-carbon heat or low-carbon electricity (hydropower, solar and other renewable energy, or nuclear energy);
3. If 1 or 2 are not feasible, use low-carbon (‘green’) hydrogen (see *Annex to Chapter 0*, below, second section), which often means indirectly using (even more) electricity;
4. In hard-to-abate industries, emissions arise from the process itself (in the cement industry for example) and cannot be simply reduced by the use of low carbon electricity or hydrogen. If the process itself cannot be decarbonised, carbon capture and storage (CCS) may be the solution, if it is proven to be cost-effective and practical in a specific location.

Passing from one of the above options to the next usually entails increasing costs to avoid emissions: the 'low-hanging fruit' are often associated with electrification (option 2). They are consistent with the new uses or extensions of uses of electricity, while at the same time advancing the decarbonisation of electricity (which is not the subject of this report).

Even if the energy efficiency of equipment and systems improves, the increasing level of electrification of a growing number of activities, the improvement of the quality of life in poorer countries and regions, and further demographic growth in some parts of the world will generate an increased need for the production of electricity. Such production thus needs to be increasingly decarbonised to sustain the emissions reduction.

For these reasons, the IEA and most other international and national institutions increasingly foresee and promote a higher level of electrification in energy systems and, at the same time, an increase in electricity consumption⁶: at the global scale, the share of electricity in final energy consumption could increase from 19.3% in 2020 to 50% in 2050. As a result, electricity consumption would more than double, from 22 300 TWh in 2020 to around 50 000 TWh in 2050.

At the same time, the related CO₂ emissions from electricity production must decrease. Per kilowatt-hour, indeed, this has been achieved since 1990, as shows *Fig. 0.3*⁷ below, dropping from 533 gCO₂/kWh to 485 gCO₂/kWh. This decrease is, however, counterbalanced by an expansion in consumption, resulting in an increase in the total emissions from electricity production from 1990 to 2019.

The global decarbonisation of electricity must therefore proceed, as rapidly as possible especially through increasing the share of renewable and nuclear energy, as previously seen.

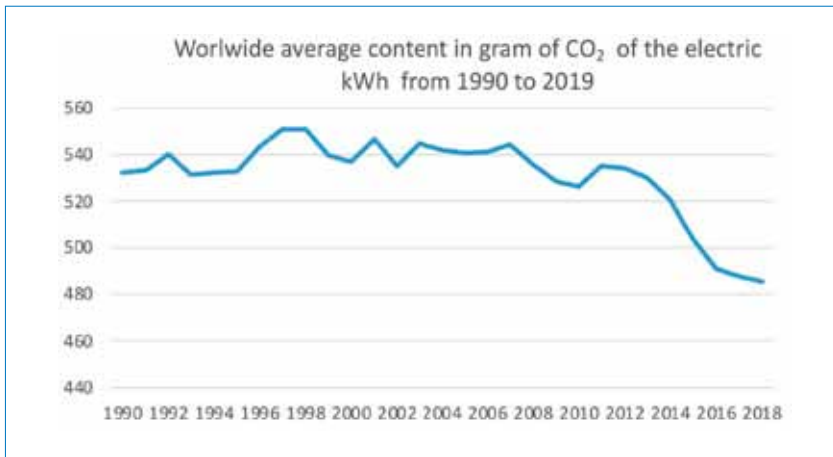


Fig. 0.3. Worldwide average CO₂ content of electricity 1990 to 2019 [CO₂/kWh]

Source: IEA. Reproduced with permission

<https://www.iea.org/data-and-statistics/data-product/emissions-factors-2021>

For the last two options above, technologies are available but still need incentives, such as new regulations imposing higher prices for CO₂ emissions, or new business models to be deployed extensively. The number of demonstration projects, pilot projects, and first industrial projects in different countries is increasing. Some of them are described in the chapters of the report.

⁶ The potential level of electrification sector by sector of the European countries has been studied in the extremOS project realised by a consortium of academic and industrial German partners: <https://extremos.ffe.de/>

⁷ See for reference: <https://www.iea.org/data-and-statistics/data-product/emissions-factors-2021>

3. Fifteen general comments

The following general comments apply to most, if not all, of the sectors studied in this report and generally to other sectors it does not cover. Some are more oriented on technical aspects, other more on regulatory or industrial policy choices. These comments are evidence-based, and while some may seem 'simple', many obstacles beyond technical aspects are still standing in the way of their implementation.

Unfortunately, it is not very difficult to find examples in many countries of feasible choices or solutions that do not seem to be implemented at a sufficient scale, or at all. There are nevertheless a large number of examples in which best practices and solutions have been properly taken into consideration and implemented. Some are listed below; others can be found in the various chapters and the annex of the report.

Low-carbon available technologies

The urgency of climate mitigation implies deploying as soon as practicable the best available and most cost-effective lower-carbon intensive technologies. Fortunately, a number of such technologies are already commercially available and at an affordable cost; moreover, many of them offer co-benefits such as reduced energy bills, improved comfort and health, improved industrial processes and/or increased demand flexibility. This is especially true for the first and second options listed above.

The heat pumps family

While the use of heat pumps is increasing worldwide, it is worth further promoting this family of technologies as it has an increasing range of applications, from residential and tertiary sectors to many industrial processes. Furthermore, the reuse of waste heat might have more applicability in the future. By "pumping" heat, heat pumps bring heat (or cold) where it is needed while using less electricity than would otherwise be needed to heat (cool) a space or equipment, and this by a factor which may be frequently higher than 3. Heat pumps are a key lever for reducing CO₂ emissions. They are described in the first section of the annex to this chapter.

Local adaptation of some technologies

Many existing technologies are available globally, but some have been developed and will be used in highly developed countries, also known as the 'Global North'. These technologies may require adaptation to different climates and local contexts. In some cases, further developments are needed. In particular, some equipment is climate sensitive. For example, air-air heat pumps and solar water heaters are sensitive to temperature and humidity.

Energy efficiency and the rebound effect

Energy efficiency is always useful: technologies that are improving equipment efficiency and system insulation save energy. So does adding a modern command-control into an industrial process or into a heating system at a home: replacing a thermomechanical thermostat with an electronic one reduces the energy consumption by 5% to 10%, as it avoids overheating. Command-control with a learning capacity, using AI, may be increasingly useful.

Frequently, these improvements rapidly pay for themselves and become profitable if the outdated equipment is replaced at the right time with a more efficient one, at the end of its life, for example.

Increased energy efficiency may improve the quality of life in a home, especially for the less affluent for whom energy costs tend to be a large portion of their disposable income. However, improvements in energy efficiency may often be subject to the well-known rebound effect (also known as the 'Jevons paradox') when consumption is no longer limited by cost. Higher efficiency may indeed lead to an increased, often wasteful, use of resources as their prices decrease and their availability increase. This trend may limit or cancel the expected reduction in energy consumption and emissions. This is often the case for heating at home: people now tend to maintain their homes at higher temperature than before the improvement of the equipment, to feel more comfortable. Other well-documented indirect rebound effects occur when the cost reduction due to an increase in efficiency lets the consumer spend more energy on other activities.

Life Cycle Assessment

Life Cycle Assessment (LCA, also known as Life Cycle Analysis) is useful for assessing not only the impact of a process, equipment or system, but also its proposed replacement by another process, equipment or system to produce a more effective and sustainable decrease in GHG emissions. The goal is not necessarily to obtain a highly precise LCA figure but to evaluate the externalities of an initial choice or of a potential replacement that could be useful for reducing GHG emissions. The different types of LCAs are presented in the third section of the annex of this chapter.

Recycling, circular economy and the reduction of GHG emissions

The development of long-life products, recycling and a circular economy generally leads to reductions in GHG emission, pollution, and use of materials. Recycling requires energy (both to recover what is to be recycled and for recycling itself). For some important materials such as steel and aluminium, the emissions produced by recycling are indeed lower than for the initial production, but this is not always the case. Recycling is not necessarily easy to organise, implement and finance, but it is often desirable.

Example: the recycling of steel

The recycling of steel generally requires less than one fourth of the energy needed for its production from iron ore; furthermore, recycling scrap uses mainly electricity, thus allowing less CO₂ emissions, if the electricity is produced from lower carbon intensive sources. This approach may be especially useful during the next 30 years or more until hydrogen reduction processes are available and applied on a large commercial scale. With increased recycling, the average energy use for 1 tonne of steel could be reduced by 30% to 40% and the average CO₂ emissions per tonne by about 70% (see *Chapter 6. on the Iron and Steel industry: Fig. 6.10. in Section 2.4., Footnote 15. in Section 2.3., Table 6.1. in Section 2.5.2.*).

Importance of holistic approaches

Holistic approaches are essential for an effective and affordable transition to a lower carbon intensive economy to be achieved because there are many interconnections between sectors, political choices, regulations and industrial developments or decline. This implies that public and local services should work across and between administrations and governmental agencies without forgetting interaction with industry. Collaborations are also needed at the national and international levels. It is important to specify the varying timing of the different transformations: roadmaps or planning based on solid and transparent simulations are the basic tools needed to gain acceptance and support. Many IPCC reports are examples of such a holistic approach.

Different impacts of ICT

The increasingly ubiquitous digitalisation of our world and daily lives is transforming the world's value chains, offering numerous possibilities for measures, analysis, optimisation, etc., which may contribute to reducing energy consumption and GHG emissions. On the other hand, information and communications technology (ICT) induces GHG emissions as it requires important amounts of energy in operation, principally in the form of electricity, and also other energy vectors in manufacturing. This report is principally devoted to the energy use on the operation side (see *Chapter 7.*).

Stability and predictability of regulatory changes

Public policies (regulations, mandates, incentives, etc.) usually concern many stakeholders (from citizens to industrial companies but also cities and national governments). To be accepted and sustainable in many countries, these policies need to be transparent, adequate and, if possible, stable. As far as possible, the evolutions of these policies and their rationale should be announced well in advance so that key stakeholders to adapt and to gain confidence and create acceptance of the general public. Setting a clear path for coming policy

changes, and making it known to the stakeholders, will help predicting with some certainty their evolution and acceptance.

Importance of metrics and data sources

It is necessary to choose the right metrics and reliable and reproducible data when selecting or defining objectives and monitoring the implementation of any GHG reduction programme. We recommend using metrics for emissions and final consumption rather than primary consumption, because reducing primary energy consumption and reducing emissions are not necessarily synonymous: replacing coal or gas with electricity may increase primary energy consumption and yet decrease CO₂ emissions: see for example *Chapter 6*. on the steel industry, and below.

Low primary energy and low CO₂ emissions are not necessarily synonymous

Let's suppose a country has the following electricity mix⁸:

50% renewables (hydro, solar, wind), 25% nuclear, 25% gas (with 50% efficiency, thus 400 gCO₂/kWh)

In that case, following the IAE coefficients (3 for nuclear), the ratio primary energy to final energy is given by $E_p / E_f = [(50\% \times 1) + (25\% \times 3) + (25\% / 0,5)] / 100\% = 1.75$

The CO₂ content of electricity is: 25% x 400 = 100 gCO₂/kWh.

Considering two identical houses with a yearly heating need of 4 MWh.

- One house is heated by a gas furnace of efficiency 100% (to simplify).
Its primary energy consumption is thus 4 MWh and its emissions are 400 kgCO₂.
- The other house is heated by a heat pump with a Seasonal Coefficient of Performance (SCOP) of 3.
Its primary energy consumption is 7 MWh (4 x 1.75) and its emissions are (4 MWh/3) x 100 kg/MWh = 133 kgCO₂.

With this electricity mix, it is thus better to take directly CO₂ emissions as indicators than to take the primary energy.

Impact of size on the transition in capital-intensive sectors

The urgent need to reduce GHG emissions and the externalities of the required changes call for an exploration of scale issues, such as the size of the facilities under consideration.

In most capital-intensive industries, generally heavy industries, facilities have become increasingly bigger due to the benefits of economy-of-scale, and more and more have been operating continuously with fewer shut-downs for repair and maintenance. These large complex facilities have been highly optimised to increase in efficiency and consequently profitability, which makes it all the more complicated to modify them. Many of these existing facilities have long remaining life spans, which decreases incentives for replacing them.

As a result, changing today's large facilities, in order to reduce GHG emissions or integrate with other processes, requires comprehensive planning, clear regulatory environments, and large investments: such changes indeed typically take several years to implement. If their production needs to be curtailed to modify the process, the whole local industrial ecosystem might suffer from it and so might numerous customers.

⁸ Producing 1 kWh by combustion of gas produces some 200 g of CO₂. We take into account the standard ratio from the International Energy Agency of primary energy over final energy for nuclear electricity (coefficient 3).

Benchmarking

Benchmarking, particularly in industry, is a way to promote dynamics for emission reductions: comparing for example how much kgCO₂/tonne of production different companies from the same sector emit may help these companies and public authorities pursue emission reduction goals.

Japanese benchmarking system for industries

To improve energy efficiency in industrial sectors, Japan introduced a benchmark system in 2009 combining regulation and incentives. 70% of industrial and commercial sectors are currently covered by this system. In each area, a simple and easy-to-understand measurable benchmark performance indicator is defined; a benchmark target level is then set, representing the best available technology, already achieved by 10% to 20% of top performers from that sector and also high-ranking in the international EU Emissions Trading System (EU ETS) for the year 2030. This target may be revised if a majority of companies have achieved it. The benchmarking system includes: (a) Inspections by the Ministry of Economy, Trade and Industry (METI) of businesses whose efforts in energy efficiency are unsatisfactory; and (b) Energy efficiency subsidies when a benchmark target is achieved (See: <https://iea.blob.core.windows.net/assets/2867cfa4-5184-4d4e-801b-c545de7e8900/2.Mr.MasanaEZAWA%2CMETI17-03BenchmarkingWorkshop.pdf>).

With this system, the government may compare energy intensities among companies and discern each industry's energy efficiency potential; conversely, each of the industries and companies can recognise its own energy efficiency potential. The whole process is based on a strong existing relationship between METI and Japanese industrial associations.

Synergies between uses and resiliency

Developing synergies can be an effective way to reduce energy needs and associated emissions. For example, waste heat from data centres may provide heat to office buildings or swimming pools, and waste heat from industrial sites may supply heat networks.

This coupling between systems is beneficial in normal operations and should be developed where possible. However, to avoid unacceptable disruptions or at least limit them, in case one of the systems fails, the resiliency of each system should be studied and adapted if necessary; if necessary, adapted backup systems may indeed have to be installed. More generally, resiliency at the strategic level as well as for everyday operation will be studied before the transformations for GHG emissions reduction are chosen.

RD&D

RD&D efforts are essential in all areas to provide new opportunities for the needed energy transition as well as to mitigate and adapt to the currently occurring climate change and all other resulting global changes.

RD&D efforts are not only required in the areas of technology, engineering, systems modelling and simulation but also in the complementary areas of humanities and social sciences - in particular but not only how technologies are perceived with their known and unknown benefits, advantages and disadvantages, and consequences. These key issues, however, mostly lie beyond the scope of this report.

Skills and competencies

All the members of the Committee and its Working Groups are convinced that training / professional development is a key issue: many jobs will disappear in the transition driven by GHG reductions while, others will change, and new ones are likely to appear. Therefore, some skills will no longer be needed while others will have to change/adapt, and new ones will be needed.

This issue concerns all educational systems in the world, starting from elementary school. It also involves updating skills and developing new ones during one's working life, in particular in engineering and technologies. This is a concern for large and small companies, and for society as a whole. A large effort is needed to rethink teachers'

training and provide more opportunities for lifelong learning both in educational institutions and in the internal training organisations of industrial and service companies.

Leadership, collaboration, networking and social issues

The urgency of the transformation that must be accomplished, the necessity for choices and agendas to be consistent with one another in different sectors, and the need for arbitration between multiple conflicting interests, call for effective leadership is and very high level in the different sectors. Collaboration and networking contribute to the development of confidence and sharing of best practices. Such is the role, for example, of city networks. Effective cooperation also lies in the different networks that link Academies in the world with one another, as CAETS does. Social issues are ubiquitous and essential but beyond the scope of this report, as already mentioned.

Annex

Three transversal levers for the transitions: heat pumps, hydrogen, LCA

Three different and important elements or tools may be applied to almost all sectors and are described below.

- Heat pumps form a family of systems mobilising local renewable heat from the air, the water or the ground. They are not yet as widely deployed as they could be.
- Hydrogen as an energy vector: the use of hydrogen and hydrogen-based molecules (synthetic fuels) may be regarded as a stimulating way to decarbonise several industrial processes that cannot be directly electrified.
- Life Cycle Assessment methods (LCA) help understand the global impact of processes and changes to such processes.

This annex briefly describes these three technologies, which are technical levers for the transition.

1. Heat pumps: a key technology family for the transition

In nature, heat flows from a warm body to a colder one. Heat pumps work the other way around: they transfer residual heat from cold places (making them even colder) to warm or warmer ones. Refrigerators and air-conditioning systems, well-known to many, are examples of common heat pumps.

- The refrigerator ‘pumps’ heat from the inside to keep it cool or cool it even more and expels it outside, generally in the kitchen, where the temperature is about 20 °C or more. It is thus at the same time slightly heating its environment.
- The air-conditioning system extracts heat from the inside of a house or any built structure, thus transferring it to the warmer area outside. At the same time it is thus also slightly heating the outside air.

Heat pumps, which are the reverse of air conditioning, are increasingly used for heating in northern countries in winter and reduce CO₂ emissions and lower energy consumption: in such a case, the heat pump extracts residual heat from the outside, where it is cold, transferring it to the inside, where it is already warmer. This application of heat pumps for heating is generally simply referred to as ‘heat pump’.

Heat pumps demystified

The heat pump operating principle is based on the three main ideas that rule the phase shift of a heat transfer fluid from liquid to gas and conversely.

1. To vaporise a liquid into gas, heat must be transferred to the liquid (as for example when water is boiled). Conversely, liquefying a gas releases heat.
2. The higher the pressure, the more heat is needed to vaporise a liquid since the generated gas has to overcome the external pressure. In other words, the temperature needed for the vaporisation of the liquid increases with the external pressure. Likewise, the liquefaction temperature of a gas thus increases with the pressure.
3. When you rapidly compress a gas, its temperature increases (as does for example the air in a bicycle pump).

The principle of the heat pump is to find a fluid that will, under certain pressure, vaporise at the outside temperature, and under higher pressure liquefy at the inside temperature, thus releasing heat inside: this requires low outside pressure (for vaporisation to capture heat) and high inside pressure (for liquefaction to release heat).

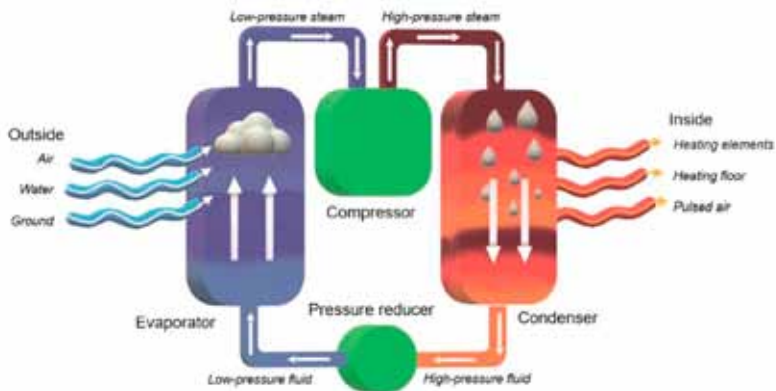


Fig. 0.4. Heat pump operating principle (© Püttgen-Bamberger) Reproduced with permission

A heat pump is thus composed of a fluid in a closed loop and:

- outside the home, a *low-pressure evaporator*, where the fluid arrives liquid and adsorbs the residual heat to vaporise;
- inside the home, a *compressor* ensuring the circulation and compression of the gas, where the temperature increases with increasing pressure;
- inside the home a *condenser*, where the gas releases heat;
- a *pressure reducer*, where the cooled gas returns to liquid before being pumped again to the outside evaporator to be vaporised again.

The key advantage of a heat pump is that it provides more heat than the energy consumed by the compressor. The ratio referred to as the Coefficient of Performance (COP) is regularly higher than 3. A COP equal to 3 means that the heat pump produces 3 kWh when only 1 kWh of electricity is consumed.

Gaining 2 kWh from the outside is generally considered as renewable energy even if a (very) little decrease of the outside temperature results from it. The COP depends on the inside and the outside temperature. It is higher when the temperature difference is lower. In addition, when the outside temperature decreases,

it becomes more difficult to recover heat and the COP decreases, which is clearly contrary to the desired output. This often imposes a limit to the temperature range in which heat pumps can work efficiently. This range is usually narrower than with direct heating.

Heat pumps are a broad family. They are characterised by the mediums from which the heat is extracted and to which it is provided. Heat pumps are referred to as air-air, air-water, etc., the first word designating the heat source, the second the medium where the heat is released. Some heat pumps are reversible and may be heating or cooling. Generally, one is more efficient than the other.

The heat transfer fluid, also known as the working fluid or coolant, is another important characteristic. Coolants themselves may be greenhouse gases which is a problem in the case of leakage. In an increasing number of countries, regulations impose coolants with low impact on climate change.

Heat pump ratings can range from a few kW to several MW. Their performance has been improving over the last 50 years, in particular for larger ranges of operation with higher COPs. They may be used for example:

- to heat or refresh apartments, houses, offices, and industrial processes
- to reuse waste heat from industrial processes by modifying their temperature
- to modify temperature from geothermal sources.

This short list suggests numerous potential applications for decarbonisation and reduction of energy consumption: comparing with a classical heating system using resistive heating, emission and consumption are divided by the COP value. If the COP is 3, then, compared to an efficient gas heating system emitting 200 gCO₂/kWh, the emissions from the heat pump system are lower, provided the electricity mix contains less than 600 gCO₂/kWh. This is the case in many regions since the average CO₂ content of 1 kWh in the world in 2019 was 485 g.

2. Hydrogen: a key vector to complete electricity

Hydrogen is a key chemical element in many industries such as petroleum refining and chemicals production. Currently, more than 95% of it is produced from fossil fuels, natural gas, petroleum and coal – by far the cheapest way to obtain it as will be detailed below. Hydrogen can yet also be produced from a wide range of energy sources and technologies, as highlighted in *Table 0.1*. The most commonly used colours to depict hydrogen are green, blue and gray, and also brown as in *Table 0.1*. below.

Hydrogen color spectrum	
Green: hydrogen produced by electrolysis of water, using electricity from renewable sources like hydropower, wind, and solar. Zero carbon emissions are produced.	Turquoise: hydrogen produced by the thermal splitting of methane. Instead of CO ₂ , solid carbon is produced.
Pink/purple/red: Hydrogen produced by electrolysis using nuclear power.	Black/gray: hydrogen extracted from natural gas using steam-methane reforming.
Yellow: hydrogen produced by electrolysis using grid electricity.	Blue: gray or brown hydrogen with its CO ₂ sequestered or repurposed.
White: hydrogen produced as a byproduct of industrial processes (i.e. fracking).	Brown: hydrogen extracted from fossil fuels, usually coal, using gasification.

Source: North American Council for Freight Efficiency, 2020.

Table 0.1. Hydrogen colour spectrum

Source: <https://nacfe.org/wp-content/uploads/2020/12/Hydrogen-Color-Spectrum-HiRes-2.png>

The cleanest versions, as it were, are 'green' and 'purple' hydrogen. Both are generated in relatively small quantities today by electrolysis, using electricity respectively from renewable energy sources and from nuclear energy.

The most common type of hydrogen is known as 'gray' hydrogen as its production releases significant amounts of greenhouse gases in the atmosphere. A cleaner proposed version is 'blue' hydrogen, which would still be produced from fossil sources but for which CO₂ emissions will be captured and geologically sequestered or reused, instead of being released into the atmosphere.

Gray hydrogen is mainly produced by the chemical conversion of methane at high temperatures. In some countries, significant amounts of hydrogen are produced from coal. The most common method of production is *Steam Methane Reforming* (SMR), where pure steam is used as the oxidant. Through endothermic (absorbing heat) reactions at 700-900 °C, methane and water are converted into hydrogen, carbon monoxide and carbon

dioxide ('synthesis gas').

Gray hydrogen can also be produced by one of the processes below.

- By the *Partial Oxidation (POX)* of methane or heavy hydrocarbons. The process takes place under high pressure and at high temperatures (up to 1 400 °C).
- By *Auto-Thermal Reforming (ATR)*, a combination of steam reforming and partial oxidation. The advantage of the auto-thermal reaction is that it is not dependent on external heat supply. However, ATR benefits are offset by increased investment and operating costs for the air separation unit and a more complicated flue gas purification process.

Table 0.2. below presents the CO₂ emissions associated with the production of gray hydrogen in the best-case scenario (D. Jakobsen & V. Åtland, 2016).

Process	CO ₂ Emission (tonne CO ₂ / tonne H ₂)
SMR	8.5
POX	8.6
ATR	8.2

Table 0.2. CO₂ emission from H₂ production with natural gas for SMR, POX and ATR

To address the high CO₂ emissions of hydrogen plants, carbon capture, utilisation, and storage (CCUS) has been proposed. Different methods are possible, including an up to 90% reduction for the ATR plant. CCUS, however, increases natural gas consumption and plant operating costs and requires significant capital investment, which translates into higher costs for the production of hydrogen.

Adding CCUS to SMR plants results, on average, in increases of 50% for CAPEX and 10%-20% for energy, with the exact amounts depending on the design. It also leads on average to a doubling of OPEX as a result of CO₂ transport and storage costs. CCUS cost indications are given in the literature.

In the case of natural gas, costs from SMR with CCUS are in the range of USD 1.4–2.6 /kgH₂, compared to USD 1.0- 1.9/kgH₂ without CCUS (IEA, 2019), (IRENA, 2019). For more information on the current development of CCUS, which is beyond the scope of this short note, the reader may visit the IEA's website or the global CCS Institute Website (<https://www.globalccsinstitute.com>).

Water electrolysis is an electrochemical process that breaks down water into hydrogen and oxygen gases under the influence of a direct electric current. A product allowing the current to pass through the water, the electrolyte, has to be added. The oldest electrolysis technology, alkaline electrolysis, is mature. Two other types are differentiated by the electrolyte material and operating temperature. The main technical and economic characteristics of the three types of electrolysis and their acronyms are summarised Table 0.3..

The efficiency of the electrolysis process is defined as ratio of the Higher Heating Value of hydrogen (HHV) to the input electricity used by electrolysis per kilogram of hydrogen produced (Detlef Stolten, 2010).

	Alkaline electrolysis cells (AEC)	Proton exchange membrane electrolysis cell (PEMC)	Solid oxide electrolysis cells (SOEC)
Electrolyte	KOH/NaOH (liquid)	Polymer (solid)	Ceramic (solid)
Operating Pressure (bar)	2-10	15-30	<30
Operating Temperature (°C)	60-90 (up to 200)	50-90	500-1000
Stack Lifetime (h)	<90,000	<40,000	<40,000
System Lifetime (year)	20-30	10-20	-
Efficiency (HHV)	62-82%	67-84%	~90%
Cold Startup (min)	>15	<10	>60
Annual Degradation (%)	2-4	2-4	17
Cost at 2019 (US\$/kW)	500–1400	800–1800	> 2800
Target Cost by 2050 (\$/kW)	~574	~700	~200

Table 0.3. Source: Electrolyser key features (Kai Zeng, 2010) (Mergel, 2013) (Bertuccioli, 2014) (IEA, 2016) (Uosaki, 2017) (M. Carmo, 2013), (IEA, 2019), (Nel, 2019) https://transitionenergetique.gouv.qc.ca/fileadmin/medias/pdf/expertises/Etude_hydrogene_Volet_B.pdf

As mentioned earlier, at present, the production cost of ‘green’ hydrogen is significantly higher than that of ‘gray’ hydrogen – up to 5 times or more. The magnitude of the cost differential depends on the cost of electricity at the point of production and the electrolysis technology used. The cost of electrolysers per kilo of produced hydrogen is decreasing, in particular through their increasing capacity: a 20 MW PEMC electrolyser producing 8.2 tonnes hydrogen a day is operated by Air Liquide since 2021.

Production parity cost between gray, blue and green hydrogen could be met in the present decade. The following figure from IRENA gives some projections concerning green hydrogen costs (see Fig. 0.5.).

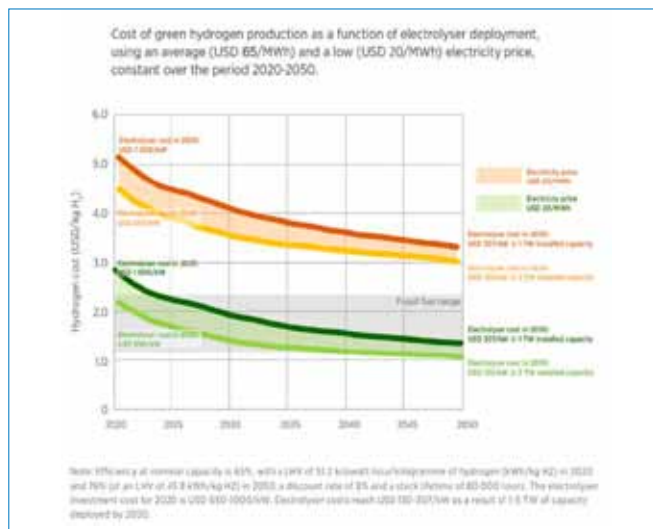


Fig. 0.5. Green hydrogen production costs projected by IRENA. © IRENA (2020), Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.5°C Climate Goal,

International Renewable Energy Agency, Abu Dhabi.

https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Dec/IRENA_Green_hydrogen_cost_2020.pdf

To complete this brief description on hydrogen production and cost, it is useful to compare the energy efficiency of electrolysis as a means to produce hydrogen with that of processes synthetically producing fuels,

respectively methane, diesel, methanol and ammonia, and combining electrolysis and supplementary chemical reactions (DNV 2019, Energy Transition Outlook (2020)). Such is the object of *Table 0.4.* below.

	Hydrogen	Synthetic methane (LNG)	Synthetic diesel	Synthetic methanol	Ammonia
Energy efficiency (%)					
Electrolysis	71	71	71	71	71
Power-to-gas process	-	75	-	-	87
Liquefaction	83	96	-	-	-
Power-to-liquid process	-	-	75	75	-
Overall efficiency	59	51	53	53	62

Table 0.4. Compared energy efficiency in per cent of different synthetically produced fuels

3. Life Cycle Assessment (LCA): a key methodology to analyse emissions

Life cycle assessment, or Life Cycle Analysis, both referred to as LCA, is an established method to model and quantify multiple input and output impacts on processes, products and services. The proper use of Life Cycle Assessments helps understand the effects of any change in a process, product, or technology. For example, it may be useful to assess whether any change to a process, such as trying to reduce its carbon intensity or the resulting GHG emissions, is effective and what its side effects may be. Indeed, well-intentioned actions to reduce the GHG emissions of a process or a product may often inadvertently produce the opposite effects.

LCAs are complex and are not perfect, and in many cases lead to different results. It is therefore critical for LCAs to be conducted using fully transparent assumptions and data sets, stating the accuracy of the inputs and estimating variabilities and uncertainties.

LCA is broadly defined by the ISO 14040:2006 standards⁹ as a “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.” ISO 14040, however, does not provide specific recommendations on methods or tools for conducting an LCA since there are a wide variety of methods for it.

The 4 basic phases of an LCA are described below.

1. The first phase of a typical LCA according to ISO 14040 is the goal and scope definition phase, which lays out the basis for the LCA. In this phase, the modeller specifies the goal for conducting the analysis and the intended use. Typical goals could be: to quantify GHG emissions for different product or process options; to guide R&D; or to define regulatory regimes.
2. Detailed life-cycle inventory (LCI) analysis forms the second phase of an LCA. This may include overall material and energy balances, and a compilation of all relevant and available data throughout a well-defined LCA system boundary.
3. LCA impact assessment (LCIA) is the third phase. Data gathered in the second phase is used to calculate impact results for the chosen parameters, for example, tonnes of CO₂ emitted per unit of product or process. However, much broader desired output parameters may and should be used, such as societal, health, climate, and various other environmental effects. Life-Cycle GHG emissions may be calculated for any pollutant, or as the sum of equivalents of GHG compounds such as water vapour, CO₂, methane, N₂O, etc. In many studies, these are combined and reported as global warming potential (GWP) in the form of CO₂-equivalents (CO₂e).
4. The fourth usual phase of an LCA is the interpretation phase. Results are then used for reporting, further analysis, or guidance for formulating regulations.

⁹ <https://www.iso.org/standard/37456.html>

The LCA process tends to be iterative, as the initial results often highlight uncertainties and the need for additional data or improved modelling tools.

The main LCA types are Attributional, Consequential and Societal, but hybrids or combinations are numerous and common.

Attributional and Consequential LCAs are typically quite different from one another in their formulation, usage and results. *Fig. 0.6.* below sketches their conceptual difference.

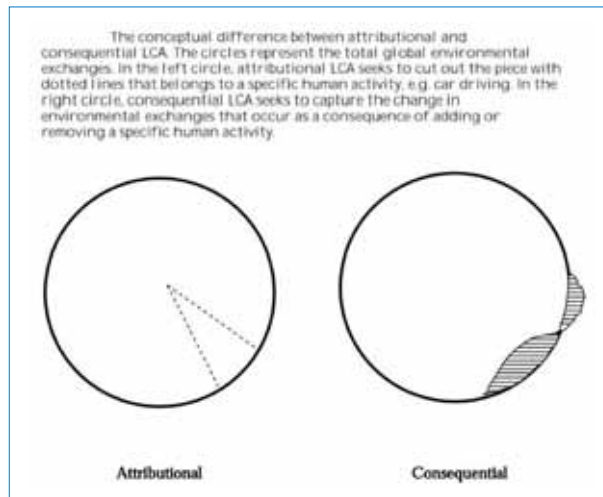


Fig. 0.6. The conceptual difference between Attributional and consequential LCAs (from Weidema BP. Market Information in Life Cycle Assessment. Environmental Project no. 863. Copenhagen: Danish Environmental Protection Agency; 2003. 147p. Page 15. <https://www2.mst.dk/Udgiv/publications/2003/87-7972-991-6/pdf/87-7972-992-4.pdf>)

A description of these differences may also be found in *Attributional vs. Consequential LCA Methodology Overview, Review and Recommendations with focus on Well-to-Tank and Well-to-Wheel Assessments*, a study commissioned by EUCAR to IFP Energies Nouvelles and Spheramodels¹⁰.

Regulators, indeed, use LCAs and, in doing so, aim at being comprehensive, using for example the ‘well-to-wheels’ approach. However, they do not capture all the rebound effects, unknowns, uncertainties or unintended consequences. Consequential LCA, also known as the CLCA model, is thus increasingly used to try to also take into account some of these indirect and follow-up effects. Still, this model is not really adapted for long-term prediction.

The IPCC uses the Integrated Assessment Model (IAM), or a version of LCA known as Societal-LCA, or S-LCA, which focuses on the demand side, impacts on societies and economies and climate change, and hence provides an insight into how real sustained reductions in energy use and GHG emissions may be achieved.

¹⁰ <https://www.eucar.be/wp-content/uploads/2020/08/20200820-EUCAR-Attributional-vs-Consequential-updated-2.pdf>

Part III - Who is Who

Who is Who in the Academy



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(2003), Faculty of Electrical Engineering and Computing,
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Radio Communications FWA, Mobile Communications



Agić Darko, Prof. Ph.D.

Born: 1947

Department of Graphical Engineering

Emeritus of the Academy (admitted 2004)

B.Sc. in Chemical Engineering (1972), M.Sc. in Chemical Engineering (1981), Faculty of Chemical Engineering and Technology, University of Zagreb, Ph.D. (2001), Faculty of Organization and Informatics, University of Zagreb University of Zagreb, Faculty of Graphic Arts, Getaldićeva 2, 10000 Zagreb

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Graphic Technology, Screening Systems, Reproduction of Picture Information and Color Management in the Area of Printing Science and Graphic Communication

Secretary of the Department of Graphical Engineering (2013-2017)

Deputy-Secretary of the Department of Graphical Engineering (2017-2022)



Alfirević, Ivo, Prof. Ph.D.

Born: 1939

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1993)

B.Sc. in Mechanical Engineering (1962), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, M.Sc. in Mechanical Engineering (1968), Illinois Institute of Technology in Chicago, Ph.D. in Mechanical Engineering (1972), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 5, 10000 Zagreb

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Continuum Mechanics, Mechanics of Solids, Orthotropic Materials, Experimental Stress Analysis, Structural Analysis, Orthotropic Structures

Secretary of the Department of Mechanical Engineering and Naval Architecture (1993-1997)

Vice-President of the Academy (1997-2001)

**Andrassy, Maja**, Prof. Ph.D.

Born: 1946

Department of Textile Technology

Emerita of the Academy (admitted 2007)

B.Sc. Textile Technology (1971), M.Sc. Textile Technology (1979), Ph.D. Textile Technology (1994), all from the Faculty of Textile Technology, University of Zagreb

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Textile Fibers, Textile Materials, Fiber Science, Recycling And Restoration Of Textile Materials

*Secretary of the Department of Textile Technology (2013-2014)**Deputy-Secretary of the Department of Textile Technology (2013)***Andročec, Vladimir**, Prof. Ph.D.

Born: 1946

Department of Systems and Cybernetics

Emeritus of the Academy (admitted 1994)

B.Sc. in Naval Architecture (1970), M.Sc. in Naval Architecture (1976), Ph.D. in Naval Architecture (1986), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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Fluid Mechanics, Hydraulics, Hydraulic Modeling, Hydraulic Engineering, Coastal Engineering, Environmental Studies

*Member of the Scientific Council (2010-2013)**President of the Academy (2013-2017) and (2017-2022)**Member of the Governing Board of the Academy (2022-2026)*



Androić, Boris, Prof. Ph.D.

Born: 1944

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 1998)

B.Sc. in Civil Engineering (1971), M.Sc. in Civil Engineering (1982), Ph.D. in Civil Engineering (1986), all from the Faculty of Civil Engineering, University of Zagreb

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Steel Structures, Reliability Engineering, Fatigue, Composite Structures, Durability of Bridges

Member of the Scientific Council (2010-2013)



Aničić, Dražen, Prof. Ph.D.

Born: 1940

Department of Civil Engineering and Geodesy

Emeritus of the Academy (co-founder, 1993)

B.Sc. in Civil Engineering (1963), University of Zagreb,

M.Sc. in Civil Engineering (1970), University of Skopje,

Ph.D. in Civil Engineering (1979), University of Zagreb

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Civil Engineering, Concrete and Masonry Structures, Earthquake Engineering, Experimental Methods, Earthquake Strengthening of Masonry Structures, Reconstruction of Historical Buildings, War Damage Assessment, Standardization and Technical Terminology

Secretary of the Department of Civil Engineering and Mining Engineering (1993-1997)

Vice-President of the Academy (1993-1997)

Secretary-General of the Academy (1997-2003)

Member of the Committee for Awards (2017-2022)



Anžek, Mario, Prof. Ph.D.

Born: 1945

Department of Transport

Emeritus of the Academy (admitted 2007)

B.Sc. in Electrical Engineering (1972), M.Sc. in Electrical Engineering (1985), Ph.D. in Electrical Engineering (1996), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Telematics Technology

Deputy-Secretary of the Department of Transport Systems (2013-2017) and (2017-2022)

Member of the Committee for Awards (2013-2017)

Deputy-Member of the Scientific Council (2022-2026)



Arbanas, Željko, Prof. Ph.D.

Born: 1959

Department of Civil Engineering and Geodesy

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B.Sc. (1982), Faculty of Civil Engineering, University of Rijeka, Ph.D. (2004), Faculty of Civil Engineering, University of Zagreb

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Deputy-Chairman of the Science Foundation Committee (2022-2026)



Auf-Franić, Hildegard, Prof. Emerita Ph.D.

Born: 1941

Department of Architecture and Urban Planning

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B.Sc. in Architecture (1965), M.Sc. in Architecture (1979), Ph.D. in Architecture (1989), all from the Faculty of Architecture, University of Zagreb

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Architecture, Buildings for Education

Member of the Scientific Council (2013-2017), (2017-2022) and (2022-2026)



Babić, Darko, Prof. Ph.D.

Born: 1948

Department of Graphical Engineering
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B.Sc. in Mechanical Engineering (1975), M.Sc. in
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Graphic Technology, Finishing Processes, Ergonomics,
Quality Control, Graphic Packaging Design and
Production, Book Design and Production

*Member of the Committee for Ethics (2013-2017) and
(2017-2022)*

*Deputy-Head of the Center for Graphical Engineering
(2017-2022)*

Deputy-Member of the Scientific Council (2017-2022)



Babić, Jurislav, Prof. Ph.D.

Born: 1978

Department of Bioprocess Engineering
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Food Technology, Food Safety

Deputy-Member of the Scientific Council (2022-2026)



Baletić, Bojan, Prof. Ph.D.

Born: 1957

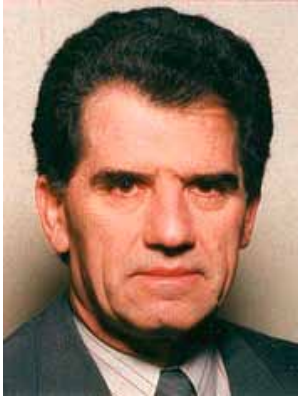
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Architecture and Urbanism, Computer Application in
Architecture, Housing Design, Solar Architecture

*Deputy-Secretary of the Department of Architecture and
Urban Planning (2017-2022) and (2022-2026)*

**Ban, Drago**, Prof. Ph.D.

Born: 1939

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Power Engineering, Electrical Machines and Drives, Development and Application of Electrical Machines and Drives, Education

**Barbir, Frano**, Prof. Emeritus Ph.D.

Born: 1954

Department of Power Systems

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B.Sc. in Mechanical Engineering (1978), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, M.Sc. in Chemical Engineering (1984), Faculty of Technology, University of Zagreb, Ph.D. in Mechanical Engineering (1992), University of Miami

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Fuel Cells, Hydrogen, Heat Transfer, Electrochemical Energy Conversion

Member of the Scientific Council (2022-2026)**Baotić, Mato**, Prof. Ph.D.

Born: 1973

Department of Systems and Cybernetics

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Advanced Control and Estimation Strategies, Model Predictive Control, Optimal Control, Mathematical Programming, Cyber-physical Systems


Baranović, Mirta, Prof. Ph.D.

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Department of Information Systems

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Big Data, Software Support for Business Processes, Semantic Data Integration Research Group – SEDATIN, Semantic Web


Barić Adrijan, Prof. Ph.D.

Born: 1958

Full Member of the Academy (admitted 2017)

Department of Electrical Engineering and Electronics

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Electromagnetic Compatibility, Integrated Circuit Design

Member of the Committee for International Co-operation (2022-2026)

Bedeković, Gordan, Prof. Ph.D.

Born: 1967

Department of Mining and Metallurgy

Full Member of the Academy (admitted 2009)

B.Sc. in Mining Engineering (1993), M.Sc. in Mining Engineering (1999), Ph.D. in Mining Engineering (2003), all from the Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb

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Mineral Processing, Environmental Protection in Mining, Solid Waste Recycling

Deputy-Secretary of the Department of Mining and Metallurgy (2017-2022)
Deputy-Chair of the Committee for Ethics (2017-2022)
Member of the Committee for Ethics (2013–2017), (2022-2026) and (2022-2026)

**Begušić, Dinko**, Prof. Ph.D.

Born: 1960

Department of Information Systems

Full Member of the Academy (admitted 2009)

B.Sc. (1983), Faculty of Electrical Engineering, Mechanical

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Information and Communication Technologies and
Systems, Signal Processing, Networking Technologies*Deputy-Secretary of the Department of Information
Systems (2016-2017) and (2017-2022)**Secretary of the Department of Information Systems
(2022-2026)***Beslać, Jovo**, Prof. Ph.D.

Born: 1935

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 2000)

B.Sc. Civil Engineering (-), M.Sc. Civil Engineering (-),

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Winter Concreting, Rapid Hardening of Concrete,

Durability of Concrete, High Quality of Concrete, Repair

of Concrete Structures, Properties of Concrete, Concrete

Technology, Realization of Concrete Structures


Biondić, Božidar, Prof. Emeritus Ph.D.

Born: 1940

Department of Civil Engineering and Geodesy
 Emeritus of the Academy (admitted 1994)
 B.Sc. Mining Engineering (1964), Faculty of Mining,
 Geology and Petroleum Engineering, University of
 Zagreb, M.Sc. Geology (1974), Ph.D. Geology (1982),
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 Hydrogeology and Engineering Geology, Karst Water
 Protection, New Potable Water Resources, Water
 Management, Engineering Geological Research for
 Infrastructural Objects

*Deputy-Member of the Scientific Council (2017-2022) and
 (2022-2026)*


Biondić, Ranko, Prof. Ph.D.

Born: 1967

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 Hydrogeology and Engineering Geology, Karst
 Hydrogeology, Water Resources Protection and
 Management, Karst Aquifers Protection, GIS


Bogdan, Stjepan, Prof. Ph.D.

Born: 1965

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 Associate of the Academy (admitted 2017)
 B.Sc. (1990), M.Sc. (1993), Ph.D. (1999), all from the
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 Autonomous Robotic Systems, Unmanned Aerial
 Vehicles, Discrete Event Systems

**Bogdan, Željko**, Prof. Ph.D.

Born: 1949

Department of Power Systems

Emeritus of the Academy (admitted 1998)

B.Sc. in Mechanical Engineering (1973), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, M.Sc. in Mechanical Engineering (1980), Tohoku University, Japan, Ph.D. in Mechanical Engineering (1987), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 5, 10000 Zagreb
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Mathematical Modeling, Simulation and Optimization of Thermo-hydraulic Processes in Power Equipment, Thermal Power Plants

Deputy-Secretary of the Department of Power Systems (2005-2009), (2009-2013) and (2013-2017)

**Bogunović, Nikola**, Prof. Ph.D.

Born: 1944

Department of Information Systems

Emeritus of the Academy (admitted 2002)

B.Sc. in Electrical Engineering (1967), M.Sc. in Electrical Engineering (1971), Ph.D. in Computing (1984) all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Formal Methods in the Design of Computing Systems, Semi-Automatic Knowledge Elicitation from Data and Signals with Application in Biomedical and Financial Domains

*Chairman of the Committee for Awards (2005-2009)
 Secretary of the Department of Information Systems (2005-2009)*


Bolanča, Stanislav, Prof. Emeritus Ph.D.

Born: 1946

Department of Graphical Engineering

Emeritus of the Academy (admitted 1998)

B.Sc. in Chemical Engineering (1971), M.Sc. in Chemical Engineering (1978), Ph.D. in Chemical Engineering (1981), all from the Faculty of Chemical Technology, University of Zagreb

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Secretary of the Department of Graphical Engineering (2009-2013)
Member of the Committee for Awards (2013-2017), (2017-2022) and (2022-2026)

Bolanča, Zdenka, Prof. Ph.D.

Born: 1945

Emerita of the Academy (admitted 1998)

Department of Graphical Engineering

B.Sc. in Chemistry (1970), M.Sc. in Chemistry (1972),

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Bolanča Mirković, Ivana, Prof. Ph.D.

Born: 1976

Associate of the Academy (admitted 2019)

B.Sc. (2002), Faculty of Science, University of Zagreb,

M.Sc. (2005), Faculty of Graphics Arts, University of

Zagreb, Ph.D. (2007), Faculty of Graphics Arts, University of Zagreb

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Sustainability and New Graphics Technologies,
Sustainable Graphic Design, Graphic Technology and
Recovery Procedures Including Recycling, Durability of
Graphic Materials and Products, Sustainable Formulations
of the Graphic Materials

*Deputy-Secretary of the Department of Graphical
Engineering (2022-2026)*



Bolf, Nenad, Prof. Ph.D.

Born: 1968

Department of Chemical Engineering

Associate of the Academy (admitted 2017)

B.Sc. (1996), M.Sc. (1999), Ph.D. (2003), all from
the Faculty of Chemical Engineering and Technology,
University of Zagreb

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Advanced Process Control, Process Modeling, Process
Measurement, Monitoring & Diagnostics, Applied
Artificial Intelligence



Bonefačić, Davor, Prof. Ph.D.

Born: 1968

Department of Communication Systems

Full Member of the Academy (admitted 2004)

B.Sc. in Electrical Engineering (1993), M.Sc. in Electrical
Engineering (1996), Ph.D. in Electrical Engineering
(2000), all from the Faculty of Electrical Engineering and
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Antennas, Microwaves, Wireless Communications,
Electromagnetic Compatibility (EMC), Electromagnetic
Interference (EMI), Radar systems

*Secretary of the Department of Communication Systems
(2013-2017) and (2017-2022)*

Member of the Committee for Awards (2022-2026)


Božanić, Rajka, Prof. Ph.D.

Born: 1968

 Department of Bioprocess Engineering
 Associate of the Academy (admitted 2020)
 B.Sc. (1991), M.Sc. (1996), and Ph.D. (2000), all from
 the Faculty of Food Technology and Biotechnology,
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 Milk and Dairy Products

Brkić, Vladislav, Assoc. Prof. Ph.D.

Born: 1967

 Department of Mining and Metallurgy
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 Production of Oil, Gas and Geothermal Energy,
 Environmental Protection in the Oil Industry

Brnić, Josip, Prof. Emeritus Ph.D.

Born: 1951

 Department of Mechanical Engineering and Naval
 Architecture

 Emeritus of the Academy (admitted 1994)
 B.Sc. Mechanical Engineering (1976), Faculty of
 Engineering, University of Rijeka, M.Sc. Mechanical
 Engineering (1983), Faculty of Mechanical Engineering,
 University of Ljubljana, Ph.D. Mechanical Engineering
 (1988), Faculty of Engineering, University of Rijeka
 University of Rijeka, Faculty of Engineering, Vukovarska
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 Strength of Materials, Elastomechanics, Plastomechanics,
 Viskoplasticity, Fracture Mechanics, Experimental
 Mechanics, Finite Element Method

Member of the Scientific Council (2017-2022) and (2022-2026)

**Burum, Nikša**, Prof. Ph.D.

Born: 1963

Department of Communication Systems

Associate of the Academy (admitted 2017)

B.Sc. in Electrical Engineering (1987), M.Sc. in Electrical Engineering (1999), Ph.D. in Electrical Engineering (2004), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Born: 1936

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B.Sc. in Mechanical Engineering (1961), M.Sc. in Mechanical Engineering (1971), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, M.Sc. in Mechanical Engineering (1973), Sever Institute, Washington University, St. Louis, USA, Ph.D.

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Mechanical Engineering, Technical Mechanics, Mechanical Vibrations, Strength of Materials, Mechanical Integrity of Machines, Machine Dynamics, Power Engineering

**Cerovac, Vesna**, Prof. Ph.D.

Born: 1942

Department of Transport

Emerita of the Academy (admitted 1993)

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Traffic, Civil Engineering, Traffic Technology and Safety

*Secretary of the Department of Transport Systems (2009-2013) and (2013-2017)*


Cifrek, Mario, Prof. Ph.D.

Born: 1964

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Sensors, Electronic Measurements and Instrumentation, Biomedical Engineering, Design and Manufacturing of Electronic Equipment, Biomedical Signal Measurement and Analysis

Deputy-Member of the Scientific Council (2013-2017)
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Čanadija, Marko, Prof. Ph.D.

Born: 1970

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Thermomechanics, Nanomechanics, Computational Mechanics, Machine Learning, Plasticity


Čaušević, Mehmed, Prof. Emeritus Ph.D.

Born: 1945

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Emeritus of the Academy (admitted 2000)

B.Sc. Civil Engineering (1969), M.Sc. Civil Engineering (1973), Faculty of Civil Engineering, University of Belgrade, Ph.D. Civil Engineering (1977), Imperial College of Science and Technology, University of London

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Earthquake Engineering, Steel Structures, Bridge Engineering, Engineering Mechanics, Design of Steel and Concrete Structures, Testing of Full-Scale Structures



Čavlina, Nikola, Prof. Ph.D.

Born: 1950

Department of Power Systems

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Nuclear Energy and Technology, Nuclear Reactor Safety, Environmental Impact Assessment

Secretary of the Department of Power Systems (2009-2013) and (2013-2017)

Chairman of the Committee for International Cooperation (2017-2022)

Deputy-Member of the Scientific Council (2022-2026)



Čišić, Dragan, Prof. Ph.D.

Born: 1955

Department of Transport

Full Member of the Academy (admitted 2005)

B.Sc. in Electrical Engineering (1977), M.Sc. in Electrical Engineering (1982), Faculty of Electrical Engineering and Computing, University of Zagreb, Ph.D. in Marine Engineering (1999), Faculty of Maritime Studies, University of Rijeka

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Logistics, Supply Chain Management, e-Business, e-Commerce, Digital Economy

Črnko, Josip, Prof. Ph.D.

Born: 1943

Department of Mining and Metallurgy

Emeritus of the Academy (admitted 2002)

B.Sc. in Metallurgy (1967), M.Sc. in Chemistry and Technology of Silicates (1973), Ph.D. in Metallurgy (1978) all from the Faculty of Technology, University of Zagreb

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Separation of Metals from Secondary Raw Materials, Thermotechnology, Industrial Furnaces, Mathematical Models of Cooling of Steel Semiproducts, Possibilities of Structural Improvements in Heating Furnaces



Deputy-Secretary of the Department of Mining and Metallurgy (2002-2005), (2005-2009) and (2013-2017)
Secretary of the Department of Mining and Metallurgy (2009-2013)

Čunko, Ružica, Prof. Ph.D.

Born: 1946

Department of Textile Technology

Emerita of the Academy (admitted 1998)

B.Sc. in Textile Technology (1970), M.Sc. in Textile Technology (1976), Ph.D. (1980) all from the Faculty of Chemical Technology, University of Zagreb, Department of Chemical Technology of Textiles

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Development of New Textile Materials and Methods of Objective Evaluating them, Man-made Fibres Processing and Modification, Textile Quality Assurance and Quality Management Systems in Textile Technology, Eco-friendly Textiles and Environmental Management Systems in Textile Technology



Member of the Scientific Council (2013-2017) and (2017-2022)

**Čosić, Kresimir**, Prof. Ph.D.

Born: 1949

Department of Systems and Cybernetics

Emeritus of the Academy (admitted 2005)

B.Sc. in Electrical Engineering (1973), M.Sc. in Electrical Engineering (1978), Ph.D. in Electrical Engineering (1984), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Interactive Simulation Systems, Applied Virtual Reality (VR), Defense and Security Research and Development

Member of the Committee for Awards (2016-2017) and (2017-2022)**Čurković, Lidija**, Prof. Ph.D.

Born: 1966

Department of Mechanical Engineering and Naval Architecture

Associate of the Academy (admitted 2017)

B.Sc. in Chemical Engineering and Technology (1990),

M.Sc. in Natural Sciences, scientific field Chemistry

(1995), Ph.D. in Natural Sciences, scientific field

Chemistry (1999), all from the University of Zagreb,

Faculty of Chemical Engineering and Technology

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Materials Science and Engineering, Nanotechnology, Advanced Synthesis Processes, Characterization of Materials

Chairman of the Committee for Ethics (2022-2026)



Dalbela Bašić, Bojana, Prof. Ph.D.

Born: 1958

Department of Information Systems

Full Member of the Academy (admitted 2012)

B.Sc. in Mathematics (1982), Faculty of Science,

University of Zagreb, M.Sc. in Computer Science (1993),

Faculty of Electrical Engineering and Computing,

University of Zagreb, Ph.D. in Computer Science (1997),

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dalbela-basic

Data Science, Machine Learning, Multivariate statistics,

Artificial Intelligence, Data and Text Mining, Natural

Language Processing


Damić, Vjekoslav, Prof. Emeritus Ph.D.

Born: 1941

Department of Systems and Cybernetics

Emeritus of the Academy (admitted 2004)

B.Sc. in Mechanical Engineering (1964), Faculty of

Mechanical Engineering, University of Sarajevo, Ph.D.

in Electrical Engineering (1985), Faculty of Electrical

Engineering, University of Sarajevo

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Mathematical and Computer Modeling and Simulations,

Bond Graph Modeling, Engineering Graph Modeling


Debrecin, Nenad, Prof. Ph.D.

Born: 1953

Department of Power Systems

Full Member of the Academy (admitted 1999)

B.Sc. in Electrical Engineering (1975), M.Sc. in Electrical

Engineering (1984), Ph.D. in Electrical Engineering

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Computing, University of Zagreb

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Heat Transfer, Nuclear Power Plants, Accident Analysis,

Nuclear Power Plant Simulation, System Thermal-

hydraulic Codes, Uncertainty Analysis

**Dobrilović, Mario, Prof. Ph.D.**

Born: 1972

Department of Mining and Metallurgy

Associate of the Academy (admitted 2019)

B.Sc. (1999), Ph.D. (2008)

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Petroleum Engineering, Pierottijeva 6, 10000 Zagreb

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Civil Blasting Technologies, Industrial Application
of Explosives, Environmental Influences of Blasting,
Demolition by Blasting, Underground Chambers and
Tunnel Excavation*Secretary of the Department of Mining and Metallurgy
(2022-2026)***Domazet, Željko, Prof. Ph.D.**

Born: 1954

Department of Mechanical Engineering and Naval
Architecture

Full Member of the Academy (admitted 1998)

B.Sc. in Mechanical Engineering (1978), M.Sc. in

Mechanical Engineering (1986), Ph.D. in Mechanical

Engineering (1993), all from the Faculty of Mechanical

Engineering and Naval Architecture, University of Zagreb

University of Split, Faculty of Electrical Engineering,

Mechanical Engineering and Naval Architecture, Ruđera

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e-mail: zeljko.domazet@fesb.hr; [http://www.fesb.](http://www.fesb.hr/~domazet)[hr/~domazet](http://www.fesb.hr/~domazet)Mechanical Engineering, Naval Architecture, Steel
Structures, Fatigue Strength of Materials, Fracture
Mechanics*Deputy-Secretary of the Department of Mechanical
Engineering and Naval Architecture of the Academy
(2013-2017)**Member of the Committee for Economic and Regional Co-
operation (2013-2017)**Secretary of the Department of Mechanical Engineering
and Naval Architecture of the Academy (2017-2022)**Member of the Committee for Awards (2022-2026)*

**Dragčević, Zvonko, Prof. Emeritus Ph.D.**

Born: 1946

Department of Textile Technology

Emeritus of the Academy (admitted 2007)

B.Sc. in Textile Technology (1971), M.Sc. in Textile Technology (1976), Ph.D. in Textile Technology (1981), all from the Faculty of Textile Technology, University of Zagreb

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Industrial Engineering, Ergonomics, Technical Textile, Corrosion and Protection of Materials

*Chairman of the Committee for Awards (2013-2017)**Member of the Committee for Awards (2017-2022)**Member of the Science Foundation Committee (2013-2017) and (2017-2022)*

**Dragović-Uzelac, Verica, Prof. Ph.D.**

Born: 1970

Department of Bioprocess Engineering

Associate of the Academy (admitted 2017)

B.Sc. in Biotechnology (1993), M.Sc. in Biotechnology (1998), Ph.D. in Biotechnology (1996), all from the Faculty of Food Technology and Biotechnology, University of Zagreb

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Food Technology, Novel Technique, Nutrition, Functional Food, Bioactive Molecules

Member of the Committee for Economic and Regional Cooperation (2022-2026)

**Duić, Neven**, Prof. Ph.D.

Born: 1965

Department of Power Systems

Full Member of the Academy (admitted 2002)

B.Sc. in Mechanical Engineering (1990), M.Sc. in Mechanical Engineering (1993), Ph.D. in Mechanical Engineering (1998), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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 Energy Policy and Planning, Climate Change Mitigation, Energy Economics, Sustainable Development Policy and Resource Planning, Research and Innovation Policy, Combustion Engineering and Modelling

*Member of the Scientific Council (2010-2013)**Member of the Committee for International Cooperation (2013-2017)**Secretary of the Department of Power Systems (2017-2022)**Vice-President of the Academy (2022-2026)***Dujmović, Darko**, Prof. Ph.D.

Born: 1954

Department of Civil Engineering and Geodesy

Full Member of the Academy (admitted 2009)

B.Sc. in Civil Engineering (1978), M.Sc. in Civil Engineering (1989), Ph.D. in Civil Engineering (1996) all from the Faculty of Civil Engineering, University of Zagreb

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**Đapo, Almin**, Assoc. Prof. Ph.D.

Born: 1974

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Deputy-Secretary of the Department of Civil Engineering and Geodesy (2022-2026)



Fajt, Siniša, Prof. Ph.D.

Born: 1963

Department of Electrical Engineering and Electronics

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B.Sc. in Electrical Engineering (1989), M.Sc. in Electrical Engineering (1994), Ph.D. in Electrical Engineering (2000), all from the Faculty of Electrical Engineering, University of Zagreb

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Acoustics, Electro Acoustics, Audio Techniques, Sound Broadcasting, Architectural Acoustics, Processing of Acoustical Signals in Communications

Deputy-Secretary of the Department of Electrical Engineering and Electronics (2013-2016)

Member of the Scientific Council (2017-2022)



Ferić, Miljenko, Prof. Emeritus Ph.D.

Born: 1936

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1998)

B.Sc. Mechanical Engineering (1962), Faculty of Engineering, University of Zagreb, Ph.D. in naval architecture (1989), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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Transport Machinery, Road Vehicles, Ship Hydrodynamics – Model Tests, Basin Experiments Ship Structure – Strength and Vibrations

**Fertalj, Kresimir**, Prof. Ph.D.

Born: 1964

Department of Information Systems

Full Member of the Academy (admitted 2007)

B.Sc. in Electrical Engineering (1988), M.Sc. in Computer Science (1993), Ph.D. in Computing (1997) all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Information Systems, Project Management, Software Engineering, Software Security

Secretary of the Department of Information Systems (2009-2013)**Filetin, Tomislav**, Prof. Emeritus Ph.D.

Born: 1949

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1994)

B.Sc. in Mechanical Engineering (1973), M.Sc. in Mechanical Engineering (1979), Ph.D. in Mechanical Engineering (1986), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb
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Selection of Materials, Heat Treatment of Metals, Recycling of Materials, Modeling of Materials Properties

*Vice-President of the Academy (2001-2005)**Head of the Centre for Lifelong Education (2005-2015)*

**Firšt Rogale, Snježana, Prof. Ph.D.**

Born: 1968

Department of Textile Technology

Full Member of the Academy (admitted 2017)

B.Sc. (1994), M.Sc. (2002), Ph.D. (2007), all from the

Faculty of Textile Technology, University of Zagreb

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e-mail: sfrogale@tff.unizg.hr; <https://www.tff.unizg.hr/en/teachers-and-associates/snjezana-first-rogale/17>Processes of Clothing Production, Intelligent Clothing,
Clothing Thermal Properties, High-tech Joining Methods
of Textile*Member of the Scientific Council (2022-2026)*

**Frančula, Nedjeljko, Prof. Emeritus Ph.D.**

Born: 1937

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 1998)

B.Sc. in Geodesy (1962), Faculty of Architecture, Civil
Engineeringand Geodesy, University of Zagreb, Ph.D. in Geodesy
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Landwirtschaftliche Fakultät, Bonn

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Geodesy, Cartography, Map Projections, Digital

Cartography, Geoinformatics, Cartographic

Generalization, Future of Geodesy and Surveying

**Franekić, Jasna, Prof. Ph.D.**

Born: 1945

Department of Bioprocess Engineering

Emerita of the Academy (admitted 1994)

B.Sc. in Biology (1969) Faculty of Science, University of Zagreb, M.D. (1982), School of Medicine, University of Zagreb, Ph.D. in Biology (1987), Faculty of Science, University of Zagreb

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Genetic Toxicology, Ecotoxicology, Genotoxicity
Action of Environmental Agents Antimutagenicity of
Glucosinolates*Secretary of the Department of Bioprocess Engineering
(2005-2009) and (2009-2013)**Member of the Committee for Awards (2013-2017)***Franković, Bernard, Prof. Ph.D.**

Born: 1946

Department of Power Systems

Emeritus of the Academy (admitted 1998)

B.Sc. in Mechanical Engineering (1971), Faculty of Mechanical Engineering Rijeka, University of Zagreb, M.Sc. in Mechanical Engineering (1978), Ph.D. in Technical Sciences (1990), both from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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Applied Thermodynamics, Heat Transfer: Heat Conduction, Heat Convection and Evaporation, Heat Radiation, Heat and mass Transfer, Heat Exchangers, Regenerations, Renewable Energy

*Deputy-Member of the Scientific Council (2013-2017) and
(2017-2022)*

**Frece, Jadranka, Prof. Ph.D.**

Born: 1974

Department of Bioprocess Engineering

Associate of the Academy (admitted 2017)

B.Sc. in Food technology, Biochemical Engineering (1997), M.Sc. in Biotechnical Sciences, Scientific field of Biotechnology (2003), Ph.D. in Biotechnical Sciences, Scientific field of Biotechnology (2007) all from the Faculty of Food Technology and Biotechnology, University of Zagreb

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Microbiology, Probiotics, Lactic Acid Bacteria, Bioconservation, Starter Cultures

**Galić, Irena, Prof. Ph.D.**

Born: 1974

Department of Communication Systems

Associate of the Academy (2017)

B.Sc. in Mathematics and Computer Science (1999), University of Osijek, M.Sc. in Computer Science (2004), University of Saarland, Ph.D. in Electrical Engineering (2011), University of Osijek

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Visual Computing, Computer Graphics, Image Compression, Partial Differential Equations, Variational Methods, Artificial Intelligence, Image Processing, Medical Image Analysis

Member of the Committee for International Co-operation (2022-2026)

**Galović, Antun**, Prof. Ph.D.

Born: 1950

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1998)

B.Sc. in Mechanical Engineering (1974), M.Sc. in Mechanical Engineering (1979), Ph.D. in Mechanical Engineering (1985), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 5, 10000 Zagreb tel: +385 1 6168255, fax: +385 1 6156940

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Technical Thermodynamics, Temperature Fields in Solids, Heat Exchange in Fluidized Beds, Exergy and Entropy Analysis in Thermo Processes Irreversibilities

Deputy-Secretary of the Department of Mechanical Engineering and Naval Architecture (2017-2022)**Gaurina-Medimurec, Nediljka**, Prof. Ph.D.

Born: 1957

Department of Mining and Metallurgy

Full Member of the Academy (admitted 2002)

B.Sc. in Petroleum Engineering (1980), Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, M.Sc. in Petroleum Engineering (1986) from Faculty of Mining and Geology, University of Belgrade, Ph.D in Petroleum Engineering (1993), Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, 10000 Zagreb tel: +385 1 5535825, fax: +385 1 4836074

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Drilling Technology, Drilling Fluids, Well Cementing, Workover and

Completion Fluids, Environment Protection in Petroleum Engineering, Waste Management in Petroleum Engineering

*Member of the Scientific Council of the Academy (2013-2017) and (2022-2026)**Secretary-General of the Academy (2017-2018)*

**Glasnović, Antun**, Prof. Ph.D.

Born: 1948

Department of Chemical Engineering

Emeritus of the Academy (admitted 2009)

B.Sc. in Chemical Engineering (1972), M.Sc. in Chemical Engineering (1974), Ph.D. in Chemical Engineering (1980), all from the Faculty of Chemical Engineering and Technology, University of Zagreb

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Separation Processes; Characterization of System, Design and Operation of Separation and Contacting Processes (Comminution, Filtration, Drying, Crystallization, Mixing), Newton and Nonnewton Fluid Dynamic, Suspension, Rheology

*Secretary of the Department of Chemical Engineering (2013-2017)**Deputy-Member of the Scientific Council (2017-2022) and (2022-2026)***Goić, Ranko**, Prof. Ph.D.

Born:

Department of Power Systems

Associate of the Academy (admitted 2021)

B.Sc. (1992), Ph.D. (2002), all from the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split

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**Gold, Hrvoje, Prof. Ph.D.**

Born: 1951

Department of Transport

Full Member of the Academy (admitted 2015)

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Intelligent Transportation Systems, Transport Optimization, Remote Sensing

Secretary of the Department of Transport (2017-2022) and (2022-2026)

**Gomzi, Zoran, Prof. Emeritus Ph.D.**

Born: 1940

Department of Chemical Engineering

Emeritus of the Academy (admitted 1993)

B.Sc. in Chemical Engineering (1963), Ph.D. in Chemical Engineering (1975), all from the Faculty of Chemical Engineering and Technology, University of Zagreb University of Zagreb, Faculty of Chemical Engineering and Technology, Marulićev trg 19, 10000 Zagreb
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Chemical Engineering, Chemical Reaction Engineering, Kinetics and modeling, Process Design and Development, Mathematical Modeling, Education

Secretary of the Department of Chemical Engineering and the Related Fields (2000-2003)

Member of the Scientific Council (2010-2013) and (2013-2017)

**Grancarić, Ana Marija, Prof. Emerita Ph.D.**

Born: 1943

Department of Textile Technology

Emerita of the Academy (admitted 1998)

B.Sc. (1967), M.Sc. (1974) and Ph.D. (1979), all from the Faculty of Textile Technology, University of Zagreb University of Zagreb, Faculty of Textile Technology, Prilaz baruna Filipovića 28a, 10000 Zagreb
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Member of the Committee for International Co-operation (2013-2017) and (2017-2022)

**Granić, Goran**, Assist. Prof. Ph.D.

Born: 1950

Department of Power Systems

Emeritus of the Academy (admitted 1998)

B.Sc. in Electrical Engineering (1972), M.Sc. in Electrical Engineering (1976), Ph.D. in Electrical Engineering (1979) all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Electrical Engineering, Strategic Energy Planning, Energy Legislation,

Power System Planning and Scheduling, Energy Sector Organization and Management, Energy Supply Costs and Energy Pricing Policy

*Chairman of the Committee for Development and Regional Relations (2005-2009)**Secretary-General of the Academy (2005-2009) and (2009-2013)**Member of the Science Foundation Committee (2013-2017)*

**Grbac, Ivica**, Prof. Emeritus Ph.D.

Born: 1955

Department of Bioprocess Engineering

Full Member of the Academy (admitted 2004)

B.Sc. Forestry (1978), M.Sc. Forestry (1985), Ph.D. Forestry (1988), all from the Faculty of Forestry, University of Zagreb

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Furniture and Medicine Design, Construction and Quality of Wood Products, Interdisciplinary Research, Forestry, Wood Industry

Member of the Committee for Ethics (2013-2017) and (2017-2022)

**Grbavac, Vitomir**, Prof. Ph.D.

Born: 1954

Department of Transport

Full Member of the Academy (admitted 2004)

B. Sc. (1980), Faculty of Organization and Informatics, University of Zagreb, B.Sc. law (1984), Faculty of Law, Zagreb, Ph.D Law (1986), Faculty of Law, University of Zagreb

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Information and Communication Systems in Traffic, Information Systems, Evolution of Information Technology, Development Computer Systems, e-Education in Traffic

**Grgić, Davor**, Prof. Ph.D.

Born: 1959

Department of Power Systems

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B.Sc. in Electrical Engineering (1981), M.Sc. in Electrical Engineering (1989), Ph.D. in Electrical Engineering (2001), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Nuclear Power Plants

*Member of the Scientific Council (2017-2022)**Member of the Committee for Ethics (2022-2026)***Grgić, Mislav**, Prof. Ph.D.

Born: 1973

Department of Communication Systems

Full Member of the Academy (admitted 2004)

B.Sc. in Electrical Engineering (1997), M.Sc. in Electrical Engineering (1998), Ph.D. in Electrical Engineering (2000), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Image and Video Compression, Digital Mammography, Face Recognition

Member of the Committee for International Co-operation (2009-2013)



Grgić, Sonja, Prof. Ph.D.

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Department of Communication Systems

Full Member of the Academy (admitted 1998)

B.Sc. in Electrical Engineering (1989), M.Sc. in Electrical Engineering (1992), Ph.D. in Electrical Engineering (1996), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Digital Image and Video Processing, Picture Quality Assessment, Digital Television

Secretary of the Department of Communication Systems (2009-2013)

Member of the Committee for Awards (2013-2017) and (2017-2022)

Deputy-Member of the Scientific Council (2017-2022) and (2022-2026)



Guzović, Zvonimir, Prof. Ph.D.

Born: 1958

Department of Power Systems

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B.Sc. in Mechanical Engineering (1982), M.Sc. in Mechanical Engineering (1988), Ph.D. in Mechanical Engineering (1998), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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Aerodynamics, Thermodynamics and Heat transfer in Steam and Gas Turbines; Small Hydro, Geothermal and Wind Power Plants

Deputy-Chairman of the Committee for International Cooperation (2022-2026)

Deputy-Secretary of the Department of Power Systems (2022-2026)



Herceg, Zoran, Prof. Ph.D.

Born: 1969

Department of Bioprocess Engineering

Full Member of the Academy (admitted 2013)

B.Sc. in Biotechnical Sciences (1994), M.Sc. (1997),
Ph.D. in Food Technology (2000), all from the Faculty
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Food Engineering, Innovative Technique of Food
Processing

Head of Biotechnical Center (2017-2022)

*Member of the Program Committee of the Center for
Technological Development (2022-2026)*



Hnatko, Emil, Prof. Ph.D.

Born: 1941

Department of Transport

Emeritus of the Academy (admitted 2004)

B.Sc. in Mechanical Engineering (1966), Faculty of
Mechanical Engineering, University of Belgrade, M.Sc.
in Mechanical Engineering (1973), Faculty of Mechanical
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Zagreb, Ph.D. in Mechanical Engineering (1982), Faculty
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Engines and Vehicles, Thermodynamics and Construction,
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Deputy-Member of the Scientific Council (2013-2017)

Member of the Committee for Ethics (2017-2022)


Hocenski, Željko, Prof. Ph.D.

Born: 1952

Department of Systems and Cybernetics

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B.Sc. in Electrical Engineering (1976), M.Sc. in Electrical Engineering (1984), Ph.D. in Electrical Engineering (1996), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Computer Design, Diagnostics, Reliability, Fault Tolerance, Automation, Process Control, Image Processing


Horvat, Predrag, Prof. Ph.D.

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Bioprocess Engineering, Industrial Biotechnology


Hraste, Marin, Academician

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Chemical Engineering, Unit Operation Transport

Phenomena, Engineering of Particulate Systems: Particle Systems and Use of their Description to Predict Behavior in a Given Geometrical Shape

Secretary of the Department of Chemical Engineering of the Academy (1993-1997)

**Hruškar, Mirjana, Prof. Ph.D.**

Born: 1966

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B.Sc. (1991), M.Sc. in Biotechnical Sciences (1997),

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Food Safety, Food Quality, Food Analysis, Sensory

Analysis, Quality Management

**Ilić, Ivan, Prof. Emeritus Ph.D.**

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Department of Electrical Engineering and Electronics

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Electrical Engineering, Electrical Machines, Drive

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B.Sc. in Wood technology (1991), M.Sc. Scientific Area of Biotechnical Sciences, Scientific Field of Wood Technology (1996), Ph.D. Scientific Area of Biotechnical Sciences, Scientific Field of Forestry (2000), all from the Faculty of Forestry, University of Zagreb

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Wooden Composite Materials

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Chemical Engineering, Petrochemistry, Polymer Materials, Petrochemical Processes and Products, Polymerization Processes, High Performance Polymeric Materials, Rheological Modifiers

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Born: 1947

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B.Sc. Mechanical Engineering (1971), M.Sc. Mechanical Engineering (1980), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Ph.D.

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Mechanical Engineering Design, Operational Strength, Gear Design, Damage Tolerant Design, Reliability, Fatigue Life Prediction, Mean Stress Influence on Fatigue Assessment, Fatigue Assessment at Combined HCF/LCF Loadin

Jerbić, Bojan, Academician

Born: 1957

Department of Systems and Cybernetics

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B.Sc. Mechanical Engineering (1983), M.Sc. Mechanical Engineering (1987), Ph.D. Mechanical Engineering (1993), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb
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Robotics, Artificial Intelligence, Computer Methods in Designing and Programming of Automatic Systems

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Deputy-Secretary of the Department of Systems and Cybernetics (2017-2022)

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Ježek, Damir, Prof. Ph.D.

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Heat Exchanger, Fluidization, Extrusion, Texture Analysis, Ultrasound, High Hydrostatic Pressure

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**Jirouš-Rajković, Vlatka, Prof. Ph.D.**

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Wood Finishing, Wood Surface Modifications, Durability of the Coating-wood System

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Born: 1982

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Innovative Green Extraction Techniques, Medicinal Herbs, Isolation of Bioactive Compounds, Food Industry Byproducts, Process Optimization

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Wearable and Adaptive Antennas and Circuits, Biomedical Applications of Electromagnetics, Urban Models of Wireless Power Transfer, IoT



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**Jugović, Alen**, Prof. Ph.D.

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Seaborne Passenger Traffic**Jukić, Ante**, Prof. Ph.D.

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Polymer Materials, Energy and Fuels*Deputy-chairman of the Council of the Centers (2017-2022)**Deputy Head of the Center for Environmental Protection**and Development of Sustainable Technologies (2017-2022)***Jukić, Tihomir**, Prof. Emeritus Ph.D.

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Urbanism, Environmental Planning

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Regional and Landscape Planning, Urban and Landscape Design

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Operational Research, Mathematical Modelling, Data Modelling, Software for Linear Programming and Related Fields, Production Planning Software, Business Process Reengineering, Information Systems, Natural Language Processing


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Biomechanics, Aneurysm, Aorta, Numerical Modeling, the Finite Elements


Kasum, Josip, Prof. Ph.D.

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B.Sc. in Maritime Traffic Engineering (1989), Faculty for Maritime and Traffic Studies, University of Rijeka, M.Sc. in Technical sciences, field of technology of traffic and transport (1997) Faculty of Maritime Studies University of Rijeka, Ph.D. in Technical Sciences, field of technology of traffic and transport, maritime and river traffic (2002), Faculty of Maritime Studies University of Rijeka

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Hydrography, Reambulation, Maritime Safety, Maritime Forensic, Electronic Navigation


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Theoretic and Applied Electrical Engineering, R/D in Power and Instrument Transformers as Products, Power and Instrument Transformers in Interaction with Networks, Development of Power and Instrument Transformers for Voltages up to 400 kV

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Information Science, Intelligent Systems, Data Science, Multimedia Systems, Complex Systems, Information Technology in Tourism

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**Knezić, Željko**, Assoc. Prof. Ph.D.

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Member of the Committee for Economic and Regional Cooperation (2022-2026)



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BioChemical Engineering, Cell Culture Technology, Endocrine Secretion and Regulation, Science Policy, Intellectual Property Protection

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Electric Power Systems, Electric Power Networks, Distribution Networks, Liberalization of Energy Markets, Power Engineering


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Probiotic, Antibiotic, Enzyme and Functional Starter Culture Technologies, Microbial Ecology

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Member of the Scientific Council (2022-2026)**Kovačević, Meho Saša**, Prof. Ph.D.

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Geotechnical Investigation Works, Geotechnical Monitoring, Risks in Underground Engineering, Geothermal Energy

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**Kovačević Zelić, Biljana**, Prof. Ph.D.

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Fluid Mechanics, Environmental and Structural Aerodynamics

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**Kralik, Gordana, Prof. Emerita Ph.D.**

Born: 1943

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B.Sc. in Agriculture (1965), M.Sc. in Agriculture (1974), Faculty of Agriculture, University of Belgrade, Ph.D. in Chemical Engineering (1976), Faculty of Technology, University of Zagreb and Ph.D. in Agronomy (1985), Faculty of Agriculture, University of Osijek

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Biotechnical Sciences, Zootechnics, Animal Products, Functional Food

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Mechanism and Kinetics of Crystallization and Precipitation of Slightly Soluble Salts, Industrial Crystallization, Precipitation in Natural and Technology Waste Waters, Biomineralization

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Machine Elements, Engineering Design, Engineering Terminology

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B.Sc. (1994), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Ph.D. (2000), Universität Hannover, Institut für Baumechanik und Numerische Mechanik

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Experimental Mechanics, Numerical Mechanics, Non Destructive Testing, Infrared Thermography

Secretary of the Department of Mechanical Engineering and Naval Architecture (2022-2026)**Krumes, Dragomir**, Prof. Ph.D.

Born: 1945

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 2000)

B.Sc. in Mechanical Engineering (1970), M.Sc. in Mechanical Engineering (1977), Ph.D. in Mechanical Engineering (1985), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb
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Materials in Mechanical Engineering, Heat Treatment Materials, New Materials and Technologies, Heat Treatment and Surface Engineering, Thermomdiffusion in Heat Treatment, Tribology

**Kujundžić, Trpimir, Prof. Ph.D.**

Born: 1964

Department of Mining and Metallurgy

Full Member of the Academy (admitted 2009)

B.Sc. in Mining Engineering (1989), M.Sc. in Mining Engineering (1997), Ph.D. in Mining Engineering (2002), all from the Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb

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Rock Mechanics, Mechanical Rock Comminution, Quarrying of Dimension Stone

*Member of the Committee for Awards (2013-2017) and (2017-2022)**Deputy-Chairman of the Committee for Awards (2022-2026)*

**Kurajica, Stanislav, Prof. Ph.D.**

Born: 1965

Department of Chemical Engineering

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Materials, Nanotechnology, Ceramics, Advanced Synthesis Methods, Solid-State Reactions

Deputy-Chairman of the Committee for Economic and Regional Cooperation (2022-2026)

**Kurtanjek, Želimir**, Prof. Ph.D.

Born: 1946

Department of Chemical Engineering

Emeritus of the Academy (admitted 1998)

B.Sc. in Chemistry (1971), Faculty of Science, University

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Engineering (1979), Chemical Engineering Department,

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Chemical Engineering, BioChemical Engineering, Food

Engineering, Process Control, Process Modelling

*Deputy-Member of the Scientific Council (2013-2017)**Member of the Scientific Council (2017-2022) and (2022-2026)***Kuzle, Igor**, Prof. Ph.D.

Born: 1967

Full Member of the Academy (admitted 2017)

Department of Energy Systems

B.Sc. (1991), M.Sc. (1997) and Ph.D. (2002), all from

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Power Systems Dynamic and Control, Renewable Energy

Sources, Electric Vehicles

Member of the Committee for Economic and Regional Cooperation (2022-2026)**Kviz, Boris**, Prof. Ph.D.

Born: 1931

Department of Communication Systems

Emeritus of the Academy (admitted 1994)

B.Sc. in Electrical Engineering (1957), M.Sc. in Electrical

Engineering, Ph.D in Electrical Engineering (1964), all

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Optoelectronics, Optical Communications,

Radiopositioning


Lapaine, Miljenko, Prof. Emeritus Ph.D.

Born: 1952

Department of Civil Engineering and Geodesy

Full Member of the Academy (admitted 1998)

 M.Eng. in Mathematics (1976), Faculty of Science,
 University of Zagreb, M.Sc. in Geodesy (1991), Ph.D. in
 Geodesy (1996), Faculty of Geodesy, University of Zagreb
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 Geodesy, Cartography, Geoinformatics, Mathematics,
 History of Science, Map Projections

Secretary-General of the Academy (2003-2005)
Vice-President of the Academy (2009-2013)
Member of the Scientific Council (2013-2017)
*Member of the Committee for Ethics (2013-2017) and
 (2017-2022)*

Lakušić, Stjepan, Prof. Ph.D.

Born: 1968

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Lipovac, Nenad, Prof. Ph.D.

Born: 1953

Department of Architecture and Urban Planning

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B.Sc. Architecture (1978), M.Sc. Architecture (1994)

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Physical Planning (2000) Faculty of Architecture,

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Urban and Physical Planning

**Lipovac, Vladimir, Prof. Ph.D.**

Born: 1956

Department of Communication Systems

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Mobile Radio Communications, Microwave Communication Systems, Communications Theory, Computer Networks and Protocols, Test and Measurement in Communication Systems

**Lončar, Dražen, Prof. Ph.D.**

Born: 1967

Department of Power Systems

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Born: 1961

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B.Sc. in Electrical Engineering (1985), M.Sc. in Electrical Engineering (1989) all from the Faculty of Electrical Engineering and Computing, University of Zagreb, Ph.D. (1994) University of Cincinnati USA

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 Image Processing, Image Analysis, Computer Vision,
 Pattern Recognition, Medical Imaging, Medical Image
 Analysis, Volume Visualization, Neural Networks, Virtual
 Reality

*Deputy-Secretary of the Department of Information
 Systems (2013-2017)*

*Secretary of the Department of Information Systems
 (2016-2017) and (2017-2022)*



Lulić, Zoran, Prof. Ph.D.

Born: 1966

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 Architecture

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Ljuljka, Boris, Prof. Emeritus Ph.D.

Born: 1937

Department of Bioprocess Engineering
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B.Sc. in Forestry (1960), M.Sc. in Forestry (1970), Ph.D.
 in Forestry (1974), all from the Faculty of Forestry,
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Wood Finishing, Wood Gluing, Furniture Quality,
 Manufacturing of Furniture

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Information Systems, Production Management, Maintenance Planning Methods, Development of ERP Systems, Single Production Management, Maintenance of Information Systems, New Planning Methods, Optimization of Project Duration, Digital Factory

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Biotechnology, Food Technology, Human Nutrition

*Deputy-Secretary of the Department of Bioprocess Engineering (2013-2017)**Member of the Scientific Council (2017-2022)***Mandžuka, Sadko**, Prof. Ph.D.

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B.Sc. Electrical Engineering (1980), M.Sc. Electrical Engineering (1992), Ph.D. Electrical Engineering (2003), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Intelligent Transport Systems, Incident Management System, Complex Control Theory, Underwater Systems and Technology



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Born: 1961

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Research, Protection and Rehabilitation of Architectural
Heritage, Diocletian's Palace in Split, Spatial
Development of Split, The Castles of Kaštela Bay,
Medieval and Renaissance Fortifications of Dalmatia


Margeta, Jure, Prof. Emeritus Ph.D.

Born: 1950

Department of Civil Engineering and Geodesy

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Water Resources Management, Urban Water System
Management, Water Resources System Engineering


Markotić, Anto, Prof. Ph.D.

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Department of Mining and Metallurgy

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B.Sc. in Metallurgical Engineering (1966), M.Sc. in
Metallurgical Engineering (1973), Ph.D. in Metallurgical
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Metallurgy, Metallurgy of Iron and Steel, Metallurgy of
Aluminium, Development of Metallurgy, Technical Culture



Marović, Pavao, Prof. Emeritus Ph.D.

Born: 1954

Department of Civil Engineering and Geodesy

Full Member of the Academy (admitted 2000)

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Computational Mechanics, Experimental Methods, Numerical Modeling of Reinforced and Prestressed Concrete Structures, Computational Modeling of Engineering Structures, In Situ Testing of Engineering Structures



Martinović, Goran, Prof. Ph.D.

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Department of Information Systems

Full Member of the Academy (admitted 2015)

B.Sc. in Electrical Engineering (1996) Faculty of Electrical Engineering, J.J. Strossmayer University of Osijek, M.Sc. in Electrical Engineering (2000) Faculty of Electrical Engineering and Computing, University of Zagreb, Ph.D. (2004), Faculty of Electrical Engineering and Computing, University of Zagreb

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Distributed and Service-oriented Computer Systems, Real-time Computer Systems, Autonomic Computing, Computational Intelligence

Deputy-Member of the Scientific Council (2017-2022)

Member of the Committee for International Co-operation (2022-2026)



Marušić, Josip, Prof. Emeritus Ph.D.

Born: 1943

Department of Civil Engineering and Geodesy

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Water Resource Management, Hydrotechnology, Optimizing Hydromelioration Systems for Drainage, Pollution Control of Water and the Environment, Construction Management, Protection Against Harmful Water Action

Chairman of the Committee of the Science Foundation (2013-2017)



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Born: 1949

Department of Mechanical Engineering and Naval Architecture

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Theory of Elasticity and Plasticity, Dynamics of Machinery, Finite Element Method, Fracture Mechanics, Contact Problems

**Matijašević, Ljubica, Prof. Ph.D.**

Born: 1950

Department of Chemical Engineering

Emeritus of the Academy (admitted 2012)

B.Sc. in Chemical Engineering (1974), M.Sc. in Chemical Engineering (1981), both from the Faculty of Technology, University of Zagreb, Ph.D. in Chemical Engineering (1992), Faculty of Chemical Engineering and Technology University of Zagreb

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Chemical Engineering, Analysis, Synthesis and Process Control, Mass and Heat Integration of Processes, Environmental Protection, Cleaner Production

**Matijašić, Gordana, Prof. Ph.D.**

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Mechanical Separation Processes, Development of Pharmaceutical Dosage Forms, 3D Printing in Pharmaceutical Industry

**Matijević, Božidar, Prof. Ph.D.**

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Geodesy, Geoinformatics, Geomatics, Spatial Databases, Spatial Data Analysis, Software Engineering

Deputy-Member of the Scientific Council (2013-2017)
Secretary of the Department of Civil Engineering and Geodesy (2009-2013)
Head of the Center for Geoinformation and Cartography (2013-2017) and (2017-2022)
Deputy-Secretary of the Department of Civil Engineering and Geodesy (2017-2022)
Member of the Program Committee of the Center for Technological Development (2022-2026)

Medved, Vladimir, Prof. Ph.D.

Born: 1951

Department of Systems and Cybernetics

Full Member of the Academy (admitted 1998)

B.Sc. in Electrical Engineering (1974), M.Sc. in Electrical Engineering (1977), Ph.D. in Electrical Engineering (1988), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Biomedical Engineering, Biomechanics, Biomedical Signal Processing, Kinesiological Electromyography, Human Locomotion

Secretary of the Department of Systems and Cybernetics (2003-2008)
Secretary-General of the Academy (2006-2008)
Chairman of the International Relations Committee (2009-2013)
Vice-President of the Academy (2013-2017)
Member of the Committee for Awards (2013-2017)
Member of the Scientific Council (2017-2022) and (2022-2026)

**Medved-Rogina, Branka**, Prof. Ph.D.

Born: 1958

Department of Communication Systems

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B.Sc. in Electrical Engineering (1981), M.Sc. in Electrical Engineering (1992), Ph.D. in Electrical Engineering (1997), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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High-speed Electronics and Optoelectronics, Signal Processing and Statist

*Deputy-Member of the Scientific Council (2013-2017)**Member of the Committee for Awards (2013-2017)**Member of the Scientific Council (2017-2022) and (2022-2026)***Meštrović, Krešimir**, Prof. Ph.D.

Born: 1958

Department of Electrical Engineering and Electronics

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B.Sc. in Electrical Engineering (1982), M.Sc. in Electrical Engineering (1988), Ph.D. in Electrical Engineering (2008), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Electrical Engineering: Electric Power, High Voltage Switching, Devices and Switchgear

Deputy-Member of the Scientific Council (2017-2022)**Mihanović, Ante**, Prof. Emeritus Ph.D.

Born: 1948

Department of Civil Engineering and Geodesy

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B.Sc. Civil Engineering (1972), M.Sc. Civil Engineering (1975), Ph.D. Civil Engineering (1981) all from the Faculty of Civil Engineering, University of Zagreb

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Structural Mechanics, Numerical Modeling of Structures, Lightweight Concrete Structures, Numerical Analysis of Structures, Design of Concrete and Lightweight Concrete Structures

Member of the Scientific Council (2017-2022) and (2022-2026)



Mikac, Tonči, Prof. Ph.D.

Born: 1955

Department of Mechanical Engineering and Naval Architecture

Full Member of the Academy (admitted 2005)

B.Sc. in Mechanical Engineering (1979), M.Sc. in Mechanical Engineering (1991), Ph.D. in Mechanical Engineering (1994), all from the Faculty of Engineering, University of Rijeka

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Manufacturing Systems, Computer Integrated Manufacturing, Operations Management, Organization of Production Systems, Production Engineering

Deputy-Member of the Scientific Council (2013-2017)



Mikota, Miroslav, Assist. Prof. Ph.D.

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Department of Graphical Engineering

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Member of the Committee for Ethics (2022-2026)

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B.Sc. (1977), M.Sc. (1985), Military Academy, Zagreb,

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Motor Vehicles, Special Vehicles, Construction Machines

Mikuličić, Vladimir, Prof. Ph.D.

Born: 1944

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B.Sc. Electrical Engineering (1968), M.Sc. Electrical

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Electric Power Engineering, Energy Conversion Processes

for Electricity Generation, Electric Power System

Reliability Evaluation, Reliability Modeling in Electric

Power Systems and Related Statistical Inference

*Secretary of the Department of Power Systems (1997-
2001) and (2001-2005)*



Miličević, Krno, Prof. Ph.D.

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Nonlinear Systems and Deterministic Chaos, Metrology and Measurement Uncertainty, Usage of Information Technology in Traceability of Measurement Results, Cryptography and Cryptographic Algorithms Based on Chaos Theory, Digitalization of Business Systems and Processes

Deputy-Secretary of the Department of Electrical Engineering and Electronics (2022-2026)



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Power Engineering, Electrical Machines and Drives

Member of the Committee for Economic and Regional Co-operation (2013-2017)



Milković, Marin, Prof. Ph.D.

Born: 1975

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Multimedia Systems, Colorimetry, Graphic Technology,
Psychophysics

Member of the Committee for Economic and Regional Co-operation (2017-2022)

**Mlinarić, Hrvoje**, Prof. Ph.D.

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Computer Science, Advance Processor Architecture, HPC, Hardware Design, Programmable Logic, Software Design

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Member of the Science Foundation Committee (2022-2026)**Modrić, Damir**, Prof. Ph.D.

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Holography, Graphic Technology, Multy/Hyperspectral Analysis, Imaging, 3D Print

Member of the Committee for Economic and Regional Cooperation (2022-2026)


Mognuš-Milanković, Andrea, Prof. Ph.D.

Born: 1953

Department of Chemical Engineering

Full Member of the Academy (admitted 2005)

B.Sc. in Chemistry (1978), M.Sc. in Chemistry (1982),

Faculty of Science, University of Zagreb, Ph.D. in Chemistry

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Andrea-Mogus-Milankovic

Electrical/Dielectric Properties of Materials, Glass, Glass-Ceramics, Impedance Spectroscopy


Mornar, Vedran, Prof. Ph.D.

Born: 1959

Department of Information Systems

Full Member of the Academy (admitted 2007)

B.Sc. in Electrical Engineering (1981), M.Sc. in

Computing (1985), Ph.D. in Computing (1990), all from

the Faculty of Electrical Engineering and Computing,

University of Zagreb

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Operations Research, Information Systems, e-Learning

*Member of the Committee of the Science Foundation
(2013-2017)*
President of the Academy (2022-2026)

Mrnjavac, Edna, Prof. Ph.D.

Born: 1958

Department of Transport

Full Member of the Academy (admitted 1998)

B.Sc. (1981), M.Sc. (1985), Ph.D. (1986) all from the

Faculty of Maritime Studies, University of Rijeka

University of Rijeka, Faculty of Tourism and Hospitality

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Traffic in Tourism, Managing Traffic in Tourism

Destination, Logistics and Supply Chain in Tourism and

Hospitality

*Member of the Program Committee of the Center for
Technological Development (2022-2026)*



Mrša, Vladimir, Prof. Ph.D.

Born: 1957

Department of Bioprocess Engineering

Full Member of the Academy (admitted 2012)

B.Sc. in Biotechnology (1980), Faculty of Technology,

University of Zagreb, Ph.D. (1984), Faculty of Food

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Biotechnology, Pierottijeva 6, 10000 Zagreb

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Molecular Biotechnology

Member of the Committee for International Co-operation (2017-2022)

Secretary of the Department of Bioprocess Engineering (2018-2022)

Secretary-General of the Academy (2018-2022) and (2022-2026)



Mrvac, Nikola, Prof. Ph.D.

Born: 1969

Department of Graphical Engineering

Full Member of the Academy (admitted 2017)

B.Sc. (1994), Faculty of Graphic Arts, University of

Zagreb, M.Sc. (2001), Faculty of Organization and

Informatics, University of Zagreb, Ph.D. (2003), Faculty

of Graphic Arts, University of Zagreb

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Head of the Center for Graphical Engineering (2017-2022)



Muštra, Mario, Assoc. Prof. Ph.D.

Born: 1984

Department of Communication Systems

Associate of the Academy (admitted 2017)

M.Sc. in Electrical Engineering (2007), Ph.D. in Electrical

Engineering (2013), all from the Faculty of Electrical

Engineering and Computing, University of Zagreb

University of Zagreb, Faculty of Transport and Traffic

Sciences, Vukelićeva 4, 10000 Zagreb

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 Image and Video Processing, Computer Vision,
 Unmanned Aerial Vehicles, Navigation Systems, Mobile
 Communications

*Deputy-Secretary of the Department of Communication
 Systems (2022-2026)*



Novak, Doris, Prof. Ph.D.

Born: 1971

Department of Transport

Associate of the Academy (admitted 2019)

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Aeronautics and Air Traffic Management, Flight Planning
 and Performances, Helicopter Theory of Flight

*Deputy-Secretary of the Department of Transport (2022-
 2026)*



Obad-Šćitaroci, Mladen, Academician

Born: 1955

Department of Architecture and Urban Planning

Full Member of the Academy (admitted 1998)

B.Sc. in Architecture (1979), M.Sc. in Architecture (1986),

Ph.D. in Architecture (1989), all from the Faculty of
 Architecture, University of Zagreb

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Architecture and Urbanism, Landscape Architecture,
 Cultural and Urban Heritage, Heritage Urbanism, Town
 Planning, History of Landscape Architecture and Town
 Planning



Ožanić, Nevenka, Prof. Ph.D.

Born: 1963

Department of Civil Engineering and Geodesy

Full Member of the Academy (admitted 2016)

B.Sc. in Civil Engineering (1986), Faculty of Civil Engineering, University of Rijeka, M.Sc. in Technical Sciences (1994), Faculty of Civil Engineering, University of Zagreb, Ph.D. in Technical Sciences (1996), Faculty of Civil Engineering, Architecture and Geodesy, University of Split

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Hydrology, Water Management, Hydro-Technical Regulation and Melioration, Science, Development

Member of the Committee for Economic and Regional Cooperation (2022-2026)



Pap, Klaudio, Prof. Ph.D.

Born: 1963

Department of Graphical Engineering

Full Member of the Academy (admitted 2005)

B.Sc. in Electrical Engineering (1988), M.Sc. in Electrical Engineering (1997), Ph.D. in Electrical Engineering (2004), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Graphic Technology, Computer Graphics, Computer Modeling and Simulation, Digital Printing, Image and Text Processing, Graphic Programming Languages, Interactive Web Program

Member of the Scientific Council (2010-2013)

Deputy-Secretary of the Department of Graphical Engineering (2013-2017)

Member of the Committee for Economic and Regional Cooperation (2013-2017)

Secretary of the Department of Graphical Engineering (2017-2022)

**Parac-Osterman, Durdica**, Prof. Emerita Ph.D.

Born: 1946

Department of Textile Technology

Emerita of the Academy (admitted 2005)

B.Sc. in Textile Technology (1970), M.Sc. in Textile Technology (1977), Ph.D. in Textile Technology (1985), all from the Faculty of Textile Technology, University of Zagreb

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Color Measurement and Color Management, Textile Dyeing and Printing, Rheological Characteristics to the System Thickener / Paint, Color Phenomena in Practical Use and Multimedia, Environmentallyfriendly Dyeing Processes, Physical-chemical and Dyeing Properties of Natural and Man-made Fibers

*Secretary of the Department of Textile Technology (2014-2017)**Deputy-Member of the Scientific Council (2017-2022)*

**Pavić, Ivica**, Prof. Ph.D.

Born: 1962

Department of Electrical Engineering and Electronics

Full Member of the Academy (2007)

B.Sc. in Electrical Engineering (1987), M.Sc. in Electrical Engineering (1992), Ph.D. in Electrical Engineering (1999), all from the Faculty of Electrical Engineering, University of Zagreb

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Power System Analysis, Transmission Lines, Power System Control

*Member of the Scientific Council (2013-2017)**Acting Deputy-Secretary of the Department of Electrical Engineering and Computing (2016-2017)**Deputy-Secretary of the Department of Electrical Engineering and Computing (2017-2022)*

**Pavković, Branimir, Prof. Ph.D.**

Born: 1958

Department of Mechanical Engineering and Naval Architecture

Full Member of the Academy (admitted 2012)

B. Sc. in Mechanical Engineering (1982), M.Sc. in Mechanical Engineering (1993), Ph.D. in Mechanical Engineering (1999), all from the Faculty of Engineering, University of Rijeka

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Refrigeration, Air-conditioning and Building Energetics, Energy Efficiency, Renewable Energy Sources

**Pegan, Srećko, Prof. Emeritus Ph.D.**

Born: 1949

Department of Architecture and Urban Planning

Emeritus of the Academy (admitted 2002)

B.Sc. in Architecture (1972), M.Sc. in Architecture (1987), Ph.D. in Architecture (1990), all from the Faculty of Architecture, University of Zagreb

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Regional Planning, Town Planning, Urban Development, Environmental Protection

Secretary of the Department of Architecture and Urban Planning (2005-2009)

Deputy-Secretary of the Department of Architecture and Urban Planning (2009-2013) and (2013-2017)

Member of the Committee for Ethics (2013-2017), (2017-2022) and (2022-2026)



Penava, Željko, Prof. Ph.D.

Born: 1964

Department of Textile Technology

Full Member of the Academy (admitted 2014)

B.Sc. in Textile Technology (1989), M.Sc. in Textile Technology (1993), Ph.D. in Textile Technology (2004), all from the Faculty of Textile Technology, University of Zagreb

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Textile Mechanical Technology, Textile Mechanics, CAD/CAM in Textiles, Smart Textiles, Construction and Design of the Textiles

Deputy-Secretary of Department of Textile Technology (2022-2026)



Perić, Nedjeljko, Prof. Emeritus Ph.D.

Born: 1950

Department of Systems and Cybernetics

Full Member of the Academy (admitted 1998)

B.Sc. in Electrical Engineering (1973), M.Sc. in Electrical Engineering (1980), Ph.D. in Electrical Engineering (1989) all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Plant and Process Automation, Servo Systems, Advanced Control Algorithms (Predictive Control, Neuro-fuzzy Control), System Identification, Estimation, Applications in Power Engineering and Transport

Chairman of the Committee for Economic and Regional Cooperation (2013-2017), (2017-2022) and acting Chairman (2022-2026)

**Petrak, Slavenka**, Prof. Ph.D.

Born: 1970

Department of Textile Technology

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B.Sc. (1995), Ph.D. (2007) all from the Faculty of Textile Technology, University of Zagreb

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CAD/CAM in Clothing Engineering, Computer Design, Construction and 3D Simulation of Clothing, Anthropometric Measurements and Analysis of the Human Body by Using a 3D Body Scanner, 2D/3D Computer Design and Simulation of Functional and Custom-made Clothing, Development of Computer Parametric 3D Clothing Model Prototypes

Petrović, Ivan, Academician

Born: 1961

Department of Systems and Cybernetics

Full Member of the Academy (admitted 2005)

B.Sc. in Electrical Engineering (1983), M.Sc. in Electrical Engineering (1989), Ph.D. in Electrical Engineering (1998), all from the Faculty of Electrical Engineering, University of Zagreb

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Mobile Robotics, Telerobotics, Intelligent Control and Estimation Theory

*Member of the Scientific Council (2013-2017)**Member of the Committee for Ethics (2017-2022) and (2022-2026)*



Picek, Stjepan, Assoc. Prof. Ph.D.

Born: 1984

Department of Textile Technology

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Ph.D. (2015), Faculty of Electrical Engineering and Computing, University of Zagreb and Radboud University, Nijmegen, The Netherlands

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Member of the Scientific Council (2022-2026)



Pribanić, Tomislav, Prof. Ph.D.

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B.Sc. in Electrical Engineering (1996), M.Sc. in Electrical Engineering (2001), Ph.D. in Electrical Engineering (2005), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Computer Vision, Image Processing, Biomedical Engineering,

Biomedical Signal Measurement and Analysis



Pribičević, Boško, Prof. Ph.D.

Born: 1962

Department of Civil Engineering and Geodesy

Full Member of the Academy (admitted 2009)

M.Eng (1986), Faculty of Geodesy, University of Zagreb,

M.Sc. in Geodesy (1999), Ph.D. in Geodesy (2000) both from the Faculty of Civil Engineering and Geodesy, University of Ljubljana

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Geodesy, Hydrography, Geodynamics

Deputy-Head of the Center for Development Studies and Projects (2017-2022)

Deputy-Head of the Center for Technological Development (2022-2026)

**Pušić, Tanja, Prof. Ph.D.**

Born: 1962

Department of Textile Technology

Full Member of the Academy (admitted 2015)

Graduated engineer of textile chemical technology (1986),

Faculty of Technology, University of Zagreb, M.Sc. in

technical sciences (1990), Faculty of Textile Technology,

University of Zagreb, Ph.D. in technical sciences (1997),

Faculty of Textile Technology, University of Zagreb

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Ecological Issues in Finishing and Textile Care Processes,

Bioscouring, Mercerization, Electrokinetic Potential

of Textile Materials, Pastel Shades – Washing Impact,

Primary and Secondary Effects, Fluorescent Compounds,

Detergents, Adsorption and Desorption of Surfactants,

Microcapsulation: Effects and Washing Persistence,

Aftertreatment of Textiles, Dry and Wet Cleaning, Dry

Cleaning Solvents, Enzymes in Finishing and Textile Care,

UV Protection

*Deputy-Secretary of Department of Textile Technology (2017-2022)**Member of the Committee for Economic and Regional Cooperation (2017-2022)**Secretary of Department of Textile Technology (2022-2026)***Rimac-Drlje, Snježana, Prof. Ph.D.**

Born: 1965

Department of Communication Systems

Full Member of the Academy (admitted 2005)

B.Sc. in Electrical Engineering (1987), M.Sc. in Electrical

Engineering (1994), Ph.D. in Electrical Engineering

(2000), all from the Faculty of Electrical Engineering and

Computing, University of Zagreb

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Image Processing, Image and Video Compression and

Coding, Multimedia Communication System, Wireless

systems, Radiowave Propagation

*Deputy-Secretary of the Department of Communication Systems (2013-2017) and (2017-2022)**Deputy-Chairman of the Committee for Ethics (2022-2026)*

Rogale, Dubravko, Prof. Ph.D.

Born: 1955

Department of Textile Technology

Full Member of the Academy (admitted 1996)

B.Sc. in Textile Technology (1981), Faculty of Technology, University of Zagreb, M.Sc. in Textile Technology (1987), Faculty of Technology, University of Zagreb, Ph.D. in Textile Technology (1994), Faculty of Textile Technology, University of Zagreb

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Technological Processes of Clothing Production and Development of Conventional and Intelligent Clothing, Application of Modern High-tech Joining Technique of Clothing, Thermal Properties of Conventional and Intelligent Clothing

*Secretary of the Department of Textile Technology (2009-2013)**Secretary-General of the Academy (2013-2017)**Member of the Committee for Awards (2017-2022)**Vice-President of the Academy (2017-2022)**Deputy-Member of the Scientific Council (2022-2026)*

Rogošić, Marko, Prof. Ph.D.

Born: 1969

Department of Chemical Engineering

Full Member of the Academy (admitted 2015)

B.Sc. (1991), M.Sc. (1994), Ph.D. (1998), all from the Faculty of Chemical Engineering and Technology, University of Zagreb

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Chemical Engineering Thermodynamics, Polymer Reaction Engineering

*Member of the Committee for Awards (2017-2022) and (2022-2026)*

**Roje, Vesna**, Prof. Ph.D.

Born: 1944

Department of Electrical Engineering and Electronics
Emerita of the Academy (admitted 2002)B.Sc. in Electrical Engineering (1967), Faculty of
Electrical Engineering, University of Split, M.Sc.
in Electrical Engineering (1974), Ph.D. in Electrical
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Electromagnetic Fields, Antennas, Electromagnetic
Compatibility**Rožić, Nikola**, Prof. Ph.D.

Born: 1942

Department of Information Systems

Emeritus of the Academy (admitted 1999)

B.Sc. in Electrical Engineering (1967 and 1968), Faculty
of Electrical Engineering, University of Split, M.Sc.
in Electrical Engineering (1977), Ph.D. in Electrical
Engineering (1981), Faculty of Electrical Engineering,
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Telecommunication and Information Systems, Forecasting
and Planning, Communication and Information Services
and Applications, Resource Management in Wireless
Systems, Multimedia Systems, Signal Processing and
Coding



Salopek, Branko, Prof. Ph.D.

Born: 1942

Department of Mining and Metallurgy

Emeritus of the Academy (admitted 2002)

B.Sc. Mining Engineering (1968), Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, M.Sc. (1979), Ph.D. (1982), Faculty of Natural Sciences and Engineering, University of Ljubljana University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, 10000 Zagreb
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Mineral Processing Technology, Recycling of Solid Waste Materials, Environmental Protection

Secretary of the Department of Mining and Metallurgy (2005-2009) and (2009-2013)



Sander, Aleksandra, Prof. Ph.D.

Born: 1969

Department of Chemical Engineering

Associate of the Academy (admitted 2019)

B.Sc. (1994), Ph.D. (2003), all from the Faculty of Chemical Engineering and Technology, University of Zagreb

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Thermal Separation Processes, Scale-up, Transport Phenomena

Member of the Committee for Ethics (2022-2026)



Sečen, Josip, Prof. Ph.D.

Born: 1939

Department of Mining and Metallurgy

Emeritus of the Academy (admitted 1998)

B.Sc. in Petroleum Engineering (1965), M.Sc. in Petroleum Engineering (1977), Ph.D. in Petroleum Engineering (1982), all from the Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb Lonjšćina 25, 10000 Zagreb

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Development of Oil, Gas and Gas-condensate Reservoirs, Primary, Secondary and Tertiary Stages


Senjanović, Ivo, Academician

Born: 1940

Department of Mechanical Engineering and Naval Architecture

Emeritus of the Academy (admitted 1994)

B.Sc. in Naval Architecture (1967), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, M.Sc. in Civil Engineering (1969), Faculty of Civil Engineering, University of Zagreb, Ph.D. in Naval Architecture (1970), Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb
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Naval Architecture, Ship and Offshore Structures, Wave Load and Structure Response, Submarine, LPG tanks, Hydroelasticity, Numerical Methods


Skala, Karolj, Prof. Ph.D.

Born: 1951

Department of Communication Systems

Full Member of the Academy (admitted 1998)

B.Sc. Electrical Engineering (1975), M.Sc. Electrical Engineering (1979), Ph.D. Electrical Engineering (1981), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Optoelectronics, Microcontrollers, Informatics, Optoelectronic Detection and Measurements, Laser and Fiber Optic Communications, Microcontrollers and Programmable Microelectronic Systems and Grid Applications

Member of the Committee for International Co-operation (2013-2017)

Deputy-Chairman of the Committee for International Co-operation (2017-2022)

Member of the Program Committee of the Center for Technological Development (2022-2026)

**Slavica, Anita**, Prof. Ph.D.

Born: 1970

Associate of the Academy (admitted 2021)

Department of Bioprocess Engineering

B.Sc. (1993), Faculty of Food Technology and
Biotechnology, University of Zagreb, M.Sc. (2002),Faculty of Food Technology and Biotechnology,
University of Zagreb, Ph.D. (2006), Faculty of Technical
Chemistry, Chemical and Process Engineering, Graz
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e-mail: aslavica@pbf.unizg.hr; http://www.pbf.unizg.hr/zavodi/zavod_za_biokemijsko_inzenjerstvo/laboratorij_za_bi_im_i_tsp/anita_slavica**Solaric, Nikola**, Prof. Emeritus Ph.D.

Born: 1934

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B.Sc. Geodesy (1958), Faculty of Engineering, University
of Zagreb B.Sc. Physics (1969), Faculty of Science,University of Zagreb, Ph.D. Geodesy (1979), Faculty of
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Geodesy, Astronomy, Metrology, Automatization in
Geodetical Astronomy, Automatization in Surveying,
Calibration Line for Electrooptical Distancemeters,
Optimization



Soljačić, Ivo, Prof. Emeritus Ph.D.

Born: 1935

Department of Textile Technology

Emeritus of the Academy (admitted 1993)

B.Sc. in Chemistry (1959), from Faculty of Chemistry, Food Technology and Mining Engineering, University of Zagreb, M.Sc. (1967), Faculty of Pharmacy and Biochemistry, University of Zagreb, Ph.D. (1971), Faculty of Technology, University of Zagreb

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Textile Chemistry, Textile Pretreatments, Optical Brightening, Textile Finishing, Textile Care, Optical Brighteners, Fluorescence Quenching, Whiteness Degree, Hue Change on Lightly Colored Fabrics

Secretary of the Department of Textile Technology of the Academy (2005-2009)



Somek, Branko, Prof. Ph.D.

Born: 1931

Department of Electrical Engineering and Electronics

Emeritus of the Academy (admitted 1994)

B.Sc. in Electrical Engineering (1959), Ph.D. in Electrical Engineering (1972), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Acoustics, Electro Acoustics, Audio Technology, Sound Broadcasting, Musical Acoustics, Architectural Acoustics, Sound Broadcasting (RDS Systems for FM Broadcasting, Digitalization of Radio Broadcasting), Noise and Vibrations, Acoustical Signal Processing

**Sorić, Jurica**, Prof. Emeritus Ph.D.

Born: 1954

Department of Mechanical Engineering and Naval Architecture

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B.Sc. in Mechanical Engineering (1978), M.Sc. in Mechanical Engineering (1984), Ph.D. in Mechanical Engineering (1989), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 5, 10000 Zagreb tel: +385 1 6168103, fax: +385 1 6168187

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Numerical Modeling of Nonlinear Deformation Processes, Multiscale Modeling, Finite Element Method, Meshless Method

*Member of the Scientific Council (2010-2013) and (2013-2017)**Member of the Science Foundation Committee (2022-2026)*

**Sorić, Zorislav**, Prof. Ph.D.

Born: 1947

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 1993)

B.Sc. in Civil Engineering (1971), Faculty of Civil Engineering, University of Zagreb, M.Sc. in Civil Engineering (1982), Faculty of Civil Engineering, University of Zagreb, Ph.D. in Civil Engineering (1987), University of Colorado, Department of Civil, Environmental and Architectural Engineering, Boulder, Colorado, USA

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**Srbljić, Siniša**, Prof. Ph.D.

Born: 1958

Department of Information Systems

Full Member of the Academy (admitted 1998)

B.Sc. in Electrical Engineering (1981), M.Sc. in Computer Engineering (1985), Ph.D. in Computer Science (1990), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Advanced Conventional and Experimental Nonconventional Architectures of Computer and Information Systems, Theory of Computing, and Consumer Computing

*Secretary of Department of Information Systems (1999-2004)**Member of the Scientific Council (2010-2013)**Member of the Committee of the Science Foundation (2017-2022)***Sršen, Mate**, Prof. Emeritus Ph.D.

Born: 1943

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 1993)

B.Sc. in Civil Engineering (1968), M.Sc. in Civil Engineering (1981), Ph.D. in Civil Engineering (1985), all from the Faculty of Civil Engineering, University of Zagreb

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Civil Engineering, Pavement Engineering, Design and Optimization of Pavement Structures, Road and Asset Management, Pavement Maintenance and Rehabilitation Technology, Road Traffic Safety, Teaching

Secretary of the Department of Civil Engineering and Geodesy of the Academy (1999-2009)


Stipaničev, Darko, Prof. Ph.D.

Born: 1955

Department of Systems and Cybernetics

Full Member of the Academy (admitted 1998)

B.Sc. in Electrical Engineering (1977), M.Sc. in Electrical Engineering (1980), Ph.D. in Electrical Engineering (1987), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Artificial Intelligence, Computational Intelligence, Complex Systems Modelling and Control, Digital Image Analysis, Advanced Internet Technologies

Deputy-Member of the Scientific Council (2017-2022) and (2022-2026)

Sućeska, Muhamed, Prof. Ph.D.

Born: 1954

Department of Chemical Engineering

Full Member of the Academy (admitted 2002)

B.Sc. (1977), Military Academy, Zagreb, M.Sc. in Chemistry (1986), Faculty of Science, University of Zagreb, Ph.D. (1991), Military Academy, Zagreb

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Thermal Analysis, Chemistry and Physics of Explosion and Explosives, Thermal Analysis of Energetic Materials, Kinetics and Mechanism of Thermal Decomposition, Numerical Modeling of Combustion, Detonation and Thermal Initiation of Explosive Reactions


Sučić, Viktor, Prof. Ph.D.

Born: 1973

Department of Electrical Engineering and Electronics

Full Member of the Academy (admitted 2022)

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Signal Analysis and Processing

Deputy-Member of the Scientific Council (2022-2026)



Sumina, Damir, Prof. Ph.D.

Born: 1978

Department of Electrical Engineering and Electronics
Associate of the Academy (admitted 2021)

B.Sc. (2001), Ph.D. (2009), all from the Faculty of
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Šantek, Božidar, Prof. Ph.D.

Born: 1966

Department of Bioprocess Engineering

Full Member of the Academy (admitted 2012)

B.Sc. (1990), M.Sc. (1994), Ph.D. (1996), all from
the Faculty of Food Technology and Biotechnology,
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Bioprocess Engineering, Biofuels and Biopolymer
Production, Mathematical Modeling of Bioprocesses,
Malting and Brewing Technology, Wastewater Treatment,
Algae Technology

**Šarolić, Antonio**, Prof. Ph.D.

Born: 1971

Department of Communication Systems

Associate of the Academy (admitted 2014)

B.Sc. in Electrical Engineering (1995), M.Sc. in Electrical Engineering (2000), Ph.D. in Electrical Engineering (2004), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Antennas, Electromagnetic Compatibility, Wireless Communication, Maritime Radio Communications, Flow Measurement, Electromagnetic Measurements

Secretary of the Department of Communication Systems (2022-2026)

**Šercer, Mladen**, Prof. Ph.D.

Born: 1953

Department of Mechanical Engineering and Naval Architecture

Full Member of the Academy (admitted 1998)

B.Sc. in Mechanical Engineering (1977), M.Sc. in Mechanical Engineering (1984), Ph.D. in Mechanical Engineering (1989), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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Mechanical Engineering, Production Engineering, Polymer Processing, Injection Moulding Process Control, Troubleshooting in Injection Moulding, Polymer Recycling and Waste Management, Production of Rubber Parts and Appropriate Moulds

Secretary of the Department of Mechanical Engineering and Naval Architecture of the Academy (2013-2017)



Šerman, Karin, Prof. Ph.D.

Born: 1964

Department of Architecture and Urban Planning
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B.Sc. (1989), Faculty of Architecture, University of Zagreb (1989), M.Sc. (1996), Harvard University Graduate School of Design, Cambridge, USA, Ph.D.

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Architectural History and Theory, Architectural Design,
Urban Theory



Šikić, Mile, Prof. Ph.D.

Born: 1972

Department of Information Systems

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B.Sc. (1996), Ph.D. (2008), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Šimić, Zdenko, Prof. Ph.D.

Born: 1964

Department of Power Systems

Associate of the Academy (admitted 2012)

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Nuclear Safety, Low Carbon Transition Risk, Power System Reliability, Energy Sources Sustainability



Šljivac, Damir, Prof. Ph.D.

Born: 1974

Department of Power Systems

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B.Sc. (1997), Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, Josip Juraj Strossmayer University of Osijek, Ph.D. (2005), Faculty of Electrical Engineering and Computing, University of Zagreb

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Šubarić, Drago, Prof. Ph.D.

Born: 1963

Department of Bioprocess Engineering

Full Member of the Academy (admitted 2009)

B.Sc. in Food Engineering (1988), Faculty of Food Technology, University of Osijek, M.Sc. in Food Engineering (1994), Ph.D. in Food Engineering (1999), Faculty of Food Technology and Biotechnology, University of Zagreb

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Food Technology; Development and Improvement of Processes for Food Production; Improvement of Quality and Stability of Food Products; Rheological and Thermophysical Properties of Food

Deputy-Member of the Scientific Council (2013-2017)

Deputy-Secretary of the Department of Bioprocess Engineering (2017-2022) and (2022-2026)

Deputy-Chairman of the Committee for Awards (2017-2022)



Šušković, Jagoda, Prof. Emerita Ph.D.

Born: 1955

Department of Bioprocess Engineering

Full Member of the Academy (admitted 2007)

B.Sc. in Biotechnology (1980), M.Sc. in Biotechnology (1989), Ph.D. in Biotechnology (1996), all from the University of Zagreb, Faculty of Food Technology and Biotechnology

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Microbial Biotechnology - Probiotic, Antibiotic, Enzyme and Starter Culture Technology

Head of the Biotechnical Center (2013-2017)

Secretary of the Department of Bioprocess Engineering (2017-2018)



Tarbuk, Anita, Assoc. Prof. Ph.D.

Born: 1975

Department of Textile Technology

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Interfacial Phenomena on Textiles, Enzymes in Textile Finishing, Pretreatment and Surface Modification of Textiles, UV Protection, Hospital Protective Textiles

Chairman of the Committee for International Co-operation (2022-2026)

**Terze, Zdravko**, Prof. Ph.D.

Born: 1966

Department of Systems and Cybernetics

Full Member of the Academy (admitted 2004)

B.Sc. in Mechanical Engineering (1991), M.Sc. in Mechanical Engineering (1994), Ph.D. in Mechanical Engineering (1996), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb
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Dynamics of Structural Systems, Numerical Methods and Computation, Dynamics of Aircraft Structures, Multibody Dynamics and Non-linear Dynamics, Computational Aeroelasticity

Member of the Committee of the Science Foundation (2013-2017)

Vice-President of the Academy (2013-2017) and (2017-2022)

President of the Scientific Council (2013-2017) and (2017-2022)

Chair of the Committee for International Co-operation (2013-2017) and (2017-2022)

**Tomas, Srećko**, Prof. Ph.D.

Born: 1954

Department of Chemical Engineering

Full Member of the Academy (admitted 2009)

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Food Engineering, Chemical Engineering (Heat and Mass Transfer, Drying, Extraction, Distillation, Ecological Engineering)

**Tomašić, Vesna**, Prof. Ph.D.

Born: 1964

Department of Chemical Engineering

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B.Sc. in Chemical Engineering (1990), M.Sc. in Chemical Engineering (1993), Ph.D. in Chemical Engineering (1999), all from the Faculty of Chemical Engineering and Technology, University of Zagreb

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Catalytic Reaction Engineering and Air Pollution Control: Correlation of Fundamental Principles of Heterogeneous Catalysts with the Performance and Design of Catalytic Reactors, Application of Catalytic and Photocatalytic Processes in Air Protection and Wastewater Treatment

*Deputy-Secretary of the Department of Chemical Engineering (2013-2017)**Secretary of the Department of Chemical Engineering (2017-2022) and (2022-2026)***Tomšić, Željko**, Prof. Ph.D.

Born: 1957

Department of Power Systems

Full Member of the Academy (admitted 2002)

B.Sc. in Electrical Engineering (1981), M.Sc. in Electrical engineering (1990), Ph.D. in Electrical Engineering (2001), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Energy and Geostrategy, Energy Policy and Strategy, Economy in Energy and Ecology, Energy Markets, Deregulation in Energy, Energy and Environment, Power System Planning, Impact Assessment of Power Plants, Environmental Protection in Power Systems, Energy Management, Energy Conservation and Energy Auditing in Industry and Buildings

*Chairman of the Committee Science Foundation (2017-2022)**Deputy-Secretary of the Department of Power Systems (2017-2022)**Secretary of the Department of Power Systems (2022-2026)*



Tonković, Zdenko, Prof. Ph.D.

Born: 1966

Department of Mechanical Engineering and Naval Architecture

Full Member of the Academy (admitted 2009)

B.Sc. in Mechanical Engineering (1991), M.Sc. in Mechanical Engineering (1994), Ph.D. in Mechanical Engineering (1998), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Ivana Lučića 5, 10000 Zagreb

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Solid Mechanics, Numerical Methods, Structural Integrity

Deputy-Secretary of the Department of Mechanical Engineering and Naval Architecture (2022-2026)



Trkulja, Bojan, Prof. Ph.D.

Born: 1978

Department of Electrical Engineering and Electronics

Associate of the Academy (admitted 2021)

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Electrical Machines, Electromagnetic Compatibility, Numerical Methods

Member of the Scientific Council (2022-2026)



Tušek, Darovan, Prof. Ph.D.

Born: 1954

Department of Architecture and Urban Planning

Full Member of the Academy (admitted 2015)

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Member of the Committee for Awards (2022-2026)

**Udiljak, Toma**, Prof. Ph.D.

Born: 1955

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Machining Systems and Technologies, Machining Systems
in Medical Engineering, Modelling and Simulation
of Machining Systems, Intelligent and Autonomous
Manufacturing, CAD/CAM systems**Ugarčić-Hardi, Žaneta**, Prof. Ph.D.

Born: 1946

Department of Bioprocess Engineering
Emerita of the Academy (admitted 2002)B.Sc. in Chemical Engineering (1971), Faculty of
Technology, University of Zagreb, Ph.D. in Chemical
Engineering (1983), Eidgenossische technische
Hochschule, Zurich

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Cereal Chemistry and Technology, Technological Quality
of Flour, Milling, Bread and Pasta Production, Extruded
Products**Ujević, Darko**, Prof. Emeritus Ph.D.

Born: 1955

Department of Textile Technology
Full Member of the Academy (admitted 2007)B.Sc. in Textile Technology (1977), M.Sc. in Textile
Technology (1984), Ph.D. in Textile Technology (1998), all
from the Faculty of Textile Technology, University of Zagreb
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e-mail: darko.ujevic@tff.hr, darko.ujevic@zg.t-com.hr;

<http://www.tff.hr/index.php?str=53&osoba=24>Improvements of Methodological Procedures for Clothing
Engineering, Development of Measuring Apparatuses
and Devices, Anthropometry, Clothing Modeling and
Construction, Qualita Systems and ISO Standards*Member of the Scientific Council (2010-2013)*



Vasić-Rački, Đurđa, Prof. Emerita Ph.D.

Born: 1946

Department of Chemical Engineering

Emerita of the Academy (admitted 1995)

B.Sc. in Chemical Engineering (1971), M.Sc. in Chemical Engineering (1976), Ph.D. in Chemical Engineering (1981), all from the Faculty of Chemical Engineering and Technology, University of Zagreb

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Enzyme Reaction Engineering, Computer Modeling, Biochemical Engineering, Ecological Engineering

Head of the Center for Environmental Protection and Development of Sustainable Technologies (2009-2013) and (2013-2016)

Chairwoman of the Council of the Centers (2009-2013) and (2013-2017)



Veršić, Zoran, Prof. Ph.D.

Born: 1966

Department of Architecture and Urban Planning

Associate of the Academy (admitted 2014)

B.Sc. in Architecture (1991), M.Sc. in Architecture (2001),

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Building Construction, Sustainable Building, Thermal Insulation, Energy Efficient Building, Sound Insulation, Acoustics

Secretary of the Department of Architecture and Urban Planning (2017-2022) and (2022-2026)



Veža, Ivica, Prof. Emeritus Ph.D.

Born: 1951

Department of Mechanical Engineering and Naval Architecture

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B.Sc. in Mechanical Engineering (1975), M.Sc. in Mechanical Engineering (1980), Ph.D. in Mechanical Engineering (1985), all from Faculty of Mechanical Engineering, University of Zagreb

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Industrial Engineering, Mechanical Engineering, Plant Layout, Computer Integrated Manufacturing, Modeling and Simulation, Production Management, Logistics

Secretary of the Department of Mechanical Engineering and Naval Architecture (2005-2009)



Virag, Zdravko, Prof. Ph.D.

Born: 1955

Department of Mechanical Engineering and Naval Architecture

Full Member of the Academy (admitted 1994)

B.Sc. in Mechanical Engineering (1978), M.Sc. in Mechanical Engineering (1985), Ph.D. in Mechanical Engineering (1991), all from the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

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Fluid Mechanics, Numerical Methods in Heat and Mass Transfer, Hemodynamics of the Cardiovascular System

Deputy-Secretary of the Department of Mechanical Engineering and Naval Architecture (2009-2013)

Member of the Committee for Awards (2013-2017)

Deputy-Member of the Scientific Council (2017-2022) and (2022-2026)



Višković, Alfredo, Prof. Ph.D.

Born: 1961

Department of Power Systems

Associate of the Academy (admitted 2007)

B.Sc. Electrical Engineering (1985), M.Sc. Electrical Engineering (1989), Ph.D. Electrical Engineering (1998), all from the Faculty of Electrical Engineering and Computing, University of Zagreb, Ph.D. Information Science (2008), Faculty of Philosophy, University of Zagreb

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Complex Systems, Energy Convergence, Sustainable Energy, Green Web Energy, Social Humanistic Informatology



Vražić, Mario, Prof. Ph.D.

Born: 1971

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B.Sc. in Electrical Engineering (1996), M.Sc. in Electrical Engineering (2000), Ph.D. in Electrical Engineering (2005), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Electrical Machines, Drives and Automation, Industrial Plants, Electric Vehicles

Secretary of the Department of Electrical Engineering and Electronics Acting Secretary (2016-2017), (2017-2022) and (2022-2026)



Vrkljan, Darko, Prof. Ph.D.

Born: 1952

Department of Mining and Metallurgy

Full Member of the Academy (admitted 2009)

B.Sc. Mining Engineering (1978), M.Sc. Mining Engineering (1992), Ph.D. Mining Engineering (1998), all from the Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb

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Surface Exploitation, Mining Design, Ventilation of Mines and Tunnels, Blasting, Mining Law

Member of the Scientific Council (2017-2022)



Vujasinović, Edita, Prof. Ph.D.

Born: 1965

Department of Textile Technology

Full Member of the Academy (admitted 2012)

B.Sc. in textile technology (1988), Faculty of Technology, University of Zagreb, M.Sc. in Textile Engineering (1996), Faculty of Textile Technology, University of Zagreb, Ph.D. in Textile Technology (2003), Faculty of Textile Technology, University of Zagreb

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Structure and Properties of Textile Fibers, Objective Measurement and Evaluation, Restauration and Conservation of Textile and Clothes, Fibers and Forensics, Fiber Reinforced Composites & Textile Recycling

Secretary of the Department of Textile Technology (2017-2022)

Chairwoman of the Committee for Ethics (2017-2022)

**Vujević, Slavko**, Prof. Ph.D.

Born: 1958

Department of Electrical Engineering and Electronics

Full Member of the Academy (admitted 2017)

B.Sc. (1981), University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, M.Sc. (1987), University of Zagreb, Faculty of Electrical Engineering, Ph.D. (1994), University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture

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Numerical Modeling of Electromagnetic Phenomena,

Lightning Protection, Grounding Systems,

Electromagnetic Compatibility, Electrical Machines and Transformers

**Vusić, Damir**, Prof. Ph.D.

Born: 1971

Department of Graphical Engineering

Associate of the Academy (admitted 2019)

B.Sc. (1997), Ph.D. (2012), all from the Faculty of Graphics Arts, University of Zagreb

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Reproduction of the Color Information in the Multimedia

Communication Systems, Quality Management in the

Graphic Reproduction Processes, Application of Modern

Multimedia Information and Communication Platforms

in the Educational Process, Graphical User Interfaces

Development and Application of Virtual and Augmented

Reality

Member of the Program Committee of the Center for Technological Development (2022-2026)

**Zelenika, Saša, Prof. Ph.D.**

Born: 1966

Department of Mechanical Engineering and Naval Architecture

Full Member of the Academy (admitted 2012)

M.Sc. in Mechanical Engineering (1991), Faculty of Engineering, University of Rijeka, Ph.D. in Mechanical Engineering (1996), Polytechnic University of Turin, Italy University of Rijeka, Faculty of Engineering & Centre for Micro- and Nanosciences and Technologies, Vukovarska 58, 51000 Rijeka

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Precision Engineering, Microsystems Technologies, Compliant Mechanisms, Energy Harvesting, Mechatronics, Measurement Techniques, Machine Elements

**Zelić, Bruno, Prof. Ph.D.**

Born: 1973

Department of Chemical Engineering

Full Member of the Academy (admitted 2012)

B.Sc. in Chemical Engineering (1996), M.Sc. in Chemical Engineering (1999), Ph.D. in Chemical Engineering (2003), all from the Faculty of Chemical Engineering and Technology, University of Zagreb

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Process Development, Biochemical Engineering, Bioseparation Processes, Microreactors, Mathematical Modeling

*Head of the Center for Environmental Protection and Development of Sustainable Technologies (2016-2017) and (2017-2022)**Chairman of the Council of Centers (2017-2022)**Member of the Committee for International Co-operation (2017-2022)**Vice-President of the Academy (2009-2013)**President of the Scientific Council (2022-2026)**Member of the Committee for Awards (2022-2026)*


Zeljko, Mladen, Assist. Prof. Ph.D.

Born: 1956

Department of Power Systems

Associate of Academy (2009)

B.Sc. in Electrical Engineering (1979), M.Sc. in Electrical Engineering (1988), Ph.D. in Electrical Engineering (2003), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Energy System Operation and Expansion Planning, or Organisation and Economics of Energy Sector


Zentner, Radovan, Prof. Ph.D.

Born: 1972

Department of Communication Systems

Associate member of the Academy (admitted 2017)

B.Sc. in Electrical Engineering (1994), M.Sc. in Electrical Engineering (1998), Ph.D. in Electrical Engineering (2002), all from the Faculty of Electrical Engineering and Computing, University of Zagreb

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Antennas and Propagation, Spectrum Management


Zovko Brodarac, Zdenka, Prof. Ph.D.

Born: 1975

Department of Mining and Metallurgy

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B.Sc. (1998), Faculty of Metallurgy, University of Zagreb, Ph.D. (2009) Faculty of Natural Sciences and Engineering, University of Ljubljana

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Deputy-Secretary of the Department of Mining and Metallurgy (2022-2026)

**Zrinjski, Mladen**, Prof. Ph.D.

Born: 1972

Department of Civil Engineering and Geodesy

Associate of the Academy (admitted 2017)

B.Sc. in Geodesy (2001), Ph.D. in Geodesy (2010), all

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Geodesy, Automation of Geodetic Measurements, Geodetic

Instruments, Precision Geodetic Measurements, GNSS

*Deputy-Head of the Center for Geoinformation and
Cartography (2017-2022)***Zrnčević, Stanka**, Prof. Ph.D.

Born: 1946

Department of Chemical Engineering

Emerita of the Academy (2009)

B.Sc. in Chemical Engineering (1969), M.Sc. in Chemical

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Chemical Engineering, Catalysis, Catalytic Reaction

Engineering

Žagar, Drago, Prof. Ph.D.

Born: 1965

Department of Electrical Engineering and Electronics

Full Member of the Academy (admitted 2017)

B.Sc. in Electrical Engineering (1990), Faculty of Electrical Engineering and Computing, University of Zagreb, M.Sc. in Electrical Engineering (1995), Faculty of Electrical Engineering and Computing, University of Zagreb, Engineering Master's degree, Euro Laser Engineer (1996), University of Vienna, PhD in Electrical Engineering (2002), Faculty of Electrical Engineering and Computing, University of Zagreb



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Communication Networks, Protocols, Quality of Service QoS, Wireless Sensor Networks, Broadband Technologies, Cyber Security

*Member of the Committee for Awards (2022-2026)***Žagar, Martin**, Assoc. Prof. Ph.D.

Born: 1981

Department of Information Systems

Associate of the Academy (admitted 2015)

B.Sc. (2004), Faculty of Electrical Engineering and Computing, University of Zagreb (2004), M.Sc. Faculty of Electrical Engineering and Computing, University of Zagreb (2005) and Faculty of Chemical Engineering and Technology, University of Zagreb (2006), Ph.D. (2009), Faculty of Electrical Engineering and Computing, University of Zagreb



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Telemedicine, Multimedia Applications and Architectures

Deputy-Member of the Scientific Council (2022-2026)


Žagar, Zvonimir, Prof. Ph.D.

Born: 1931

Department of Civil Engineering and Geodesy

Emeritus of the Academy (admitted 1998)

B.Sc. in Civil Engineering (1957), Ph.D. in Civil Engineering (1985), all from the Faculty of Civil Engineering, University of Zagreb

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Structures, Timber Structures, Expert Systems, Civil and Mechanical Engineering, Artificial Intelligence, Computer Sciences


Žarko, Damir, Prof. Ph.D.

Born: 1972

Department of Electrical Engineering and Electronics

Full Member of the Academy (admitted 2017)

B.Sc. (1996) and M.Sc. (1999) from the Faculty of Electrical Engineering and Computing, University of Zagreb, Ph.D. (2004) University of Wisconsin – Madison, USA

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Design of Electrical Machines for Various Applications in Industry, Power Engineering and Transport, Analysis, Design and Modeling of Distribution and Power Transformers, Application of Mathematical Optimization in Design, Application of the Finite Element Method in the Analysis and Design of Electrical Machines, Transformers and Other Electromagnetic Devices

Chairman of the Science Foundation Committee (2022-2026)



Žiljak, Vilko, Prof. Emeritus Ph.D.

Born: 1946

Department of Graphical Engineering

Emeritus of the Academy (admitted 1998)

B.Sc. in Physics (1973) Faculty of Science, University of Zagreb, Ph.D. in Electrical Engineering (1982), Faculty of Electrical Engineering and Computing, University of Zagreb

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Graphic Technology, Computer Sciences, Printing Processes, Prepress, Digital Press, Postpress, Computer Modeling and Simulation, Computer Graphics

Vice-President of the Academy (2009-2013)

Deputy-President of the Academy (2012-2013)

Head of the Center for Graphical Engineering (2013-2017)



Žiljak Gršić, Jana, Prof. Ph.D.

Born: 1972

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