The Encyclopedia of Technology Part 2 – Creation of Original List of Entries

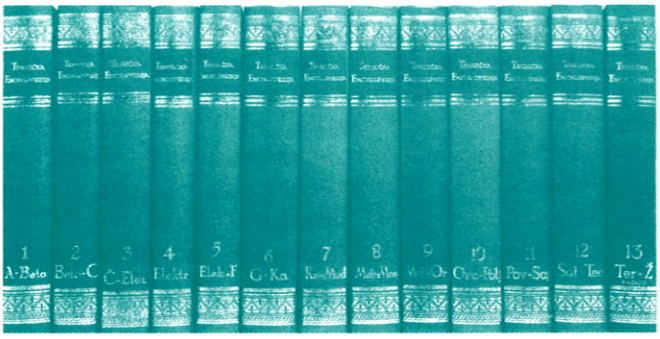
As originally conceived, *The Encyclopedia of Technology* was to include a comprehensive biography of past and present Croatian and foreign scientists, inventors and others who had contributed to the development of technology and science. But this idea was dropped during preparation for the first volume, partly because of the absence of histories of technology in Croatia, and partly because of the difficulties in establishing where credit should go for inventions and other scientific and technical discoveries and achievements. In the sciences, the question of primacy has always involved nationalist and political issues, and such was the case in that period of particular ideological pressure as well. By dropping the biography, regarding who should be given the credit for the inventions and discoveries, the first editors avoided any debate such as one so often finds in biographies of that nature.

The List of Entries. One of the first tasks of the editors and contributors in creating *The Encyclopedia of Technology* was to put together an original list of entries. During the years of preparatory work on the encyclopedia, the terminology created for individual fields and disciplines was perfected and an effort was made to harmonize and coordinate usage among the disciplines. By this method, every field of expertise had its own list of entries with its extent determinated by the specific article, and all of them were combined to make a list of entries used in *The Encyclopedia of Technology*. But a complete list of entries was finalized only during work on the fifth volume. The list of entries was the basis for all succeeding volumes. In the first three volumes, however, even the terminology in articles dealing with a single field was not standardized because the various fields had standardized their vocabularies to different degrees.

During the publication of *The Encyclopedia of Technology*, merely keeping up with the rapid developments in technology and the applications of technological break-throughs was a major problem. In those early years, many technological inventions, which today are an integral part of everyday's life, were still in their infancy, while some had not even been considered. Among these were the laser, the computer, almost all current electronics based on semiconductors, artificial satellites, synthetics materials, and many others. Computers provide an excellent example. The first volume, issued in 1963, discussed the development of the *analog computer*, but six years later the third volume discussed the *digital computer* as the new direction in which computer technology was headed. But this entry also quickly became outdated. Subsequent to the articles on *Electronics* and *Impulse and Digital Technology*, the eleventh volume, which appeared in 1988, contained a new article on *Computers*, using terms and concepts, which were obviously not part of the technical vocabulary in the late 1950s. Owing to the extremely fast pace of the development of computer technology and its applications, even many details of that article become obsolete year by year.

In order to keep its articles as up-to-date as possible, during the preparation of every new volume, the editors carefully selected the terminology to be used by monitoring current literature and consulting with experts in each field. Modifications and additions to terminologies were proposed to the directing editor, who in turn would carry out a detailed review and determine a final version of a list of entries to be used for the forthcoming volume.

Owing to the rapid advances in science and technology, the size of *The Encyclopedia of Technology* quickly grew from the six volumes originally proposed to eleven volumes. However, during preparation of the tenth volume in 1986, it became clear that even eleven volumes would not be enough. Consequently, in 1986, the staff of the Lexicographical Institute conducted a basic review of the project. Academician, Hrvoje PoŽar, then directing editor, drafted a detailed proposal justifying an increase in the number of volumes. On 22 December that year, the Scientific Council of the Lexicographical Institute decided that *The Encyclopedia of Technology* would be complete with the thirteen volumes, with an additional volume for a comprehensive index. However, during the preparation of this index, it was found that a table of contents listing the contacts of the whole encyclopedia would be considerably shorter than envisaged. Finally, it was possible to include the index in the thirteenth volume.



Owing to a long gestation period, *The Encyclopedia of Technology* is a unique snapshot of technological developments in the second half of the twentieth century, both in Croatia and abroad. It is much more like a periodical publication issued during an era of particularly rapid technology innovation and application than a standard encyclopedia. However, despite all the advances in technology and the changes in technical applications during these decades, many of the articles in *The Encyclopedia of Technology* have lasting value, especially those dealing with the basic technical aspects of the disciplines of mathematics, physics, and chemistry.

To be contiued...

Communication of Knowledge

At our Monthly Scientific Forums, our members and the guests speekers have opportunity to communicate knowledge, experiences, viewpoints or research results to a multidisciplinary auditorium, as well as to debate on actual questions of engineering.

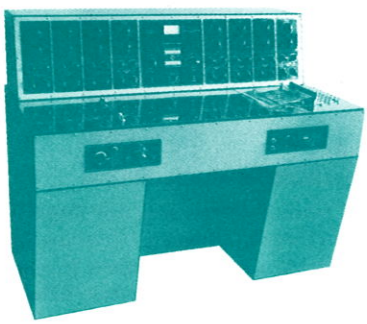
This year we have opportunity to welcome two reputable scientists and professors: Danko Gajski University of California, IRVIN from USA and Zvonko Vranesic, University of Toronto, Canada, who have pressented on the USA and Canadian models of research and development as well as their own experience. The relationship between government, university and industry in developing new technologies and products, has been particularly addressed, also the role and resources of each participant have been discussed with respect to the changing paradigm in global business approach. The impact of research globalization both motivated and was debated, particularly with regards the possible positioning of R&D programs in Croatia.

Engineering Power 3

Forty years ago, in 1959, our member, Prof. Ante Šantić, then the head of the Laboratory for Electronics at the Institute of Electrical Engineering in Zagreb, successfully initiated the development of the prototype of electroencephalograph, which was very soon followed by an order for the first five commercial apparatus. Prof. Ante Šantić designed and built complete electronic units: voltage stabilisers, amplifiers, gain and frequency controllers, while the late Eng. Miroslav Kolaj designed the moving-coil inkwriter with the electromechanical driver for the transport of paper.

Design of extremely good amplifiers with the vacuum tubes, high gain (2×10^6) and input resistance (4 MΩ), as well as with high Common Mode Rejection ratio, was a real success for an electronic engineer of that period.

The electroencephalograph is an electronic apparatus for the monitoring and registration of the electric potentials of the brain, covering the range from 2 μV to 100 μV. The brain electric potentials were discovered by Berger in 1929, and the very first encephalograph was designed in 1939. The first commercial apparatus appeared on the market in the late 1940s, and since the early 1950s, they are being applied in Croatia.



Prof. Ante Šantić was motivated to initiate R&D, by the reparation of one among the very early encephalographs from a certain hospital. His team accomplished a very friendly and efficient co-operation with the Clinics for Neurology of the University of Zagreb, which supported the development and the later-on, application of the apparatus. By the end of 1961, encephalographs made in Croatia have been installed in the hospitals in Zagreb, Rijeka, and Pula.

This was the beginning of the development of biomedical electronics in Croatia. Up until 1969, forty encephalographs have been produced under the supervision of Prof. Ante Šantić, who continuously kept on designing, improving, and introducing semi-conductors and integrated circuits. Besides the encephalograph, other instruments have also been developed. For example, we can mention the photoacustic stimulators, the measuring instrument for psycho-galvanic reflexes, and a set of other measuring instruments, developed by the modification of the encephalograph. Also, there are the measuring instruments on vestibular system, electronistagmographs, and retinographs.

Since 1970, Prof. Ante Šantić has taught Biomedical Electronics at the Faculty of Electrical Engineering and Computing, University of Zagreb, but he also plays the central role in the organisation and development of the School of Biomedical Engineering at the University. Though such activity, he has motivated a successful co-operation between the electronic engineers and the doctors/physicians.

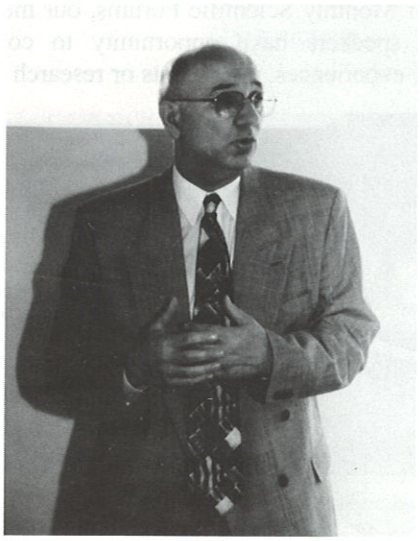
Unfortunately, the small industry initiated by Prof. Šantić in early 1960s could not endure the strength of international competition, and in the 1980s, the manufacturing

Education for the Information Society

Because of the increasing trend towards smaller businesses and the significant negative consequences of the transitional economic situation on activities and vitality of medium and large industries, Croatia has considerately reduced interest in the teaching of engineering subject. There is a feeling within the engineering community that engineering in higher education is no longer appropriate. The existence of higher engineering education is being maintained however, thanks to the traditionally well organized engineering faculties and their management responsible for educational process. In spite of its dependence on government funding, which annually decreases equally in revenue budgets and in capital, their strong aspirations to world-class is more and more challenged, and Croatian engineers are in danger of loosing their position in the international market, on which Croatian economy has come to depend. On the other hand, knowledge of the engineers of the older generations are becoming obsolete. Consequently well organized life-long engineering education is essential.

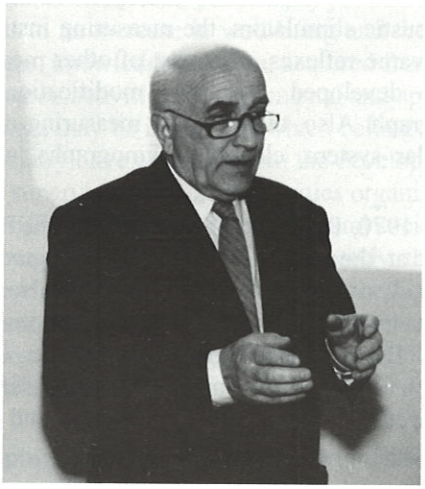
Such circumstances motivated the subject and topics of our the Fourth Colloquium Education for Information society: Engineer of the Future which was held at the Faculty of Chemical Engineering, University of Zagreb, in May this year. It was a real multidisciplinary event, participate in equally by academics and engineers from industry.

All participants have agreed on the increasing importance of the necessity of the combination of skills, which is not currently evident in a single academic qualification. Work in multidisciplinary teams was emphasised as an example, because in today's competitive environment, all members should contribute their own disciplinary knowledge in an integrated way. Therefore the need for close cooperation of the engineering faculties, as well as cooperation with the faculties of social and humanistic science, are considered particularly important for the education of future engineers.



Prof. Igor Čatić (Faculty of Mechanical and Naval Engineering) spoke in favor of the re-engineering of University and need for more socially ewore engineer

Prof. Zvonimir ž agar (Faculty of Civil Engineering) spoke on the changes working methods and skills in the field of civil engineering, and illustrated the influence on the creation of new curriculum.



Prof. Ivica Štern (Faculty of Chemical Engineering and Technology) pointed out the need for multidisciplinary cooperation which requires a rich varity of engineering skills.

Prof. Juraj Božičević (Faculty of Chemical Engineering and Technology) motivate debate on the responsibility of Croatian University for the adaptation of engineering curricula and the education if engineers which will contribute to national ability to concentrate advanced product and services and constant experiment of competitivenes.

Books

Ivo Alfirević, *Linearna analiza konstrukcija*, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu, Zagreb 1999.
Str. 398, ilustr. graf. prikazi
ISBN 953-6313-22-7

The book may be divided into two parts. The first part contains theoretical background to structural analysis. It consists of 5 chapters. In the first introductory chapter, indicial notation, scalars, vectors and tensors as well as coordinate axes transformation, are treated. In the second and third chapter, a thorough analysis of triaxial state of stress and strain is given. Constitutive equations are treated in the fourth chapter. Various forms of Hooke's law for isotorpic and orthotropic materials are presented. The fifth chapter deals with plane elasiticity, including biharmonic differential equation and Airy's stress function. Many interesting, and for industrial practice, useful problems, are solved such as: beam flexure, circular disks, wedges loaded by axial and transversal force and moment at the apex, stress concentration in plates and shells, etc.

In the second part that contains Chapters Six to Seventeen, various structural members, mostly plates and shells, are analysed. Chapter Six deals with torsion of solid and thin-walled members. Bending of axially symmetric rings is analysed in Chapter Seven. Chapters Eight and Nine are devoted to the bending theory of the two most important types of plates, the circular plates and the rectangular plates. Chapters Ten to Thirteen contain membrane theory of shells of revolution, general cylindrical shell and general shallow shell, including introduction of the stress function. Many practical problems have been solved, such as spherical, conical, toroidal and hyperboloid shell, elliptic and hyperbolic paraboloid, as well as conoid shell.

The fourteenth chapter is concerned with the bending of the cylindrical shell which is loaded in an axially symmetric way. Long and short cylindrical shells are treated. Krylov's functions are defined and tabulated. The influence coefficient are derived and tabulated in order to facilitate of the solution of practical problems.

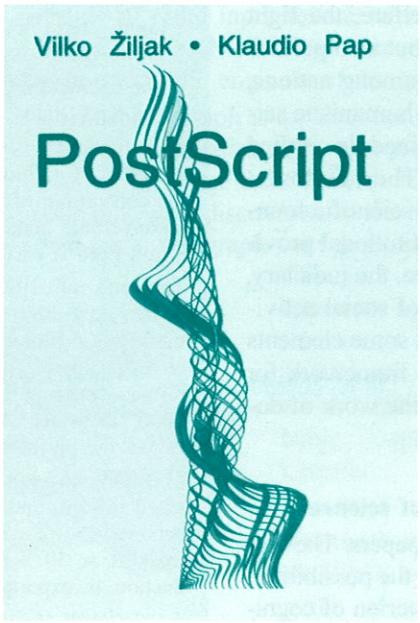
Chapters Fifteen and Sixteen contain an exact and approximate bending theory of the shells of revolution. The approximate theory applies to the shell of arbitrary generatrix. Finally, complex, thin-walled structures, tanks, containers pipelines, pressure vessels etc. are analysed.

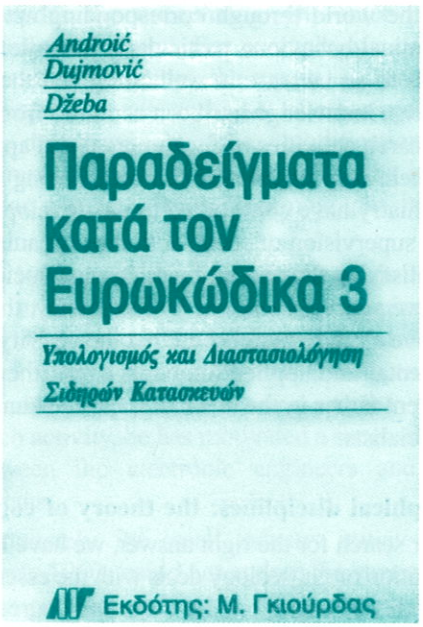
In the last, seventeenth chapter a short survey and the main features of Bessel's differential equation and Bessel's function are given. Thomson functions necessary for the solution of the shell problems are very extensively tabulated for the argument up to 40.

This book is written primarily for students and practitioners in Mechanical and Aeronautical Engineering fields, as well as Naval Architecture, however it may be used by students of Civil and Petroleum Engineering, Mining and other Engineering students.

Boris Andrić, Darko Dujmović, Ivica DŽeba, Examples according EC 3 Standards reviewed previously in Engineering Power 1(1) 1998, p. 8, published in Greek language while in German language.

Vilko Žiljak, Klaudio Pap, Postscript, PRINT & PUBLISHING International Verlags, Wien 1999, ISBN 3-9501090-5





In Search of a General Theory and Methodology of Technical Sciences

1. Fundamental and Applied Sciences: Origin and Characteristics

Fundamental sciences correspond to man's desire to get to know and understand the world that surrounds him. Applied sciences, on the other hand, correspond to man's desire to find a better, faster and easier way to carry out the work he does or would like to do. The purpose of the former is to discover the truth in the field of reality, simply to satisfy human curiosity. The aim of the latter is to act as successfully as possible in trying to increase strength and well-being and to secure health, prolong life and make it as beautiful as possible. The achievements of fundamental and of applied sciences differ from the outset: the first are scientific discoveries, and the second are inventions and discoveries.

Many books have been written about the development of sciences, discoveries and inventions. They tell us about our ancestors who have carried this progress from the beginning of history until today. One of these books has described and systemised all inventions. Its title is "Eureka! How and when the most important inventions were created". The book is divided into five large sections and each of them has its introduction in which there is a brief review of the inventions in a particular area. The book contains many thoughts on the inventors and inventions. All inventions do not require the same inventiveness and pre-knowledge. Some inventions were the result of very little observation and logical thinking, while others could not have been achieved without a significant volume of previously acquired knowledge. How an invention is arrived at seems utterly unpredictable. When an aeroplane was invented, birds and their wings were taken as models. In the field of medicine, many things happened by accident. On the other hand, there have been well-planned and specifically -directed research activities. Inventions usually take place in a paticular field of applied sciences and activities, but very often they occur outside them. There have been many inventions linked to a wide area of culture. When reading this book, we become aware that whatever is around us, except for our natural surroundings, is the result of inventors' work. They came to their inventions by implementing the knowledge acquired in the discoveries of fundamental sciences. A question remains: How did they know what knowledge from such diverse areas to apply to solve a problem?

2. Applied sciences as part of social sciences

From the classification of social sciences from the second half of the 20th century, a group of "applied social sciences" emerged. These are sciences aimed at improving conditions in the world through corresponding activities, such as social welfare, the fight against criminal behaviour, particularly juvenile crimes and drug taking, but also politics which leads to an increase in well-being and the elimination of conflicts among nations. In these areas, knowledge has been acquired from fundamental social and humanistic sciences. Research activities of fundamental and applied sciences are intertwined. In applied sciences, there may be inventions which belong to fundamental sciences. Thus, discoveries in psychiatry have contributed to the development of psychology. The scientific foundation and supervision of social activities organised according to the constitutional provisions on satisfying the needs of citizens and society, (education, health care, the judiciary, etc.), deserve special attention. Unfortunately, there is no general theory of social activities. We have already established that the activity of librarianship includes some elements of fundamental and applied knowledge, but there is no wider theoretical framework for this statement either in the work of experts at an international level or in the work of domestic specialists.

3. Philosophical disciplines: the theory of cognition and the theory of science

In our search for the right answer, we have looked into philosophical papers. The theory of cognition or gnoseology deals with the essence of truth and cognition, the possibilities and boundaries of cognition, the ways and degrees of cognition and the criterion of cogni-

KRAŠ d.d.,
Food industry
Ravnice 48,
ZAGREB

Kraš d.d. Food industry, Zagreb has become the largest manufacturer of confectionery product in the South – Eastern Europe with 89 years of successful tradition. It produces and offers a wide rang of quality products, which include all three basic groups of confectionery products: cocoa products, flour products and candy/gum products.

Projected development by the year 2005 is based on the following strategic business objectives:

- restructuring
- competitiveness domestic and world market
- increase profit.

A new period in the history of Kraš has been initiated in the beginning of the nineties with transition from public to private owership.

In the first stage of restructuring (1992–1995), 15 million Euro of its own funds were invested in modernisation of production and information system, improvment of marketing and personnel restructuring. At the beginning of 1997, key decisions and plans that would enable Kraš to join the world market were made:

- Long – term business plan 1996 – 2005
- The restructuring programme, Kraš 2000
- International syndicated loan of 30 million Euro by a consortium of banks and convertible bond of 7 million Euro is ensured.

The end of 1998 accomplishes key investment and marketing projects. They were specified in the restructuring programme, Kraš 2000, in which 45 million Euro were invested.

The marketing strategy is oriented towards spreading and conquering of new export markets, so 30 % of the production is exported, with a

foreign currency revenue of about 35 million DEM. Kraš exports to the markets of Former Yugoslavia, Central and Eastern Europe, the USA, Canada, Australia, New Zealand and Middle East.

The process of personnel restructuring has finished, and within this process, Kraš carried out its own programme of sound care for redundant employees.

The development of human resources is realised through education and training, in Kraš business school, which operates in co-ordination with the Faculty of Economics at the University of Zagreb.

Today, Kraš employs 2.130 employees, 1.700 of which work in the main company, and 430 in the subsidiaries.

Production and sale of Kraš production stands at 23.000 tonnes, 70 % of which is sold on the Croatian market, representing a 40 % share in the Croatian confectionery market.

Within the production development programme, projects concerning the formation of strategic umbrella brands have been completed: DORINA, NAPOLITANKE, KI-KI, VIC, BAJADERA, GRIOTTE, PETIT BEURRE and DIABETIC ASSORTMENT.

The Croatian Chamber of Economy awarded the world – famous Kraš products – Bajadera, the prestigious labels Croatian creation in 1998, and Griotte – Croatian quality in 1999.

Quality management is being implemented by the application of the ISO 9001 Certificate that was awarded to Kraš by Lloyd's Register, London.

The protection of environment is an integral part of the business policy and development. Kraš was thus awarded the prestigious EKO OSKAR in 1998 on the occasion of the World Day of the Protection of Environment.

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tion. A very closely connected theory is the theory of science or epistemology which limits the issue of cognition to the framework of scientific and research activities and to other aspects of science, such as its methods and systematics. Epistemology is more and more connected to some corresponding sciences and besides a general epistemology, particular epistemologies are developed. There is also logic and methodology. Logic studies the forms of valid thought and the methods of scientific cognition. Thus, methodology is part of logic on the one hand and part of the theory of cognition or epistemology on the other.

We have studied a large number of books, from textbooks to the most important works of the theory of science and the methodology of scientific work. All these works deal with only the basic sciences, i.e. natural, social and humanistic sciences. Inventions and applied sciences are not mentioned at all. All philosophers of science have dealt with the issue of truth and the acquisition of true, scientific knowledge. They have not tackled the issue of success in work. Therefore, we decided that we had to turn to the professionals of the most successful applied sciences, i.e. technical sciences.

4. Is there a general epistemology of technical sciences?

Having decided that the epistemology of technical sciences could offer us more useful knowledge of all the applied sciences, we found two major works: The Technical Encyclopedia and the Collected Papers from the scientific conference "Development and Achievements in Technical Fields in Croatia". We studied them on the basis of the following issues: (1) A list of technical fields, (2) Names and definitions of fields, (3) Headwords "Invention" and "Discovery", (4) Besides data on particular fields, is there any information on the entire group of technical sciences; what would the elements be of a general epistemology of technical sciences? We found the following:

1. In the Technical Encyclopedia, the following areas are covered: Aerotechnology, 2. Architecture, 3. Shipbuilding, 4. Electrical Engineering, 5. Geodesy, 6. Civil Engineering, 7. Chemical Technology, 8. Mechanical Engineering, 9. Metallurgy, 10. Nuclear Technology, 11. Mining Industry, 12. Textile Technology. In the Collected Papers, the same areas are represented, except for Aerotechnology and Nuclear Technology but with the addition of the areas of Food Processing Technology and Biotechnology, Traffic and Graphic Technology.

2. From the terms and explanations, it is clear that these are most commonly seen as both sciences and activities. We quote: "a branch of science and technology", "a science and a skill", "a branch of economy", "an economic and social activity". As for geodesy, it says that it belongs at the same time to natural sciences, technical sciences and social sciences. We have noticed that such a variety of content is not obvious in the designations of areas. The very names speak of technical areas or of activities (according to the ending, "-ing").

3. In the Technical Encyclopedia, among many headwords, we could not find the words "invention" or "discovery". The Collected Papers do contain the concept of "invention", but not in the sense that we are interested in.

4. At the end of the Collected Papers there are reviews that deal with all the technical sciences. These are the works by Miroslav Mirković, on the Technical Museum in Zagreb, by Leo Budin on Higher Education in the Field of Technics and Technology; by Juraj Božičević on the Role of Technical Sciences in the Croatian Economy; and by Željko Topić on Intellectual Products, Inventions and Patents. In each of these papers we were able to find the ideas that we were looking for that were close to epistemology. The intention for the Museum to become a scientific and technical centre proves that a need for such a centre has always been present in the minds of technical experts. As for higher education, a need for the education and training of future experts for inventive work (radical innovations) is emphasised. One of the reasons for the establishment of the Croatian Academy of Technical Sciences in 1994 was the atomisation of technical disciplines. They can make progress and be included in extensive global projects only if they act together and cooperate. These ideas were expressed in 1994, but for the future the destiny of the general epistemology of technical sciences is still not clear.

In the area of social sciences and activities, new academic disciplines are emerging which require a theoretical foundation. They apply the methods of both fundamental and applied sciences and would welcome the epistemology of technical sciences to help them describe their procedures of invention.

Mira Mikačić

Conference News

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The Fourth Multidisciplinary Symposium

Modelling in Science, Techniques and Society

Technical Faculty University of Rijeka
Rijeka, June 19-20, 2000

In our address to participants of the First Symposium, we emphasized the important role of modelling and its benefits to communication of scientists, engineers, economists, sociologists and other professionals and on the selected examples pointed out the usefulness of multidisciplinary gathering and exchange of ideas and experience. Now, we extend an invitation to our Fourth Multidisciplinary Symposium at which we particularly intend to motivate discussion on communication and organization of knowledge by means of modeling:

- epistemology of modelling,
- mathematical modelling,
- experimental methods in modelling,
- computer simulation,
- CAD
- virtual reality,
- applications,
- education.

Prospective authors are invited to submit original and previously unpublished papers according to the listed topics. Abstracts in advance, clearly explaining the contribution, it's originality and the relevance of the work, are expected.

Submitted abstracts should be restricted to a maximum length of one page and have to be submitted in paper form. The speaker should be clearly identified.

The abstracts will be reviewed by the Programme Committee. The authors of accepted papers will be asked to submit a full paper of 10 pages to be included in the printing of the Conference Proceedings. Detailed information for authors will be provided with acceptance.

Deadline for receipt of abstracts:
December 4, 1999

Notification of acceptance:
January 4, 1999

Deadline for ready-for-press papers:
May 6, 1999

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