SPOŠTOVANE BRALKE IN SPOŠTOVANI BRALCI,
tokrat objavljamo prvi prispevek v novi rubriki Pogledi v zgodovino. Štiridesetletnica Slovenskega društva INFORMATIKA je odlična priložnost, da usmerimo pogled tudi v preteklost, v začetke in razvoj računalništva in informatike v Sloveniji in okolici. čeprav se je v tem času informacijska tehnologija razvijala s hitrostjo, ki je neprimerljiva s hitrostjo razvoja marsikaterega drugega področja človekovega delovanja, pa se iz zgodovine in aktivnosti posameznikov in organizacij v tistem času lahko marsikaj naučimo in uporabimo tudi v današnjem času. Zato je pomembno, da razvoj računalništva in informatike v Sloveniji ne gre v pozabo. Prispevki v tej rubriki bodo pretežno odražali poglede avtorjev in njihovo poznavanje dogajanja, ki je pogosto specifično in zajema le posamezna okolja. Zato vabimo vse bralce, ki ste bili udeleženci tega razvoja ali ga dobro poznate, da nam pošljete svoje prispevke k zgodovinskemu spominu, ki jih bomo z veseljem objavili.

Uredništvo revije Uporabna informatika

A contribution to the history of computing and informatics in West Balkan countries

[1]Marijan Frković, [2]Franci Pivec, [3]Niko Schlamberger, [4]Janez Grad
[1]Croatian Computer Society
[2,3]Slovenian Society INFORMATIKA
[4]University of Ljubljana
marijan.frkovic@hiz.si; franci.pivec@izum.si; niko.schlamberger@gmail.com; janez.grad@siol.com

Abstract
The history of computing and informatics in the region which is today known as the West Balkan countries has not been systematically and methodically considered so far. There exist a limited number of books that are more or less memoirs and therefore provide a rather narrow and specific view. The ambition of this paper is not to offer a comprehensive overview of the beginnings of deployment of computers in former Yugoslavia, but rather to serve as a seminal paper for those that wish to explore the issue in depth. In particular, the paper covers the deployment of the first computers in Slovenia and Croatia and the influence the process has had on the development of related businesses, professions and science.

Izvleček
Prispevek k razvoju računalništva in informatike v državah zahodnega Balkana
Zgodovina računalništva in informatike v regiji, ki je danes poznana pod skupnim imenom zahodni Balkan, do sedaj še ni bila obravnavana niti sistematično niti metodično. Sicer obstaja omejeno število knjig, ki pa so predvsem spomini in omogočajo zgolj površen in omejen vpogled. Ta članek ne predstavlja celovitega pregleda začetkov računalništva v nekdanji Jugoslaviji, ampak izhodišče za tiste, ki bi želeli to področje raziskati podrobneje. V članku sta še posebej opisana uvedba prvih računalnikov v Sloveniji in na Hrvaškem ter vpliv, ki ga je ta proces imel na razvoj povezanih dejavnosti, poklicev in znanosti.

1. INTRODUCTION

The paper deals with the history of computing and informatics in the countries, as they are known today, of the West Balkans. However, it is actually about the history of computing and informatics in the countries that have come to existence as successors of the federal republics of the former Socialist Federative Republic of Yugoslavia. The denomination WBC is therefore somewhat misleading as the paper does not take into account the history of computing and informatics in Albania, which is certainly part of the WBC as well. Also, it cannot be considered complete since it does not deal with the respective aspects of history in Bosnia and Herzegovina, Kosovo, Montenegro, Macedonia and Serbia. Individual contributions have appeared in the IT STAR Newsletter (Vol. 6, No. 4, 2008, and Vol 12, No. 1, 2014). The former provides the story of the first computer ZUSE Z-23 installed in Slovenia, and the latter the story of development of the first Serbian-made electronic computer CER-10. To our knowledge, apart from Croatia, Slovenia and Serbia, neither computers nor peripherals were produced in the rest of the former Socialist Federative Republic of Yugoslavia. Also, the introduction of computers there was rather slow and conservative, which is understandable as the three aforementioned republics of Yugoslavia were most economically advanced. Nevertheless, we should not neglect the achievements in applied computing and informatics that have come about in the period following 1975. In 1980s, a notable achievement was recorded: namely, Suad Alagić from Bosnia and Herzegovina developed at that time one of if not the most advanced concept of a data base management system. The reason why his concept was not deservedly recognized is probably the same as with the relatively short-lived success of the Triglav/Trident computer, described further in this paper.

The history of computing in WBC can be roughly divided into three periods: before 1965s, 1965s to 1975s and post-1975s. The division is arbitrary and reflects the authors' perceptions and experiences and could be argued. Before 1965, the deployment of computers was limited to their purchase and use mostly by university. After 1965, computers were also used for commercial purposes; training centres were established and the first faculties for computing and informatics were founded. In the seventies, the state[1] developed an ambition to produce its own computers. First began the licensed production of computer peripherals in the then federal republics of Croatia and Serbia, followed by the licensed production of computers in both. This effort culminated with in-house production of minicomputers in Slovenia. Parallel to hardware production, also noticeable development of software can be registered, starting with general-purpose application software. After 1975, the achievement of Suad Alagić should not be overlooked as his data base management concept was probably the most revolutionary of the period.

2. A BRIEF HISTORY OF COMPUTING AND INFORMATICS IN CROATIA

2.1 Before 1965

In Croatia, the development and manufacture of computers started in 1948 when Tvornica računskih strojeva Zagreb (TRS, Zagreb Computing Machines Factory) was set up, the first of its kind in Croatia. Initially, the factory produced mechanical computers. From 1948 to 1973, no other computer manufacturers were present in Croatia. The pioneer in the field and the person responsible for building the first digital computer in Croatia was a Croatian scientist, a doyen of computer science in Croatia and worldwide, Professor Branko Souček, PhD. He developed and in 1959 together with the team from the Ruđer Bošković Institute carried out the project dubbed »256-channel analyzer, memory, logics and programs«, which marked the beginning of computer science development in Croatia. In the sense of achievements of the then technology, Professor Souček's computer was state-of-the-art: logic gates were based on vacuum tubes, the memory used magnetic cores and the programmes were performed at the unbelievable speed of a million cycles per second, which was downright incredible at the time. The device was placed in a 2 meter high cabinet and a cathode ray tube was used as the output for displaying the data.

After the first fully functional prototype at the beginning of 1960s, the Ruđer Bošković Institute together with a group of enthusiasts who were involved in Professor Souček's project, made a series

[1] i.e. the Socialist Federative Republic of Yugoslavia

of these computers that were used at the Institute as well as by other institutions. The computers were put to good use at the Institute while Professor Souček's project aroused the interest of scientific communities worldwide, resulting in visits to the Institute by many scientists from all across the world with the intent of copying Professor Souček's computer. One of the persons to visit the Institute was William A. Higinbotham, the director of BNL (Brookheaven National Laboratory) from the US, the biggest institute for scientific research in the world, which meant that the work of Professor Souček, i.e. the beginning of computer science in Croatia, was recognized globally.

When we look at the importance of Professor Souček's project today, we should remember a series of facts related to world trends in computer science from the period: in 1956, Japan-based Fuji developed a computer for the calculation of optical systems production with 1700 vacuum tubes; in 1957, the first FORTRAN compiler was developed and in 1958, the first prototypes of integrated electronic circuits. In 1959, the Japanese company NEC produced the first commercial transistor-based computer (transistor computer) while the first commercial mini-computers were developed at the beginning of the 1960s (DEC PDP-1 in 1960 and DEC-PDP-8 in 1965). In Croatia, the use of computers and the development of information systems also started in that period, and was based mainly on imported equipment. Due to substantial prices, only large organizations could afford to buy computers. Although the equipment only had limited capacity, highly trained staff was able develop complete applications, thus compensating for the restrictions.

2.2 From 1965 to 1975

Initially, TRS, like most of producers worldwide, would only manufacture mechanical computers. During 1968 in Croatia, the first electronic calculator incorporating an optical display was developed. The calculator was based on 100 10-component integrated circuits produced by RIZ in Croatia.

At the time, no LSI or VLSI-chips were available while integrated circuits of high and very high degree of integration were still to be developed. TRS's calculator was, in the sense of the number of components and external dimensions, one of the smallest desktop calculators in the world. A couple of years later in 1972, the first 1-chip (desktop and pocket variant) and printing calculators would appear. The first calculator in Croatia was designed in 1973 and production was started by Digitron Buje.

It was in the same year that TRS produced the first Croatian printing calculator. TRS would also produce general purpose computer equipment. At the end of 1969, TRS became the distributor for Nixdorf, in turn developing a concept of distributed data processing. From the first computer independently produced in Croatia in 1974 to the end of 1988, TRS produced and installed several thousand units of series 700 and 900 computers manufactured in-house, fitted primarily with own-produced keyboards, video terminals and printers, as well as operating systems and user software. During the period, TRS also collaborated with MDS and Metalka based in Ljubljana, Slovenia, in the production of series 711 computers, as well as with IBM in the production of Series 1 and System 1 devices equipped with peripherals from Croatia, intended for use in the economy and by schools, railways and others.

From 1973 to 1987, many other companies in Croatia started to engage in the production of computer equipment. However, the public and professional organizations insisted on the non-market strategy that only one large manufacturer in Yugoslavia, and later one manufacturer in every federal republic, should be granted a »mandate« from the government for the exclusive production of computer equipment. The government would also ensure the full protection of machines produced in such a manner. The companies were: in Slovenia it was Iskra, in Serbia EI Niš, in Bosnia and Herzegovina Energoinvest, UNIS and Rudi Čajavec, while in Croatia, such a company did not exist at that time.

The end of 1960s was when third-generation computers were being introduced, that is computers with real-time applications, with the capacity to manage production processes, implement communication systems, databases, as well as multiprogramming and multiprocessing which enabled coupled with faster processing units and a larger external memory the development of integrated information systems for the economy and public administration. With respect to equipment production, the most prominent players were IBM, UNIVAC, ICL, Burroughs, BULL GAMMA, Honeywell and PDP.

At the beginning of 1973 in Zagreb, the Impuls business association was set up with the purpose of

bringing together every notable producer of telecommunication, electronic and computer equipment in Croatia. The founders were Nikola Tesla – Tvornica telekomunikacijskih uređaja, TRS and ELKA – Tvornica električnih kabela, all of them based in Zagreb. During 1974, an idea was sparked that the development of computer equipment production in Croatia could progress in collaboration with only a single technologically developed foreign partner capable of reliable financial backing. As a result, in 1976, the Government of the Republic of Croatia upheld the initiative and contacted ICL and SPERRY UNIVAC. In other parts of Yugoslavia, contacts were established as well: in Slovenia with Philips, in Serbia with Olivetti and Rockwell, and in Bosnia and Herzegovina with NCR and Olympia. These contacts were the result of a computer equipment import ban due to the lack of foreign exchange resources.

Continuing the development of computer science in Croatia, in 1966 Professor Souček set up the first Laboratory for Cybernetics, and in the 1966/67 school year the first research electronic computing centre: Znanstveni elektronski računski centar – ZRCE (renamed in 1973 to the present day's Sveučilišni računski centar - SRCE (University Computing Centre). The same year, the subject Digital computers was introduced at the Faculty of Electrical Engineering and Faculty of Science; and in 1970, FEE introduced a new undergraduate course for 3rd and 4th year students dubbed Computer science alongside the postgraduate course of the same name.

The books that Professor Souček wrote at the time – Microcomputers in Data Processing and Simulation (New York, 1973) and Microprocessors and Microcomputers (New York, 1976) – made a major contribution in the development of computer science in Croatia. Professor Souček also delivered many seminars and lectures in that period throughout the world (New York, Boston, Paris, London, Rijeka, Opatija and elsewhere). There was also a seminar on Microprocessors, a 3-day event in Croatia, which in 1978 grew into the MIPRO scientific conference which is still held annually today.

2.3 After 1975

During the period, there were a number of companies that produced equipment for process management in telephone exchange, CAD CAM systems and graphics workstation, personal computers and peripherals (printers, cash registers, video terminals, discs) etc. Due to the open market, the production of hardware in Croatia developed at a steadier pace. It is important to point out that Croatian hardware production in an open market environment, without a planned development policy and funds and incentives, could not be developed to a greater extent. It is encouraging to note that as the atmosphere changed the development of Croatian software accelerated along with network development, end-user training etc., opportunities for buying foreign state-of-the-art hardware and software, while the quality of collaboration with foreign partners improved.

There were leading manufacturers of computer equipment, such as IBM, SPERRY UNIVAC (UNISYS) and others, who continued their efforts by installing and building powerful computers, developing information systems with the support of highly qualified and educated Croatian experts, which culminated into the establishment of private IT companies that positioned well in the foreign market.

3. A BRIEF HISTORY OF COMPUTING AND INFORMATICS IN SLOVENIA

3.1 Before 1965

First and foremost, it should be mentioned that the division of the history of computing and informatics is arbitrary and roughly follows the evolution of digital computers from electronic tubes to transistors and integrated circuit technology. Before 1965, the general awareness of computers, let alone of their potential to impact our lives, was virtually non-existent. More knowledgeable were technically educated individuals that perceived computers as an aid to release them of the burdens of intellectually non-demanding but arithmetically extensive tasks, such as calculating the statics for several tens to hundreds statically undefined constructions. However, the slide rule was still the main calculating aid in the technical domain while for extensive arithmetical calculations electromechanical devices were considered state-of-the-art. The first computer in today's sense was the Zuse Z-23.

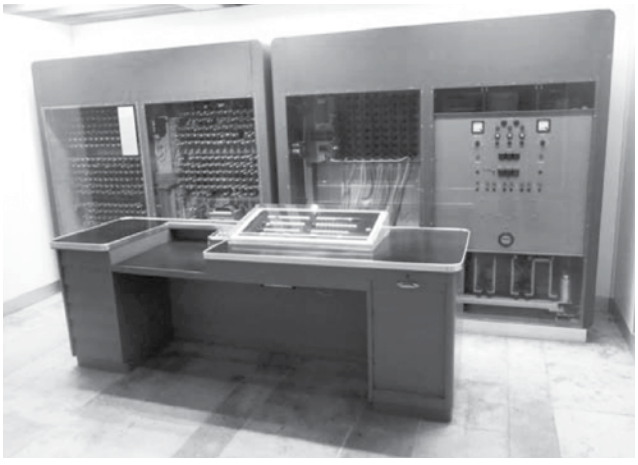

Photo 1: **Zuse in the Technical Museum in Munich**

This period of computing[2] in Slovenia is branded with the purchase and deployment of the first digital computer in the country. From today's perspective, it is difficult to understand that the choice had to have been made between the British Elliott 803 and the German Zuse Z-23. US companies did not compete. Eventually, in 1962, the Z-23 was introduced, so 1962 can be justly considered as the beginning of the computer era in Slovenia. The Z-23 was used mostly in solving academic problems and research work in physics, chemistry, mathematics, economics, electrical, machine and civil engineering etc. It was used in calculating the statics for the Ljubljanska banka building. The system contained 120 statistically undefined items and the engineers wanted to use the Z-23 to solve the problem. However, due to the lack of computer efficiency, the 120 by 120 system had to be manually reduced to 90 by 90, which took the team of three experts full three months to achieve, and it was only then that the Z-23 was able to take over and complete the task in mere days. The use of the computer in business was at the time beyond imagination. Nevertheless, the Z-23 made a public appearance during the 1967 European Figure Skating Championship in Ljubljana where it was used for adding up the scores.

3.2 From 1965 to 1975

It is remarkable to notice that during the period, an extremely novel and for the circumstances rather ambitious idea was born and also came into fruition. Namely, Slovenia-based Intertrade succeeded in obtaining the license to import IBM computers and peripherals and to distribute IBM products in the territory of the then Yugoslavia. From today's perspective, we can judge this move as the major breakthrough not only in the deployment of general purpose third-generation computers, but also as the catalyst for a myriad of aspects of accompanying activities. If computers were to be useful, they had to be supported in various ways. Technical support is one of the obvious activities that is inseparably connected to every type of technical apparatus. Customer support had to be developed to assist customers with transferring parts – at that time – of business activities onto computers, which required the training of the customers' personnel in systems analysis, programming, organization of data centres and more. At the same time, the vocabulary of computing and informatics also had to be established since no university study courses of computing and informatics existed. Electrical engineers were the only group of tertiary educated individuals with a grasp on computing essentials due to their education and understanding of the technical background, as well as mathematicians who understood the theoretical aspects of computing. Faculties of computing and informatics were not established until much later.

During this period, every major computer company had a foothold in Yugoslavia, however because of strict import and export regulations, they were restricted from establishing their own representation offices. Instead, they were represented by national companies that conducted their business in the latter's names and on their behalves. The companies that were represented then were UNIVAC, National Cash Register, RCA, General Electric, Control Data Corporation, Honeywell, Burroughs, Digital Equipment Corporation, Olivetti and others, along with providers of IBM-compatible peripherals such as magnetic tape devices and magnetic disk drives[3]. Of course, it should not be overlooked that IBM at the time made the greatest contribution to development in the field of computing and must also be credited as the pioneer of informatics as a science in line with today's perception. The IBM computers of the time were – technically speaking –

[2] Then, informatics as the discipline which goes hand-in-hand with computing did not yet exist.

[3] Computers provided an impulse for the economy at large; i.e. one of them were punch cards which were produced locally.

probably no better or worse than their competition but what provided the leading edge was the support organized using IBM's know-how, experience and knowledge. The result was that at least the major business in Slovenia and practically every federal institution, notably the Federal Statistical Office and Public Accountancy Service, were IBM customers. The prevailing argument was the support which was organized based on the IBM model. One feature was the establishment of branch offices in Belgrade, Zagreb and later also in Sarajevo, making sure customers always had access to system engineers. Soon, Intertrade established a customer training centre in Radovljica, approximately 50km from Ljubljana near the Austrian border where customer personnel from all of Yugoslavia underwent training in programming, system analysis and other related skills necessary to utilise computers most efficiently. IBM personnel was however trained based on the established IBM training scheme primarily in IBM training centres throughout Europe and elsewhere. The training centre later extended its operations to function as the regional IBM training centre for Central and East Europe.

3.3 After 1975

Along Intertrade, another Slovenian company which ought to be highlighted is Elektrotehna as it successfully qualified as a DEC representative. The division of Elektrotehna engaged with DEC computers was labelled Digital and operated quite successful, resulting in the foundation of Delta which remained part of the Elektrotehna Group[4]. The circumstances, that is business success, difficulties in providing the necessary convertible currency, a number of enthusiasts from the Ljubljana faculty of electrical engineering, possibly also the aftermath of the IFIP 1971 World Congress in Ljubljana, resulted in the idea to engage in the production of proprietary computers. The project was to use the original equipment manufacturer (OEM) approach to build a DEC compatible computer. The approach was promising as the US government was cautious about which countries US companies could export computers into. A Yugoslavian company from among the ranks of the three countries behind the idea of the Non-Aligned Movement appeared a good prospect to overcome the embargo that US government imposed on the export of computers. Nevertheless, as the essential components of computers, that is micro circuits and chips, were not produced in Yugoslavia, they still had to be obtained by Delta from DEC which seemed perfect as the computer was planned to have been DEC compatible. Eventually, efforts were successful and the first Slovenian computer, the Delta 340, was developed. The project focused particularly on technology process support as well as the development of applications to enhance business processes. The company later joined another business association, namely Iskra Group, and changed its name to Iskra Delta. The success continued partly due to the political support it enjoyed, partly due to daring business decisions, as well as the awareness of the importance of well-organized customer and technical support and own research and development. Furthermore, Iskra Delta also founded a training centre in Nova Gorica nearby the Italian border. After Delta 340, the company developed a three-processor microcomputer dubbed both Triglav (for reasons of national pride[5]) and Trident (to promote sales in the West). At the time of its introduction, it was probably among the best computers in the class in the world. The success story of Iskra Delta which just before its expiry employed over 2000 people ended with the massive political and economic changes at the end of 1990s that resulted in the dissolution of Yugoslavia and the company has since been closed down. The reason was according to the memoirs of the director of Iskra Delta a clash of interests between the CIA and KGB, where the termination of the company was collateral damage. However, if we are to apply the Occam's Razor principle, it seems more likely that the management did not understand the realities of the world. To become a global player, massive resources are required which were simply not available.

Later, in the beginning of 1980s, Intertrade also developed an ambition to produce its own computers. Whether it was a result of a sensation that the company is just as able as Iskra Delta to join the prestigious race or if another factor was at play is hard to tell. Also, the times were different in that the personal computer has already made its entrance and was obviously there to stay. It is fact that the company started assembling IBM PCs and achieved modera-

[4] The situation has been simplified, as the regulatory system was much different from what it is now or what it was in the West at the time.

[5] Triglav, 2864 m high, the highest mountain of Slovenia and also the highest mountain of the then Yugoslavia.

te success. Together with the computer, the project team under the leadership of Matjaž Čadež developed also a limited number of general purpose application programmes. The one that springs to mind is PCPIS, a word processor that at the time represented a notable achievement. However, even before the 1990s, production was terminated. Today, global players are represented in Slovenia as independent companies, established under Slovenian law and engaging in business activities more or less in the same manner as throughout the rest of the world.

What is there to say to conclude this brief outline of the history of the Slovenian computer industry? It was a great run, but it appears like the dream of world domination through home-made computers has come to an end.

4. DEVELOPMENT OF COMPUTING AN INFORMATICS AT THE UNIVERSITY OF LJUBLJANA

Considering the beginnings of the computer era in Slovenia, it would be unfair not to mention the role that the academic sphere played in the process. The chapter[6] brings up first and foremost the importance of the Republic Computing Centre (RCC) and the University[7] Computing Centre. Professor Grad has been active from 1960 onwards after having joined the then Nuclear Institute Jožef Stefan (NIJS) in Ljubljana (later renamed Institute Jožef Stefan (IJS)), that is the very beginnings of deployment of computers in the Slovenian business, research, and education domains, with special regard to research institutions in Ljubljana and Maribor. Below follows the information that the authors believe to be the integral element of a well-adjusted presentation of development of computing and informatics in Slovenia.

The most important players in the 1960s were Intertrade and the University of Ljubljana. Intertrade satisfied a considerable part of business needs via IBM technology while at the University, it was NIJS that took the role of initiator. The University also established an alliance with the United Company Iskra, the Executive Council of the Socialist Republic of Slovenia, Research Community Slovenia, and Education Community of Slovenia[8], the latter two being the main providers of research financing. For research purposes, NIJS began using the IBM 705 at the Federal Statistical Office in Belgrade. In 1962, the University and NIJS, which at the time was an independent research organisation, migrated their data processing to the Zuse Z-23 that was installed in Ljubljana in collaboration with UC Iskra which started the licenced production of the Z-23. University researchers were engaged with the company in the development of Z-23 system software.

In order to exploit the benefits of the fast developing computer technology based then predominantly on batch-oriented data processing without the use of telecommunication equipment which was too expensive and even wasteful for any individual organisation to own as it could not have been utilised to its full potential, the above mentioned entities established the RCC, chaired by Janez Grad, MSc, and procured for its operations the CDC 3300 computer. The location of RCC was rather distant from the University, so the University in turn purchased the IBM 1130 computer for education purposes. It was installed at the Institute of Mathematics, Physics and Mechanics. To facilitate coordination of activities among university members, the IJS and RCC, the University established the Computing Centre of the University of Ljubljana (CCUL) under the leadership of Janez Grad, PhD. Business collaboration between the University, the IJS and RCC were overseen by the Business Board of the CCUL while the Professional Council for Computing headed by Jernej Virant, PhD, was established to provide guidance in the field of computing and informatics. University members would use the central computer facility to perform any special tasks, as well as smaller computers which were incapable of communicating with the central one.

The need for computing power increased rapidly, so RCC in 1971 decided to purchase a significantly more powerful model labelled CDC CYBER 70 with remote access capabilities by means of terminals. The new temporary director of RCC was appointed Edo Pirkmajer, PhD, to be succeeded by Cveto Trampuž and Desan Justin, PhD. To make better use of the new computer, new users were engaged through time, among others the Ljubljana Dairy Company, Obnova Construction Company, the National Bank of Slovenia, Republic Roads Company, and Slovenian National Publishing Company.

[6] Courtesy of Professor Janez Grad
[7] i.e. University of Ljubljana
[8] It should be added that the names of companies and institutions of that time are rather hard to translate into any language of today.

More than 20.000 students in faculties and academies were using the central computer both in batch and interactive modes, increasing the workload, so in 1981 CCUL decided to set up a new computer network where University members would become entry points. The existing CYBER 70 was seen as no longer appropriate for the architecture and the choice was made to migrate to DEC System-10 computers. The new system was composed of 10 nodes with Delta computers and the Kopa 1000[9] and LA 34 terminals. In the following years, the system was eventually developed and made operational while Franc Mandelc was appointed head of CCUL. CCUL took big steps in 1987 and 1988 when the DEC System-10 was succeeded by two VAX 8550 computers controlling a network of 200+ terminals and personal computers. In that period, Yugoslavian telecommunication companies constructed the JUPAK[10] network via which the University was connected to computers in Slovenia and Yugoslavia as well as Europe. This enabled the this way, direct exchange of information between universities within the country and as well as worldwide using electronic mail (BITNET, COSINE) and maintaining and deploying of common data bases.

The development of computer technology by Slovenian universities and the society as a whole has been accompanied with intense research, development and educational activities in various organisations and companies such as the Slovenian Society INFORMATIKA, Society of Economists of Ljubljana, ISKRA Institute for Automatization, ISKRA Delta, Intertrade and others. Their activities have helped recognize the business potential of computing and informatics and introduced them into study and research programmes of practically every tertiary education course but to some extent also into secondary education. These activities and results should not be forgotten, and they should be made public and remembered to make possible a fair assessment of the role and influence that research and education have had on the development of computing and informatics in Slovenia. The list of examples below is illustrative, however far from exhaustive:

- organisation of conferences, symposia and similar events such as FCIP, INFORMATICA, IFIP, DSI, SOR, and related papers;
- creation of professional papers, studies, reports on research projects, CCUL development plans, program products, such as
  - Physical Calculations for YEGGR (a preliminary study for nuclear power stations) by the Reactor Department of NIJS, Ljubljana, 1962, carried out by Milan Osredkar, PhD et al.; the study contains a computer program for IBM 705 by J. Grad;
  - Study Material IV – Elements of Automatic Data Processing in Public Administration and Societal Services, Institute for Public Administration and Labour Relations at the Faculty of Law in Ljubljana, Ljubljana, November 1969 (9 papers, 5 overviews and schemes);
  - (1) A Study on Information Processing in Slovenia, (2) Program for a Data Processing Project in SK Bank, Ljubljana 1970, 25 authors;
  - Electronic Computers, published by Association of Electrical Engineers of Slovenia, Ljubljana, 1971, at the occasion of IFIP World Computer Congress 1971 in Ljubljana;
  - Computer Science, materials for secondary grade teachers, Institute for Education in Socialist Republic of Slovenia, 7 authors;
  - Bulletin of the University of Ljubljana, Computing, Ljubljana, 1971 to 1979, head of Professional council J. Virant, PhD, CCLU representative J. Grad, PhD;
  - System Tor Treating Documentation Information of Various Data Bases, Phase I, ISKRA Institute for Automatization, Ljubljana, 1973, A Research Project report, Vera Mirt-Levovnik et al.;
  - The experience of operating the University Computing Centre with other users. Sperry Univac International Executive Centre, COMPUTERS IN EDUCATION AND RESEARCH Symposium, Rome, Nov. 18–20, 1975, by Janez Grad;
  - Mid-Term Development Plan of the Computer System of the University of Ljubljana 1976–1980, University of Ljubljana, Computing Centre of the University of Ljubljana, Ljubljana 1977, signed by 20 authorised representatives of the members and the rector of the University;

[9] The terminals were produced in Slovenia.
[10] Yugoslavian packet switching network

– First Working Report (December 1976) and Second Working Report (November 1980), Committee of Social Planning and Information System, Working group for republic program for education workforce for computing and informatics, by J. Virant et al.;
– Organisation of Information Centre I – III, research report, Computing Centre of the University of Ljubljana, 1975, 1976, 1978, by Janez Grad et al. (14 + collaborators);
– Computer Network of the University, University of Ljubljana, Computing Centre of the University of Ljubljana, Ljubljana, 1981, main editor Janez Grad, editor in charge Franc Mandelc et al.;
– PC LIP and PC LIP, program package for linear programming, Intertrade IBM, Center for Software Development, University of Ljubljana, Faculty of Economics, Faculty Centre for Informatics, Development and Sales of Software, Ljubljana, 1986–1987, led by Janez Grad, PhD, et al. (two collaborators);
– Glossary of Business Informatics, Society of Economists of Ljubljana, Ljubljana, 1987, by Ivan Turk, PhD, et al. (37 collaborators);
– A Little Dictionary of Computing, English-Slovenian, Slovenian-English, Cankarjeva založba, Ljubljana, 1993, professional editor Matjaž Gams, PhD, et al. (9 national coordinators of computer terminology, 80 collaborators);
– Several professional papers and editorial work for a number of professional journals, also for Slovenian Society INFORMATIKA (Informatica, Applied Informatics);
– Textbooks for computing and informatics for faculties and similar educational institutions, such as
  – Ivan Bratko, Vladislav Rajkovič: Introduction into Computing, National Publishing Company, Ljubljana, 1974;
  – Long-term collaboration with the Centre for Programmed Learning, Ljubljana, chaired by Aleksandra Kornhauser, PhD.

- International cooperation, such as the cooperation within COST (Cooperation scientifique et technique) projects COST 11 – The European Informatics Network (Tomaž Kalin, PhD), and COST 12 – The European Computer Software Library (Janez Grad, PhD).

5. SOURCES AND REFERENCES

[1] Pivec, Franci: First Real Computers in Slovenia, IT STAR Newsletter Vol. 6, No. 4, 2008.
[2] Hristovic, Dusan: The First Digital Electronic Computer in Serbia, IT STAR Newsletter Vol. 12, No. 1, 2014.
[3] Schlamberger, Niko, personal recollections and experience
[4] Škrubej, Janez: Hladna vojna in bitka za informacijsko tehnologijo (The Cold War and the Battle for Information Technology), Ljubljana 2008, ISBN 978-961-6361-98-9.
[5] Grad, Janez: Development of Computing an Informatics at the University of Ljubljana (draft, non-published), Ljubljana, 2015.

▪

Marijan Frković je predsednik hrvaške informacijske zveze (HIZ) in nacionalni koordinator ECDL. Z informatiko se ukvarja več kot oseminštirideset let: štiriindvajset let je delal v železarni Sisak – od programerja do člana poslovnega odbora za informatiko Đ, kasneje pa na Centru za informatiko hrvaške gospodarske zbornice. Sodeluje v mednarodnih združenjih CEPIS, IFIP, IT STAR in ECDL. Bil je član delovnih skupin za razvoj svetovne zbornične mreže, v mednarodni trgovinski zbornici v Parizu (ICC) in za e-poslovanje. Sodeloval je v številnih telesih vlade Republike Hrvaške. Bil je med pobudniki digitalne agende za Evropo 2020 na Hrvaškem in ECDL Za konkurenčno Hrvaško. Sodeloval je pri izvajanju več informacijskih projektov v gospodarstvu, bankah in državni upravi.

▪

Franci Pivec je po prvotni izobrazbi filozof in sociolog, kasneje je opravil magisterij iz informacijskih znanosti ter petnajst let delal na področju informatike (IZUM Maribor). V tem času je bil aktiven v Slovenskem društvu INFORMATIKA (tudi podpredsednik) ter v mednarodnih združenjih FID (član upravnega odbora) in IFIP (slovenski predstavnik v TC9 in še vedno član SIG Etika računalništva). Poldrugo desetletje je bil urednik OZ – Organizacija znanja, ki je indeksirani časopis za področje knjižnične informatike. Njegova strokovna bibliografija zajema predvsem področje nastajanja informacijske družbe s posebnim poudarkom na etičnih vprašanjih.

▪

Niko Schlamberger je diplomiral na Fakulteti za strojništvo Univerze v Ljubljani. Delovne izkušnje obsegajo delo v industriji, pretežno pa v računalništvu in informatiki: programiranje, sistemsko analizo in razvijanje računalniških rešitev, predavanja, izvajanje usposabljanja na področju informatike, svetovanje, vodenje projektov, organiziranje in izvedba nacionalnih ter mednarodnih konferenc in mednarodno sodelovanje. Bil je na vodstvenih in vodilnih delovnih mestih v državni upravi. Je predsednik Slovenskega društva INFORMATIKA, bil je podpredsednik svetovne zveze IFIP in predsednik evropskega združenja CEPIS. Je avtor številnih strokovnih in znanstvenih člankov.

▪

Janez Grad je leta 1958 diplomiral iz matematike na Naravoslovni fakulteti Univerze v Ljubljani, leta 1968 je magistriral iz matematične fizike na Univerzi v Birminghamu, leta 1973 pa doktoriral iz matematičnih znanosti na Vseučilišču v Zagrebu. Po letu 1957 je bil strokovni sodelavec na Institutu Jožef Stefan, vodja Republiškega računskega centra in predstojnik Računalniškega centra Univerze v Ljubljani. Od leta 1973 do leta 1999 je sodeloval kot učitelj za informatiko na Ekonomski fakulteti Univerze v Ljubljani, nato pa je do upokojitve leta 2007 poučeval informatiko na Fakulteti za upravo Univerze v Ljubljani. Strokovno se je izpopolnjeval na Zveznem zavodu za statistiko v Beogradu, Institutu für Strahlen und Kernphysik v Bonnu, Univerzi v Birminghamu, kot gostujoči profesor pa je delal na Univerzi v Indiani, School of Business, Bloomington, ZDA. Ukvarjal se je s programiranjem na računalniku in z numerično matematiko – reševanjem problema lastnih vrednosti in vektorjev matrik; v zadnjih letih pred upokojitvijo pa se je ukvarjal predvsem z reševanjem problemov s področja operacijskega raziskovanja in s področja baz podatkov. Je soavtor šestnajstih monografij, učbenikov in knjig, 119 člankov in referatov v strokovnih revijah ter zbornikih strokovnih srečanj doma in v tujini ter 38 poročil raziskovalnih nalog in projektov. Opravil je več recenzij člankov za domače in tuje revije, bil je član številnih domačih in tujih strokovnih združenj in zvez ter član uredniških odborov več domačih in tujih strokovnih revij. Slovensko društvo INFORMATIKA mu je leta 1995 podelilo priznanje za življenjsko delo na področju razvoja in uveljavitve informatike v Sloveniji. Bil je mentor pri dvanajstih doktorskih disertacijah, več deset magisterijih in univerzitetnih diplomah na ekonomski fakulteti. Univerza v Ljubljani mu je za njegovo delo podelila zlato plaketo in naziv zaslužni profesor; na 17. mednarodni multikonferenci Informacijska družba so mu podelili nagrado Donald Michie and AlanTuring za življenjsko delo.