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Poland*

Chip design and EDA: long tradition, bright future

Dominik Kasprowicz
Institute of Microelectronics and Optoelectronics
Warsaw University of Technology (WUT)
Warsaw, Poland
D.Kasprowicz@imio.pw.edu.pl

I. Introduction

Poland (officially the Republic of Poland) is the ninth largest country in Europe and the sixth most populous member of the European Union. Poland is a democracy, with a president as the head of state, whose current constitution dates from 1997. Poland has centuries of democratic tradition, and its *Constitution of 3 May 1791* was the first of its kind in Europe. Poland is also a member of NATO and OECD.

Poland's economy is considered to be one of the healthiest of the post-communist countries and is one of the fastest growing within the EU. With a strong domestic market, low private debt, flexible currency, and not being dependent on a single export sector, Poland is the only European economy to have avoided the late-2000s recession. Since 1989 Poland has pursued a policy of liberalising the economy and today stands out as a successful example of the transition from a centrally planned economy to a market-based economy. Recent financial crisis in most EU countries brought back home a large number of Polish engineers who, having acquired new skills abroad, are now combining them with the traditional Polish entrepreneurship to start new businesses.

Famous Poles who contributed to physical sciences include astronomer Nicolaus Copernicus, Nobel Prize winner Marie Skłodowska-Curie, Julius Lilienfeld, holder of the 1925 patent for a 'device for controlling electric current', being essentially the first semiconductor field-effect transistor, and Jan Czochralski, who invented the Czochralski process for growing single crystals, now widely used in fabrication of semiconductor wafers. More recent examples are: the founder of the Monte Carlo method Stanislaw Ulam (famous for his contribution to the Manhattan project) or Stefan Banach, who developed modern functional analysis. These traditions are being continued by Poland's 20 technical universities as well as many R&D institutes. Two of these institutes: Institute of Electron Technology and Institute of Electronic Materials Technology are directly involved in R&D in microelectronics.

II. Chip Design and EDA Presence

Development of semiconductor industry in Poland started in 1972 and CEMI, the research and manufacturing semiconductor centre in Warsaw, soon became a major supplier of integrated circuits for consumer applications (TV, tape recorders etc.) in the communist block. In contrast to the Soviet Union, Polish industry maintained the world standards in electronics and in particular in microelectronics. The deep economic crisis of the 1980s that affected the entire communist block, and ultimately brought about its fall, left the CEMI manufacturing plant with obsolete technologies, equipment and designs. When Poland left the communist block in 1990 and joined the free democratic world with its market economy, this semiconductor plant went bankrupt. Today Poland, like most European countries, does not have industrial-scale IC manufacturing plants. However, there is a mini-fab, owned by Institute of Electron Technology in Warsaw (a public R&D institute), which is used for research and small scale manufacturing of niche products, mainly MEMS.

After 1990 microelectronics in Poland followed the world trend toward fabless design. Three Polish universities (technical universities in Warsaw and Lodz as well as Academy of Mining and Metallurgy in Krakow) established ADECs – ASIC Design Education Centers for knowledge transfer to the companies, mainly small and medium-sized, active in design of electronic hardware. An ASIC design supporting action was also launched by the Institute of Electron Technology. As a result of these and other efforts there is now more than 10 companies involved in chip design, either for their own purposes or acting as fabless design houses. Some examples are: Twinteq, Inside Secure Poland, Energy Micro, Silicon Creations, Evatronix (recently acquired by Cadence), Digital Core Design, Gryf Technologia. Their products include chips and IPs for near field communication, controllers and PHY blocks for wireless and wired communication, digital cores (including the world‘s fastest 8051 core and a Java-based

Capital	Warszawa (Warsaw)
Largest city	Warsaw
Language	Polish
Area Total	312,685 km^2
Population (as of June 2012)	38,500,000
Currency	Polish Zloty (PLN)
Time zone	UTC + 1
Internet TLD	.pl

processor), power management ICs and other analog and digital designs.

All three major players on the EDA market have their R&D centers in Poland: Synopsys in Gdansk, Mentor Graphics in Poznan and Cadence in Warsaw (after recent acquisition of IP business of Evatronix). Synopsys and Cadence centers focus on design of analog and digital IPs expanding in this way their IP portfolios. In addition, Semiconductor Insights and Chipworks companies also have their R&D centers in Poland doing chip analysis and reverse engineering.

New companies appear every year taking advantage of well educated, young and ambitious Polish IC designers (and also other electronic engineers and computer programmers) and relatively low labor costs in Poland.

III. Academia

Courses in microelectronic design started in Polish technical universities about forty years ago, initially in Gdansk and Warsaw. Now microelectronic design is in the curricula of the technical universities in Warsaw, Lodz, Krakow, Gdansk, Koszalin and Poznan. All are equipped with state-of-the-art design labs running commercial EDA software from Synopsys, Cadence and Mentor Graphics. In recent years more than 200 ICs were prototyped via EUROPRACTICE and CMP Service (two European MPW service organizations) for Polish universities.

Warsaw University of Technology (WUT) is the leading academic institution in the field of microelectronic design and also in EDA research. World class education is offered not only to the university students; academic teachers from WUT participate also as instructors in intensive courses (financially supported by the European Union) given in various (mainly western) EU countries for the staff and PhD students of other European universities (a „train the trainers“ action). In 2010 a team of WUT students won the first prize in European IC Design Contest sponsored by United Microelectronics Corporation and EUROPRACTICE. Chips for such practical applications as real time data processing for LHC-based experiments at CERN, for European Space Agency and for implantable medical devices have been designed at WUT. WUT has also tradition of EDA-related research. Examples from the past include FABRICS – the first statistical process and device simulator (later redesigned and extended at Carnegie Mellon University in the USA), the first fully automated toolset for physical design of hybrid ICs (presented at ICCAD’83) and novel mathematical techniques for device simulation (presented at ICCAD’84 and in IEEE Trans. on ED). In the last 15 years the WUT research group has developed a complete toolset for full custom IC design, which also includes a manufacturing process simulator and allows to evaluate design manufacturability.

Another strong group led by Prof. A. Napieralski is at the Technical University in Lodz, focusing, among other topics, on IC and MEMS codesign, multiphysics simulation and thermal problems in VLSI chips.

The research and educational group led by Prof. P. Grybos at the Academy of Mining and Metallurgy in Krakow is famous for their world class designs of IC chips for readout channels in radiation detectors, including the first 3D ICs designed in Poland and successfully prototyped at Tezzaron.

The technical university in Gdansk collaborates with Synopsys design center in Gdansk educating mainly analog designers, while in Poznan the main interests are in digital chips for applications in telecommunication.

Many researchers educated in Poland now hold top positions in academia and industry in the USA and elsewhere: W. Maly, A. Strojwas, T. Skotnicki, M. Marek-Sadowska, J. Rajski, B. Wilamowski, M. Syrzycki, M. Ciesielski and others.

IV. Government Programs

There are no special government programs addressing microelectronics and EDA. However, grants are available for fundamental and applied research from two government funding agencies: National Center for Science and National Center for Research and Development. Moreover, in the last years many university labs were expanded and received state-of-the-art equipment, funded in part by the government funds and in part by funds provided by the European Union. The largest investment of this kind in Poland is CEZAMAT – a new multidisciplinary laboratory founded by a consortium of the country's leading universities (Warsaw University of Technology, University of Warsaw, and the Military University of Technology), four institutes of the Polish Academy of Sciences (Institute of Physics, Institute of Physical Chemistry, Institute of High Pressure Physics and Institute of Fundamental Technological Research), and Institute of Electronic Materials Technology. Intended to foster design, fabrication, and characterization of novel materials as well as electronic, fotonic, and micromechanical devices and systems, CEZAMAT will also be open to researchers from other institutions.

One of strategic programs of the European Union is ICT, in which R&D in the field of micro/nanoelectronics is one of the key research directions. Warsaw University of Technology and Institute of Electron Technology are very active as participants in international ICT projects as well as project leaders. Other Polish universities also participate in such projects.

Dominik Kasprowicz was born in Warsaw in 1976. He received his M.S. and Ph.D. Degrees in Electrical Engineering (both with honors) from Warsaw University of Technology (WUT) in 2001 and 2006, respectively. Since March 2006, he has been with the Institute of Microelectronics and Optoelectronics of WUT, where he is currently employed as Assistant Professor. His fields of scientific interest include automated optimization of analog circuits and dual-gate transistor modeling. He has published about 20 journal and conference papers. He is currently the Chair of the Organizing Committee of the IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems DDECS 2014.