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Research institutes and scientific-industrial centres in the context of innovative economy in light of experiences of the Institute of Innovative Technologies EMAG

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RESEARCH INSTITUTES AND SCIENTIFIC - INDUSTRIAL CENTRES IN THE CONTEXT OF INNOVATIVE ECONOMY IN LIGHT OF EXPERIENCES OF THE INSTITUTE OF INNOVATIVE TECHNOLOGIES EMAG

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Introduction

The main tasks of the leading scientific centres in Poland, that is, universities, scientific institutes of the Polish Academy of Sciences and research institutes are discussed. On the example of the Institute of Innovative Technologies EMAG changes adapting its role and tasks to the market environment has been shown. In short the genesis of EMAG and its 37 years of work - at the beginning as a research and development unit, recently as a research institute - is shown. Changes in approach to statutory activities and market activities in the aspect of the act on research institutes and trends in changes of the assessment of scientific units are discussed. Moreover, the existing legal conditions for public-private partnership in the context of the act on research institutes are discussed. Finally, examples of achievements of the Institute of Innovative Technologies EMAG are mentioned.

The Act on Financing Research of April 30, 2010 (Official Journal of Sciences. Number 96, position 615) distinguishes between a number of different kinds of scientific units. Each of them is obliged by a separate legal act to take certain actions. There is one common goal for all of them - conducting in a continuous way scientific research and development work.

The first centre of science is universities, including basic organizational units. The main goal of these units, according to the Act of July 27, 2005 on Higher Education, is the mission of uncovering and conveying truth through research and educating students, which constitutes an integral part of the national system of education and science. In particular, universities have the right to:

- conduct research and development work and determine the scope of research work,
- cooperate with other academic and scientific units, including foreign units, in course of work on research and development, on the basis of agreements, in order to obtain funds from carrying out research, including commercialization and supporting the mobility of scientists,

- cooperation with the socio-economic environment, in particular in the area of scientific research and development work for the benefit of commercial entities.

Another centre is scientific units of the Polish Academy of Sciences, which - according to the Act on The Polish Academy of Sciences of April 30, 2010 - are supposed to serve the development, promotion, integration and popularization of science and contribute to the development of education and national culture. Among more detailed tasks we can name the following:

- conducting scientific research and development work,
- educating students of doctoral, post-graduate courses and other types of courses,
- providing, opinions, assessments, expertise and forecasts concerning issues important for planning and implementation of state policies on the request of the president of Poland, Marshall of the Sejm or Senate, ministers or central bodies of government administration or by their own initiative,
- cooperation with universities, research institutes and scientific societies and in particular in the area of conducting scientific research and development work,
- cooperation with the socio-economic environment in the area of scientific research and development work for the purpose of implementation.

Another centre covers research institutes and, according to the Act of April 30, 2010, among their basic duties are:

- conducting scientific research and development work;
- adapting the results of scientific research and development work to the needs of practice;
- implementing the results of scientific research and development work.

Moreover, there are:

- the Polish Academy of Arts and Sciences, which runs scientific activities in the area of propagating knowledge,
- other organizational units with legal personality and headquarters in the territories of the Republic of Poland, including enterprises with the status of research-development centre, which also run scientific activities.

The above shows that research institutes have to face strong competition from other scientific units as - apart from the Polish Academy of Arts and Sciences - each of them has the capacity to conduct research and development work and to cooperate with the commercial environment and conduct implementations. In this context the legal regulations included in the Resolution of the Minister of Science and Higher Education of July 13, 2012 concerning the criteria and mode of assigning scientific categories to scientific units plays a major role. The criteria set out there suggest that research institutes are supposed to focus more on science and publication, at the cost of what used to be the domain of research-development units - implementation. It is also important that in light of the act on public tenders conducting development works for service providers from the socio-economic environment is an exceptionally difficult task. Service providers usually expect fast processing of orders and procedures associated with purchasing do not facilitate this.

Finding an optimum solution reconciling the area of science and publication with application is not an easy task and requires a completely new approach.

Adapting the role and tasks of EMAG to the external environment

From the historical perspective, the current Institute of Innovative Technologies EMAG started taking shape in the years immediately following World War II. In 1945 the first organizational structures of the coal industry - State Mining Industry Authority with headquarters in Katowice - were established. On March 11 regional associations of the coal industry and a series of other units including the United Factories of Mining Machines and Equipment and Research Institute of the Coal Industry were established. In the years 1945-46 factories producing machines, equipment and other technical means necessary for exploitation of mines, especially coal mines, were established.

Over the next few years many changes in the organizational structure of the coal industry and its subordinate units took place. They resulted from the situation of the Polish industry, which lacked models and experience in central management of industry. For this reason, organizational forms were subject to frequent changes resulting from gaining more experience and learning from mistakes. The most important change was the establishment of Main Agency of the Mining Machines Construction in 1950.

After 1956, following major political changes, the management of national economy in Poland changed substantially. The decentralization of management was started. Companies were made more independent. As a result of this process, in 1957 the merger of Main Agency o the Mining Machines Construction and Institut of Mechanization of Mining into the Instytut Experimental Institute of Constructions for the Mining Industry took place. Later, in 1958 Construction and Mechanization Plants of the Coal Industr was established. The institution functioned till 1974. These institutions conducted all kinds of research, both the basic research and applied research necessary to build machines and work out systems for the complex mechanization and automation of the mining industry. They also conducted preliminary research on elements and sets of machines, experimental machines and prototypes, research on trial series, exploitation research associated with propagation of machines and other devices, as well as organizational and economic research.

On January 1, 1975 Construction and Mechanization Plants of the Coal Industry were divided into two centres: Central Unit for Design and Constructions KOMAG with headquarters in Gliwice and Research Centre of Systems of Mechanization, Electrical Engineering and Control Engineering of the Mining Industry called in short OBR SMEAG with headquarters in Katowice, which is regarded as the start of existence of the current EMEAG Institute. On January 1, 1976 OBR SMEAG was included in the newly established Centre of Science and Production EMAG, which took over all matters associated with electronics, automation, partially measuring science, lighting, communication and computerization.

In the period till the fall of communism in Poland, research and development work was conducted in teams of up to 750 scientific and engineering-technical employees. The financial means for research work came mainly from central funds (KBN). They were central research projects acquired through contests

covering a very broad, complex scope. Moreover, research-construction tasks of „local" character were financed by the technical progress fund of the Ministry of Mining. Some chosen issues were ordered by factories. Change in the rules of financing caused the necessity to introduce further, important changes during the period of transformation. First, the disintegration of the manufacturing and implementation capacities of Centre of Science and Production EMAG took place. This process led to the establishment of the following, separate entities:

- The Mining Electronics Plant ZEG in Tychy,
- The Mining Telemechanics Plant ELEKTROMETAL in Cieszyn,
- The Experimental Plant of Mining Electrical Engineering in Czeladź,
- The Factory of Rescue Equipment and Mining Lamps in Tarnowskie Góry,
- The Repair and Production Plant of Electric Machines DAMEL in Dąbrowa Górnicza,
- The Plant of Assembling of Control Engineering Systems CARBOAUTOMATYKA in Tychy
- and Research Centre of Systems of Mechanization, Electrical Engineering and Control Engineering of the Mining Industry EMAG in Katowice.

Unfortunately, this new approach to the reality of market economy and financing the scientific-research background meant that the EMAG institute of that time had little chance for survival in its organizational structure. Thus, a long-term restructuring process took place. This process led to a situation in which around OBRE, on the basis of its human capital, independent units - commercial entities formed as limited liability partnerships with specialized profiles of activity - were set up.

The first entity of this kind was TELVIS Sp. z o.o., dealing with the provision of complex security, warning and communication systems, including mainly phone com- munication and alarm-warning systems and devices for industrial setting in risk zones group I - category M and group II - category 1.

The second entity was the „EMAG-SERWIS" Sp. z o.o., which in the beginning used to deal with maintenance and later production of models, prototypes, discrete manufacturing and short - series manufacturing of electronic and electrotechnical devices and industrial automatics.

The third entity was the Maintenance Centre of Telecommunication and Telemetrics SEVITEL Sp. z o.o., dealing with design, installation and maintenance of specialist devices and control-measuring systems, power, energy and communication systems with particular attention to solutions for safety at work.

In the meantime, in 1992 the name of OBR SMEAG was changed to Centre of Electrification and Automation of the Mining Industry EMAG. It was also at that time that the scope of activities of Emag was formed - picture 1. - basing on specialized subjects.

Picture 1. Areas of activity of EMAG.

These were based on specializations.

In the area of electric engineering these were:

- designing, building and research on electric devices and equipment sets, including devices resistant to fire and protected with hoods, for use underground in mines; design, building and research on transformer stations and transformer sets, hooded and resistant to fire, for use underground in mines; designing, building and research on electric safety devices and com- ponents of control devices; designing, building electric engines with unit capacity up to 315 kW and voltage up to 1140V;
- other design and research work in the area of AC electrical engineering for the mining industry (mainly for underground parts of mines), e.g. passive power compensation in 6kV and 1kV networks, two-speed engine steering systems, steering and power supply for high-power mining machines etc.
- thyristor cascades for energy-saving regulation of speeds of winders, main mine ventilation fans, rotary furnace compressors for cement works, water pumps for heat and electric power plants etc.;
- thyristor sets and equipment for steering and regulation of speeds of fire-resistant battery locomotives with capacity of up to 40kW;
- converter sets for fast recharging of traction batteries with capacity of up to 760Ah and voltage of up to 200V.

In the area of communication and telemetry the scope of activities covered such subjects as:

- working out and adapting of phone communication devices (new generation systems of digital telephone exchanges) serving the purpose of general communication over cable networks in mines;
- working out and implementing individual systems of spark-proof phone-dispatch, alarm-warning and technological systems;
- working out spark-proof control-measuring equipment for underground telecommunication network and the implementation of technical spark-proof measuring devices in mines;

- working out devices for radio communication in mines and for local communication;
- working out systems of spark-proof transfer of data in underground parts of mines;
- working out a system for remote spark-proof power supply for underground telecom devices.

At the same time, **in the area of automation of underground devices** the main subjects were:

- designing, building and research on electro-hydraulic steering systems for longwall powered supports;
- designing, building and research on automation systems of shearer loaders and heading machines;
- development works concerning electro-hydraulic and electro-pneumatic actuators and automation of pumps, designing, building and research on spark-proof controllers for actuator systems of auxiliary devices;
- working out a range of sensors for controlling underground objects.

In the area of measuring devices the main subjects were:

- working out methods and devices for the control of quality of coal and products of coal enrichment; working out devices and systems of automation of processes of coal enrichment in heavy liquids,
- jiggers and flotation;
- working out systems weighing continuously;
- software for industrial controls;
- working out control systems for water-sludge circulation.

In the area of safety systems and steering ventilation research and construction work was conducted on systems and equipment allowing early detection and limitation of the effects of mining threats (in particular, the work concerned measuring. methane risks and risks associated with the ventilation system).

Finally, in the area of dispatch systems, work covered:

- designing and implementing dispatch systems and devices for assessment of rock burst risk, control of production parameters, control of staff movements, control of energy consumption, steering chosen industrial processes, and fibre-optic communication in coal mines;
- conducting research and carrying out analysis on the state of mines' dispatch systems and equipment used to assess the risk of rock bursts, monitoring parameters of production, monitoring staff movement, and monitoring energy consumption;
- possibilities of adapting systems and products to the requirements of EEC norms.

Further important changes took place in 2007, when the consolidation of Emag with two research-development units - Institute of Control Engineering Systems in Chorzów and Research and Development Centre of Power Engineering in Katowice - took place. This opened the way to activities in the area of applied computer sciences and energy. This and the necessity to expand with proposals for research and development work to other sectors of the industry led to a situation in which activities which could be called marketing were taken. In particular, in 2009 the change of the name of the institute from **Centre of Electrification and Automation of the Mining Industry EMAG** to **Institute of Innovative Technologies**

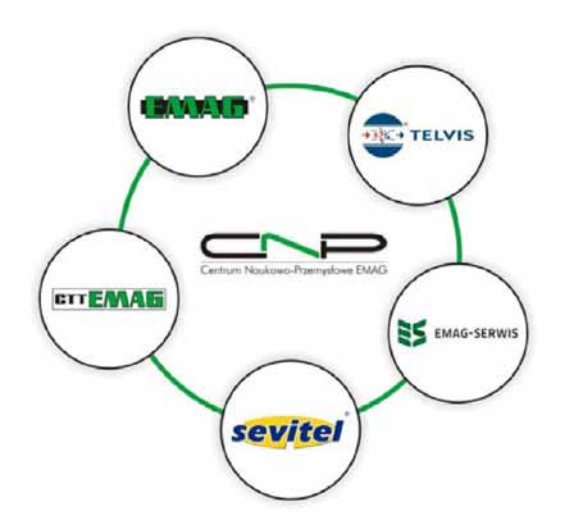
EMAG, took place. The new name does not emphasize the institute's affiliation with a single sector of the economy.

Finally, but equally important changes were caused by the introduction of regulations included in the Act of April 30, 2010 and executive directives. In the first place the status of EMAG was changed from a research and development unit to a research institute. The second thing was the change of the direction of activities, as mentioned before. For the purpose of more effective implementation of the results of research and scientific work, at the beginning of the fourth quarter of 2010 **Centre of Technology Transfer EMAG Sp. z o.o.** was established. The company took over full competences associated with the implementation of modern and unique technologies from the area of hydraulics and industrial automation, industrial gauging, geophysical systems, energy and electric engineering. One of the tasks of the company, or even its primary task, is the transfer of technological solutions of the **Institute of Innovative Technologies EMAG** and other institutes to commercial recipients. Despite only a brief presence on the market CTT EMAG can boast many successful implementation projects in Poland and in the world.

In the end, probably the most important change involved taking advantage of the opportunities provided by the Act on Research Institutes in the area of cooperation with the economic environment, that is, the establishment of a consortium of **Scientific and Industrial Centre EMAG.**

The abovementioned Act on Research Institutes made it possible for institutes to cooperate with commercial entities in the area of knowledge transfer and, more importantly, allowed commercial entities to co-finance research work. This involves defining and separating research stages – financed by the institute with financial assets allocated to statutory works – from development stages, which are financed by the funds of a commercial entity cooperating on scientific-research work. CNP (picture. 2) includes all the aforementioned commercial entities, and the **Institute of Innovative Technologies EMAG** serves in it the role of a leader and coordinator, especially in the implementation of big systems of monitoring safety and producing individual products designed at EMAG.

Picture 2. Members of the CNP EMAG Consortium.

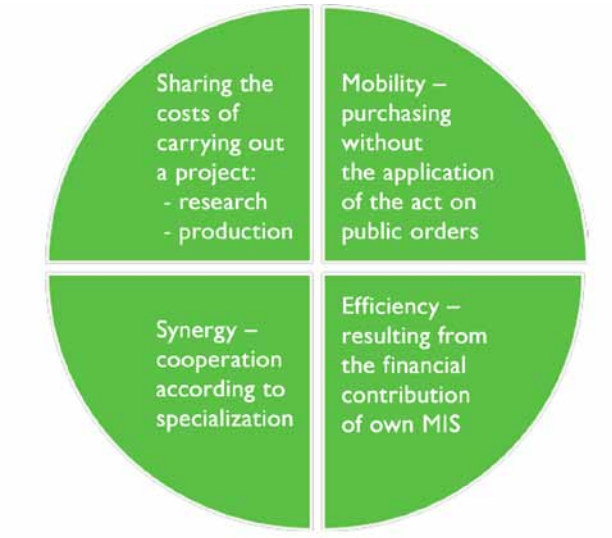


Thanks to such cooperation it is possible to create and implement even more efficient innovative technologies, devices and systems. Clients from many branches of the industry were offered a broad scope of services covering whole cycle of innovation: from an idea turned at the stage of research into a project, through carrying out a project resulting in a product and in the end implementation as well as training and maintenance - picture 3.

Picture 3. Schematic diagram of the cooperation within the Centre for Science and Industry.

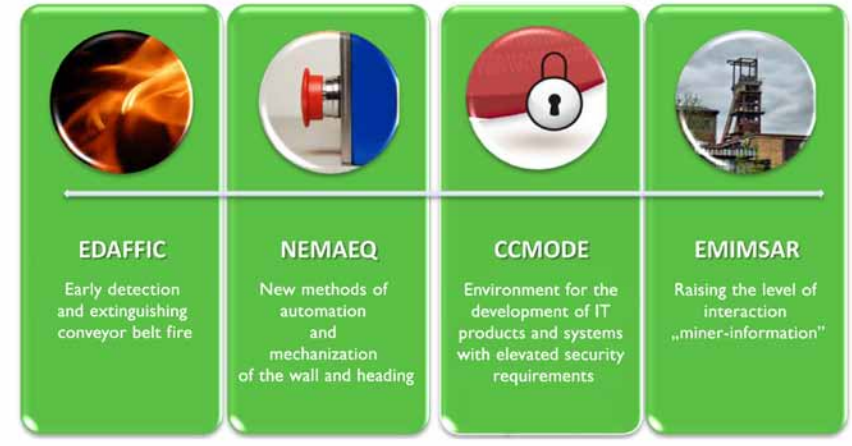
Currently, five projects are being carried out this way and the resulting benefits (picture 4) will be noticeable both for entrepreneurs taking advantage of projects carried out this way and the generated products, and for the members of CNP EMAG.

Picture 4. The effects of cooperation within CNP EMAG.

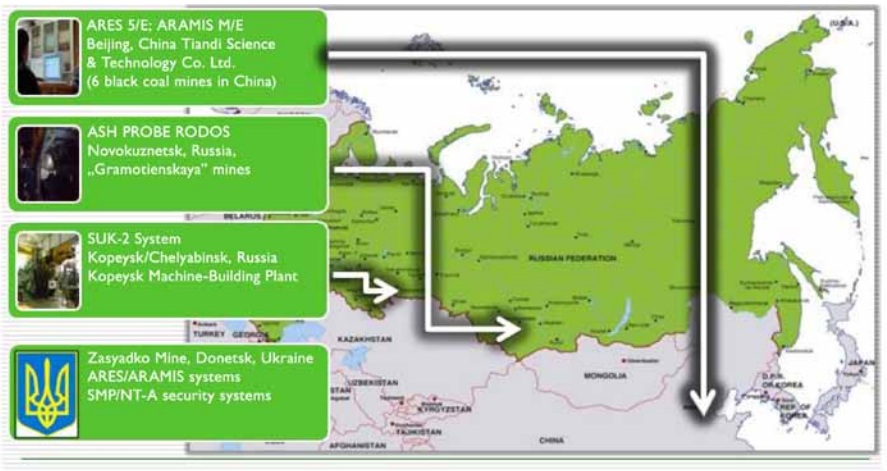


Apart from international projects, scientific and development work financed with national public funds (picture 5) as well as by national and foreign entrepreneurs scientific work and services (picture 6) are being carried out.

Picture 5. Examples of projects carried out at ITI EMAG.



Picture 6. Examples of foreign implementations.



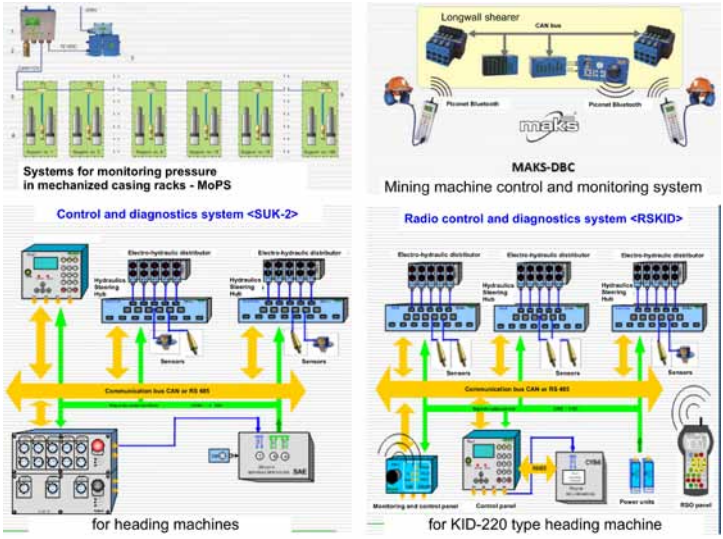
Effective results of research and development work

Regardless of this, currently the Institute of Innovative Technologies EMAG, through its Technology Transfer Centre EMAG offers:

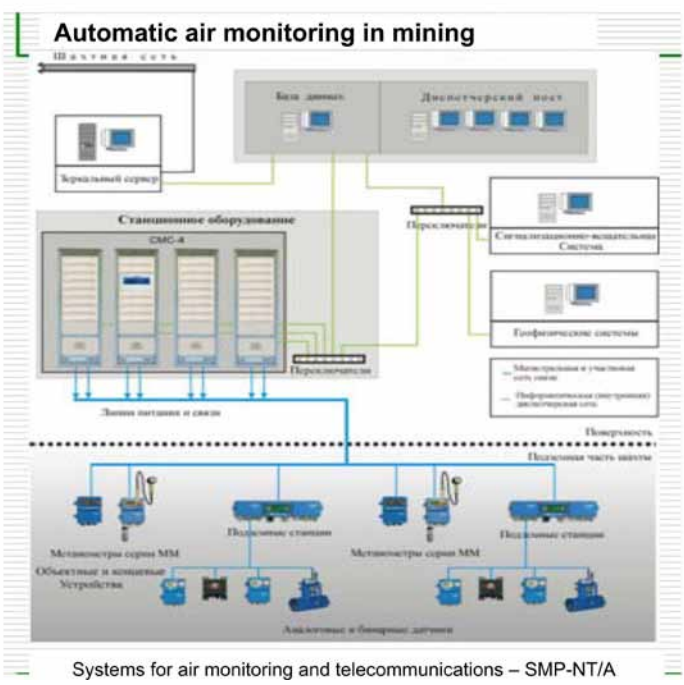
- over 300 ready solutions for the industry - devices, systems and technologies
- (examples - pictures 7-13),
- complex service for the process of creation and implementation of innovations,
- experience, knowledge, creativity and competence, modern laboratory facilities (picture 14).

Picture 7. Examples of products from the group of controllers and dividers.

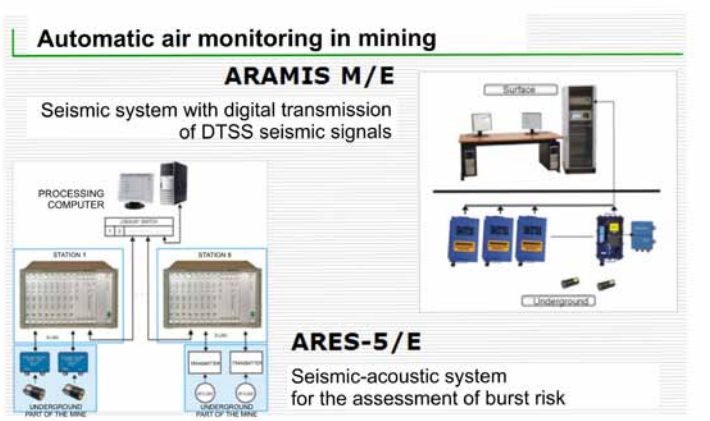
Picture 8. Examples of products from the group of control systems.



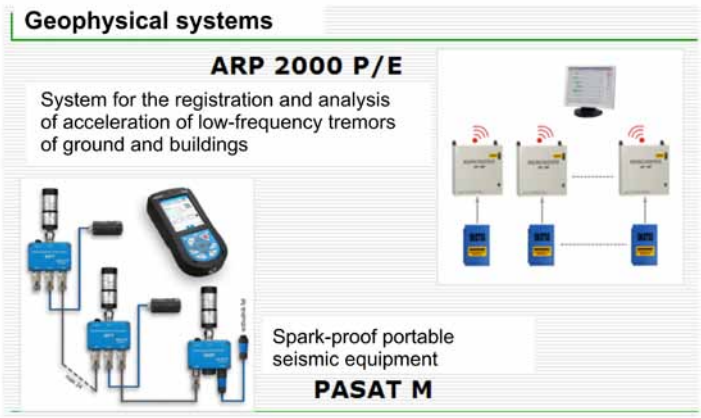
Picture 9. Examples systems for monitoring aerological threats.



Picture 10. Example of systems of automatic monitoring of geospherical threats.



Picture 11. Example of geophysical systems for registration of seismic events.



Picture 12. Example of devices from the area of industrial measuring.

Picture 13. Example of devices from the area of electric technology.

Picture 14. Example of equipment of the Centre of Research and Certification of the EMAG Institute.

Conclusion

A condition for efficient functioning of research and development units is constant adaptation of organizational structure and processes to the changing external environment.

The example of the Institute of Innovative Technologies shows innovative utilization of the new possibilities emerging in the difficult field of Polish science.

The cooperation between the EMAG Institute and the business environment within the framework of the consortium of the Scientific-Industrial Centre EMAG provides the opportunity to react faster to the needs of entrepreneurs expecting innovative solutions.

In 37 years of activity, the EMAG Institute has been recognized many times both in Poland and around the world. The evidence of this is the numerous awards and distinctions received (chosen examples - picture 15).

Rysunek 15. Examples of awards of EMAG.

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