

First outcomes of the prospective study on nanotechnologies

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Content

- NANOPROSPECT: Nanotechnologies in Romania, a prospective study
- Projects and organizations
- Topics
- SWOT analysis
- Key features



Nanotechnology in Romania: prospective study NANOPROSPECT



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- ✓ National Institute for Laser, Plasma and Radiation Physics, www.inflpr.ro
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- ✓ National Institute for R&D in Electrical Engineering, www.icpe-ca.ro
- ✓ University Babes-Bolyai (UBB), Institute for Interdisciplinary Researches in Bio-NanoSciences, www.ubbcluj.ro
- ✓ University POLITEHNICA of Bucharest, www.upb.ro
- ✓ Institute of Nonferrous and Rare Metals, www.imnr.ro
- ✓ National Institute For Chemical- Pharmaceutical Research and Development, www.ncpri.ro



Project objectives:

- ❑ Project management, activities of coordination and networking at national level in the nanotechnologies domain, includes a detailed plan for involving the human resources in NT at national level.
- ❑ Establishing the criteria and indicators for evaluating the fundamental and applicative research activities in the nanotechnologies domain precede a comprehensive analysis of the human and material potential, of the research performance in NT.
- ❑ Evaluation of the national potential of scientific research in the nanotechnologies domain – analysis of the technological competitiveness level in Romania. The activities are related to mapping the RD groups and state of the art experimental infrastructures; identifying the research directions; analysis of Romanian participation to European and international cooperation in NT; establishing the national priorities in NT domain with socio-economic impact.
- ❑ Analysis of the Romanian scientific potential in the nanotechnologies domain with the aim to promote the participation to international cooperation (calls for proposals). This analysis is essential to assure a critical mass in the advanced NT development.
- ❑ Report on the strategic orientations and main research-development directions in the domain for the period 2011-2020. Elaborating the strategy in the domain on short term (2011-2013) and respectively medium term (2014-2020).
- ❑ Information and publicity on the strategy in the nanotechnology domain: the role of science, education, market orientation, development directions.



Project summary (1):

The prospective study NANOPROSPECT is devoted to “nanotechnology” (NT). NTs are providing structuring and control of properties of matter at the nanometer scale (1-100 nm). More specifically, NTs allow creation and utilization of materials, devices and systems through the control of matter at the nanoscale, i.e. at the level of atoms, molecules and supermolecular structures. The essence of NT is the ability to work at these levels in order to generate larger structures with a fundamentally new molecular organization. NT experiences an explosive development at the global level (2000-2008), with an average annual increase of the order of 25% for R&D budgets, human resources, published papers and products on the market. EU has a strategy in the field, whereas some countries (e.g. Germany, France, U.K., and Poland) have a special programme and/or strategy.

Romania has a potential and results in NT, as shown by scientific publications in this field and by international cooperation. Through the CEEEX programme, as well as through the programmes from PNCDI II a number of **about 400 national projects** in the “nano” field have been financed since 2005 (unofficial data, January 2010), with more than 300 R&D projects. The investments through the “Capacities” programme and through structural funding provided state-of-the-art apparatus and equipments, many of them useful for NT (especially for characterization).



Project summary (2):

NANOPROSPECT will analyze the potential for applications, as well as for international cooperation, putting forward a national strategy for NT, in correlation with the EU strategy. This strategy, apart from the priority research directions, will suggest measures to accelerate innovation, industrialization of results in RD, full use of experimental facilities, formation of interdisciplinary competencies etc. A key aspect is the responsible development of NT, i.e. EHS (environment, health, safety). These topics will be debated in working groups including not only researchers, but also governmental institutions, representatives of private companies, Chambers of Commerce, NGOs, professional associations etc.

This project is developed by a powerful consortium of 7 R&D institutes and 4 universities representing various regions of the country. Besides the human and material resources in R&D, this consortium involves experts with a broad experience in international cooperation, national representation at the EC level, innovation, cooperation with industry etc. The best researchers will be involved, as well as foreign experts and will develop an extensive campaign of networking at the national level, collection and dissemination of information and results of the prospective study.



Project launch 20 October 2010, Bucharest, Romanian Academy



Lansarea proiectului:
**"Nanotehnologia in Romania:
studiu prospectiv"
(NANOPROSPECT)**

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Detalii: www.romnet.net/nano/



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Orientation

- Technology
- Technological competitiveness
- Fields of applications
 - According to the Gennesys White Book, 2010

Applications of nanotechnology

1.0. Fundamental research;

1.1.1 Nanoelectronics ;

1.1.2 Photonics;

1.2.1 Medical science;

1.2.2 Dentistry;

1.2.3 Pharmaceuticals;

1.2.4 Cosmetics;

1.2.5 Agriculture;

1.2.6 Food industry;

1.2.7 Natural nanosystems;

1.3.1 Chemical industry ;

1.3.2 Oil and petrochemistry;

1.3.3 Catalysts;

1.4 Nuclear technology;

1.5.1 Energy production;

1.5.2 Energy conversion;

1.5.3 Energy storage and
transportation;

1.5.4 Energy saving;

1.6.1 Metallurgy;

1.6.2 Ceramics;

1.6.3 Polymers and composites;

1.7.1 Transport - aircraft;

1.7.2 Transport - Automotive;

1.8 Environment;

1.9 Toxicology;

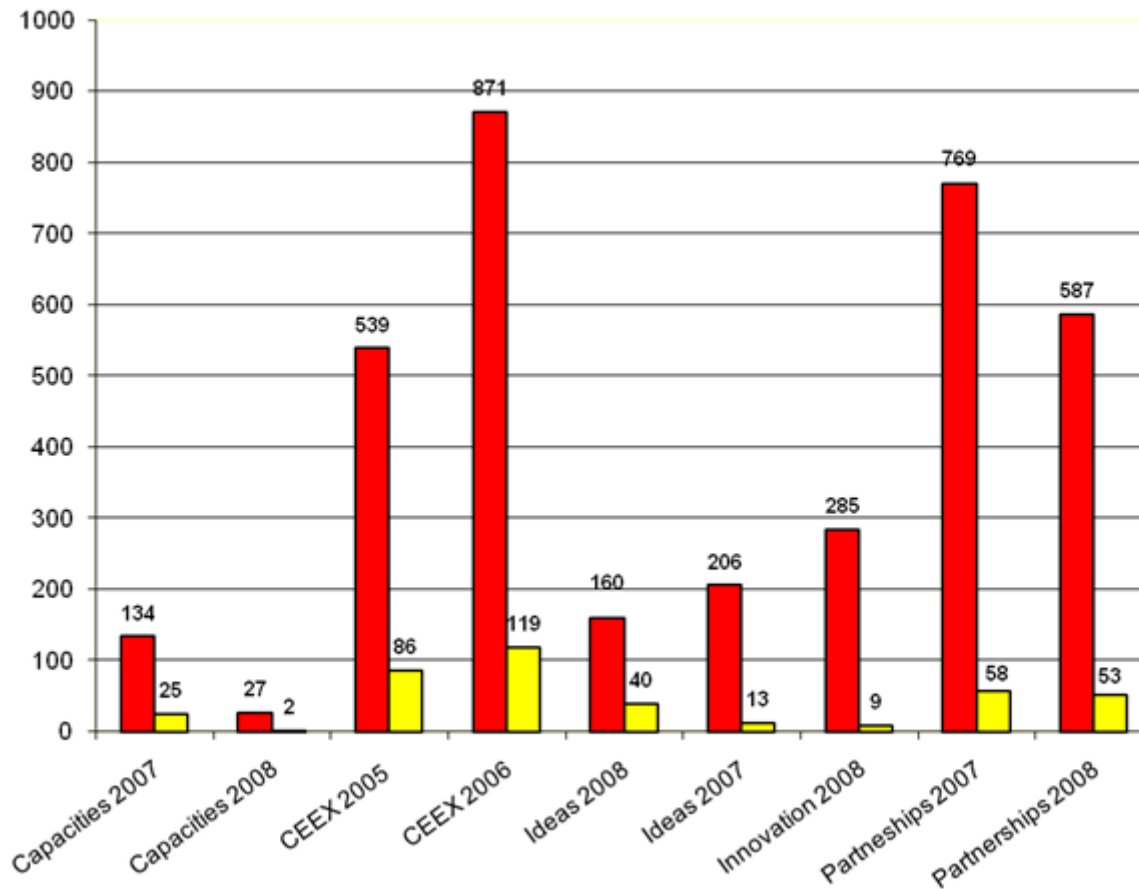
1.10 Ancient and historical systems;

1.11 Security and safety

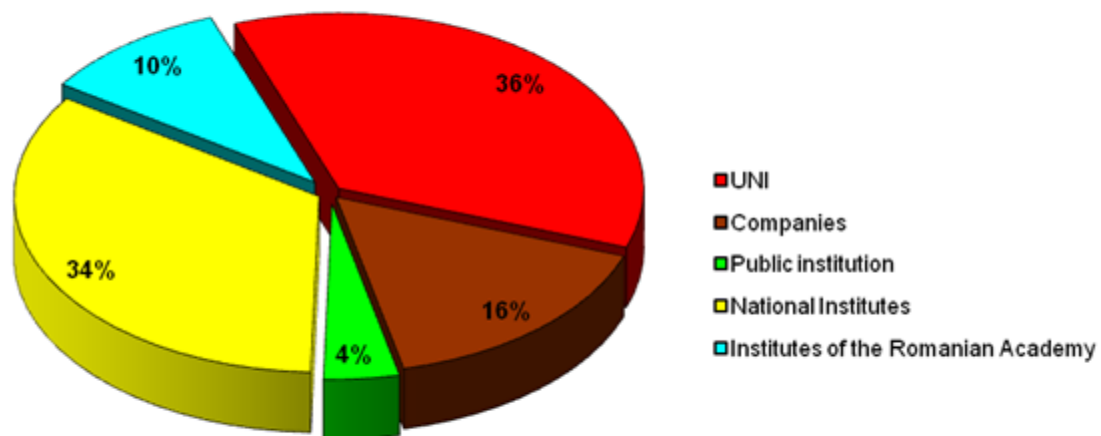
Analysis (since 2005)

- Projects
 - From national programmes
 - From European programmes
- Number of projects, topics

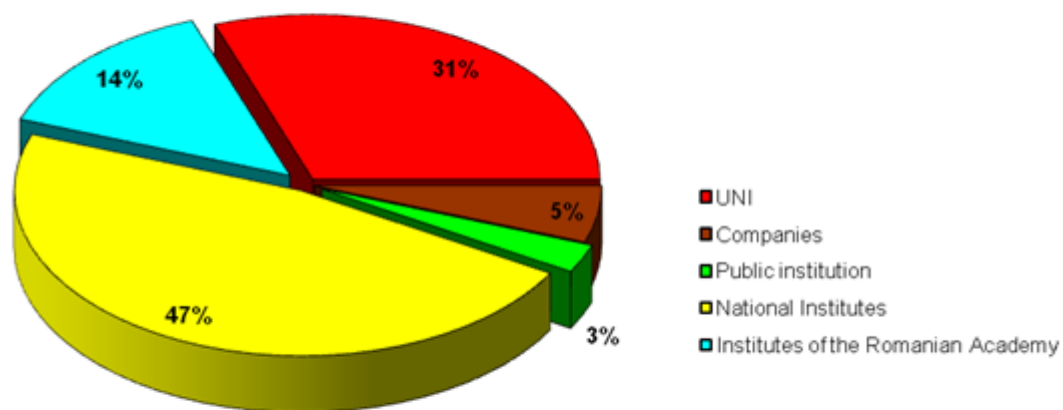
Number of "nano" projects versus the total number of projects



Projects distribution by organization type
_CEEX programmes

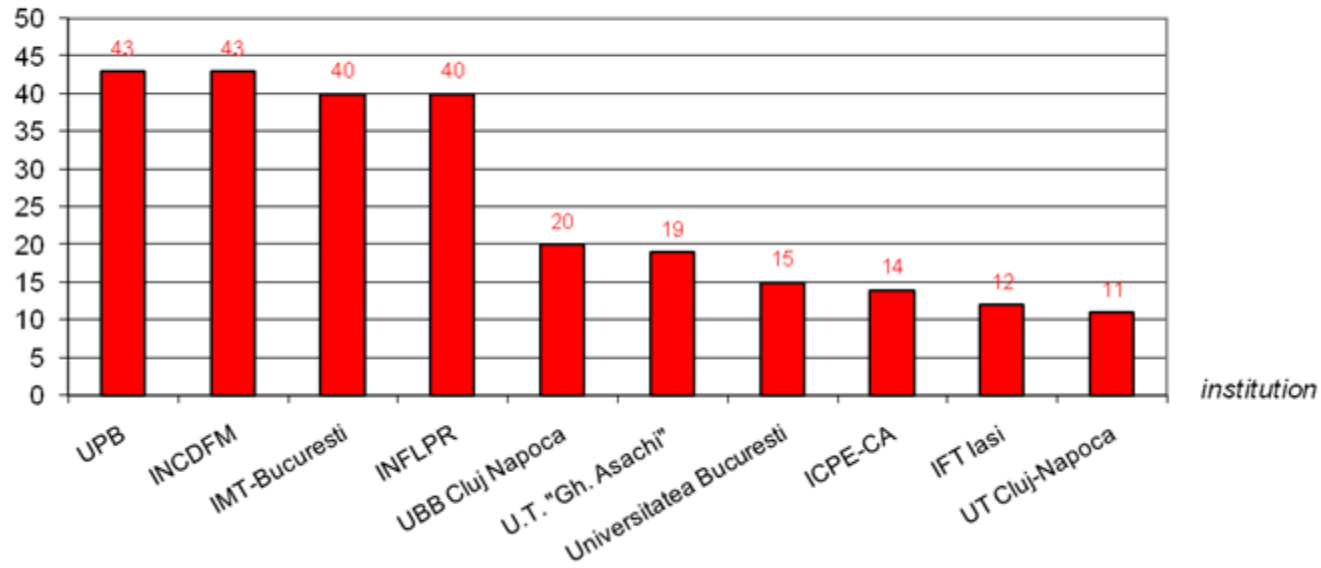


Projects distribution by organization type
_Partnerships programme

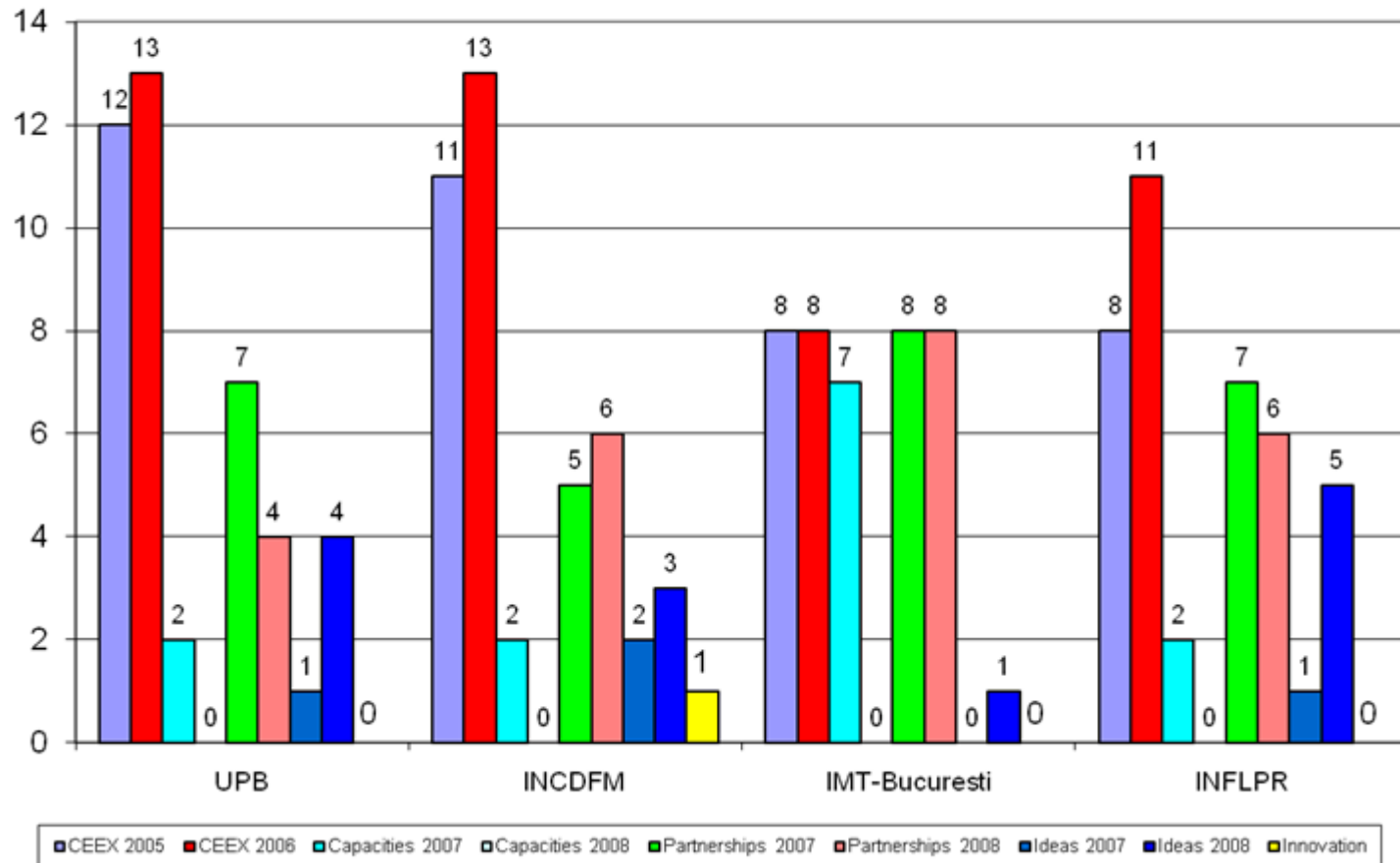


The institutions with the highest number of projects - top 10 positions

Number of projects



First ranked institutions; projects distribution by funding programmes



Research thematic areas for “Nanoelectronics, photonics and integrated Micro-nanosystems” - Direction 1.7, National R&D Plan II (PNCDI II)	Number of “nano” projects in “Partnerships” national programme, PNCDI II, corresponding to the thematic area	Corresponding ICT / NMP research thematic area from FP7
▪ Nanoelectronica		
1.7.1 Experimentarea de noi materiale și tehnologii pentru nanostructuri și circuite integrate la scara nano	- 3 projects in 2007 <i>Industry participation: 2 companies</i> - 1 project in 2008	ICT-2011.3.2 Smart components and smart systems integration Future smart components and smart systems; Materials, technologies, processes, manufacturing techniques and design methods for: - Miniaturized and integrated smart systems with advanced functionality and performance including nanoscale sensing systems NMP-2008-2.2-1 Compound semiconductors for electronics and photonics
1.7.2 Experimentarea de noi arhitecturi de sisteme pentru nanoelectronică 1.7.3 Experimentarea de noi concepte (principii) de dispozitive nanoelectronice	- 1 project in 2007 - 1 project in 2008 - 1 project in 2008	ICT-2007.8.1: FET proactive 1: Nano-scale ICT devices and systems - Demonstration of new concepts for switches or memory cells , to substantially improve performance, cost, integration density and/or power dissipation beyond those of ultimate CMOS technology using nanostructures or non-charge based approaches. Complementary challenges include circuit architectures, assembly and reconfiguration . - Demonstration of <i>new concepts, technologies and architectures for local and chip-level interconnects</i> with substantial improvements over current solutions - <i>1 project with Romanian participation</i>
1.7.4 Electronica transparentă	- 2 projects in 2007 <i>Industry participation: 1 company</i> - 2 projects in 2008 <i>Industry participation: 1 company</i>	▪ ICT-2007.3.2: Organic and large-area electronics, visualisation and display Advanced visualisation systems and novel display technologies - portable display systems such as zero-power / 'ruggedised' displays, flexible and/or transparent devices , energy efficient microprojectors, and lightweight high-resolution vision glasses ▪ ICT-2011.3.6 Flexible, Organic and Large Area Electronics and Photonics OLAE technology and components: Organic/printed logic and memory components; transparent electronic components ; power supplies, etc.

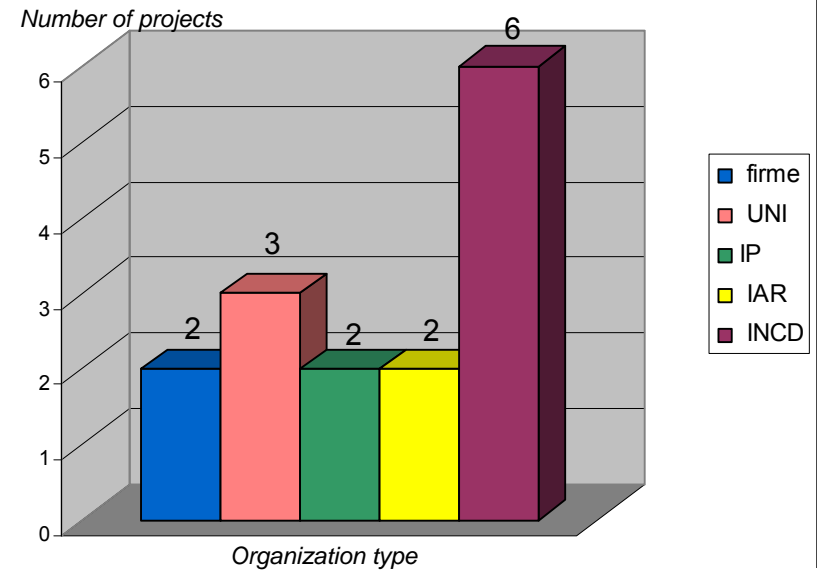
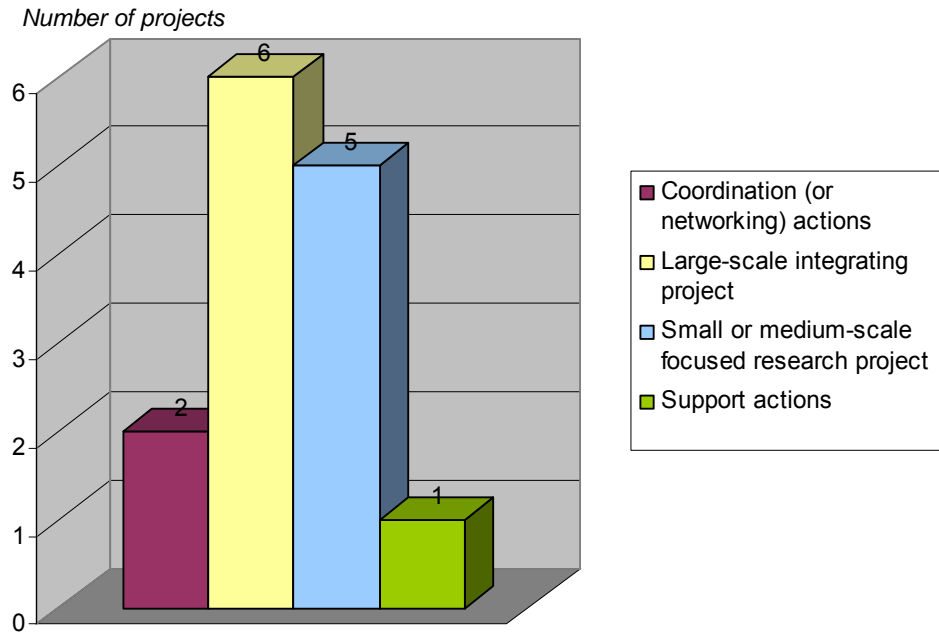
▪ Micro - și nanosisteme		
1.7.5 Dezvoltarea componentelor și microsistemelor pentru sisteme de comunicații; micro-sisteme inteligente reconfigurabile și flexibile	- 3 projects in 2007 <i>Industry participation: 2 companies</i> - 1 project in 2008 <i>Industry participation: 1 company</i>	ICT-2007.3.6: Micro/nanosystems - Smart systems for communications and data management: Smart micro/nanosystems enabling wireless access and facilitating intelligent networking with emphasis on the hardware required for communications and the management of smart device information. This includes solutions for adaptable RF and HF technologies (e.g. RFID, RF-NEMS and HF-NEMS) <i>- 1 project with Romanian participation</i>
1.7.6 Tehnologii microfluidice, micro/nano-biosenzori, laboratoare pe un cip, „microarrays”, micro- și nanostructuri și micro- și nanosisteme pentru diagnosticare și tratament medical (inclusiv nanomedicină)	- 4 projects in 2007 <i>Industry participation: 1 company</i> - 5 projects in 2008	▪ ICT-2011.3.2 Smart components and smart systems integration - Micro-Nano Bio Systems (MNBS) For those actions addressing in particular the health area, emphasis is on: – integrated systems for rapid, sensitive, specific and multi-parametric in vitro molecular analysis/detection and cellular manipulation based on biodegradable materials. Cost, manufacturing and real scenarios validation should be considered; – autonomous body sensor and actuator based systems for non- or minimally invasive targeted early detection, diagnosis and therapy ▪ NMP.2011.1.2-2 New targeted therapy using nanotechnology for transport of macromolecules across biological barriers ▪ NMP.2011.1.4-4 Nanotechnology based implantable and interfaceable devices
1.7.7 Microsenzori și actuatori (inclusiv 3D) 1.7.8 Tehnologii de integrare eterogenă și asamblare/incapsulare 3D pentru a permite realizarea de sisteme complexe pe un cip	- 1 project in 2007 - 4 proiecte in 2008 <i>Industry participation: 1 company</i>	ICT-2007.3.6: Micro/nanosystems Next-generation smart systems: -Major breakthroughs in intelligent sensor and actuator systems complexity, miniaturisation, networking, and autonomy. -Design and packaging technologies for new sensors, actuators and microsystems, their combination and integration.
1.7.9 Tehnologii convergente: micro-nano-bio-info		ICT-2007.3.6: Micro/nanosystems - Micro/nano/biotechnologies' convergence ICT-2011.3.2 Smart components and smart systems integration - Micro-Nano Bio Systems (MNBS) NMP-2008-1.1-1 Converging sciences and technologies (nano, bio, info and/or cogni) <i>- 1 project with Romanian participation</i>

▪ Fotonica		
1.7.10 Noi materiale fotonice (materiale artificiale: cristale fotonice, materiale cu indice de refracție negativ etc.)	- 3 proiecte in 2007 <i>Industry participation:</i> 2 companies - 5 proiecte in 2008 <i>Industry participation:</i> 1 company	<ul style="list-style-type: none"> ▪ NMP-2007-2.2-1 Organic materials for electronics and photonics ▪ NMP-2008-2.2-2 Nanostructured meta-materials ▪ NMP.2011.2.2-3 Materials for solid state lighting
1.7.11 Componente micro/nano-fotonice și sisteme pentru interconexiuni și comunicații		ICT-2011.3.5 Core and disruptive photonic technologies - Core photonic technologies Optical data communications – optical interconnects
1.7.12 Microsenzori optici pentru sisteme de supraveghere, monitorizare, robotizare		<ul style="list-style-type: none"> ▪ ICT-2007.3.5: Photonic components and subsystems - Core photonic components and subsystems, which are essential in multiple application fields: (1) High performance lasers. (2) High brightness, power efficient solid-state light sources for ICT and general lighting applications. (3) Optical fibres for high performance and for specific functions. (4) High performance image sensors. (5) Sensors exploiting innovative sensing principles ▪ ICT-2011.3.5 Core and disruptive photonic technologies - Core photonic technologies - Imaging and sensing for safety and security
1.7.13 Noi tehnologii fotonice și biosenzori fotonici pentru sisteme neinvazive de diagnostic <i>in vivo</i> și tratament	- 1 proiect in 2008 <i>Industry participation:</i> 1 company - 1 proiect in 2007 <i>Industry participation:</i> 1 company	<ul style="list-style-type: none"> ▪ ICT-2007.3.5: Photonic components and subsystems - Application-specific photonic components and subsystems for application fields, which are strategic for Europe and which are important drivers of photonics technology development: Components and subsystems for: - minimally invasive medical diagnosis and prevention. - sensing for environment, well-being, safety and security. ▪ ICT-2011.3.5 Core and disruptive photonic technologies - Core photonic technologies - Biophotonics for early, fast and reliable medical diagnosis of diseases, such as cancer, infectious and eye-related diseases. The applications vary from point-of-care diagnosis to functional imaging
1.7.14 Tehnologii fotonice pentru procese de fabricație avansate la nivel micro și nano și pentru controlul proceselor și calității:	- 1 proiect in 2008	

Research thematic areas for “Advanced materials”- Direction 7.1, National R&D Plan II (PNCDI II)	Number of “nano” projects in “Partnerships” national programme, PNCDI II, corresponding to the thematic area	Corresponding NMP research thematic area from FP7
7.1.1. Materiale avansate pentru generarea, transportul și utilizarea energiei	- 1 project in 2007 <i>Industry participation: 1 company</i> - 1 project in 2008 <i>Industry participation: 1 company</i>	NMP-2007-2.2-3 Advanced material architectures for energy conversion NMP-2008-2.6-1 Novel materials for energy applications NMP.2011.1.2-3 Active nanomembranes/-filters/-adsorbents for efficient water treatment with stable or regenerable low-fouling surfaces EeB.NMP.2011-1 Materials for new energy efficient building components with reduced embodied energy EeB.NMP.2011.-2 New efficient solutions for energy generation, storage and use related to space heating and domestic hot water in existing buildings NMP-2011-II.5.3 "Green Cars (GC)" - Public-Private Partnership - GC.NMP.2011-1 Advanced eco-design and manufacturing processes for batteries and electrical components
7.1.2. Materiale avansate pentru dezvoltarea infrastructurii	-	NMP-2007-4.0-6 Innovative added-value construction product-services NMP-2008-4.0-8 Smart materials for applications in the sectors of construction and of machinery and production equipment NMP-2011 Energy-efficient Buildings (EeB) - Public-Private Partnership
7.1.3. Materiale care protejează mediul înconjurător în procese legate de producerea și utilizarea lor	- 3 projects in 2007 <i>Industry participation: 4 companies</i> - 2 projects in 2008 <i>Industry participation: 2 companies</i>	NMP-2007-2.4-1 Flexible efficient processing for polymers (smart use of materials in an environmentally friendly manner) NMP-2007-3.4-2 Innovative pathways in synthesis - improving efficiency by smart synthesis, design and reduction of the number of reaction steps (environmentally friendly solvents) NMP-2008-1.2-2 Nanotechnologies for water treatment NMP-2008-1.3-2 Impact of engineered nanoparticles on health and the environment NMP.2011.1.4-1 Large-scale green and economical synthesis of nanoparticles and nanostructures
7.1.4. Materiale avansate pentru produse competitive la export	-	-

7.1.5. Materiale avansate pentru mijloace moderne de transport	<ul style="list-style-type: none"> - 3 projects in 2007 <i>Industry participation: 2 companies</i> - 2 projects in 2008 <i>Industry participation: 3 companies</i> 	<ul style="list-style-type: none"> ▪ NMP-2007-4.0-3 Multifunctional materials for future vehicles ▪ Green Cars.NMP.2011-1 Advanced eco-design and manufacturing processes for batteries and electrical components
7.1.6. Materiale și biomateriale avansate pentru creșterea calității vieții (sănătate, sport, educație etc.)	<ul style="list-style-type: none"> - 15 projects in 2007 <i>Industry participation: 12 companies</i> - 6 projects in 2008 <i>Industry participation: 8 companies</i> 	<ul style="list-style-type: none"> ▪ NMP-2007-1.1-1 Nano-scale mechanisms of bio/non-bio interactions - 2 proiecte cu participarea Romaniei ▪ NMP 2007 - 4.2.3 Novel biomaterials and bioinspired materials - NMP-2007-2.3-1 - Highly porous bioactive scaffolds favouring angiogenesis for tissue engineering 2 proiecte cu participarea Romaniei ▪ NMP-2008-2.3-1 Advanced implants and bioactive materials for critical organs ▪ NMP-2008-4.0-1 Development of nanotechnology-based systems for diagnosis and/or therapy for diabetes, musculo-skeletal or inflammatory diseases ▪ NMP.2011.2.2-2 Biomaterials for tissue engineering for age-related cancer and sensory organ diseases ▪ NMP.2011.1.2-2 New targeted therapy using nanotechnology for transport of macromolecules across biological barriers
7.1.7. Tehnologii de reciclare a materialelor avansate	-	-
7.1.8. Materiale avansate destinate sectoarelor-nișă ale economiei	<ul style="list-style-type: none"> - 3 projects in 2007 <i>Industry participation: 5 companies</i> - 2 proiects in 2008 <i>Industry participation: 1 company</i> 	<ul style="list-style-type: none"> ▪ NMP-2007-2.2-1 Organic materials for electronics and photonics ▪ NMP.2011.2.2-1 Novel superconducting materials, architectures and processes for electro-technical applications ▪ NMP.2011.2.2-3 Materials for solid state lighting

Romanian participation in FP7 European projects in the “nano” domain

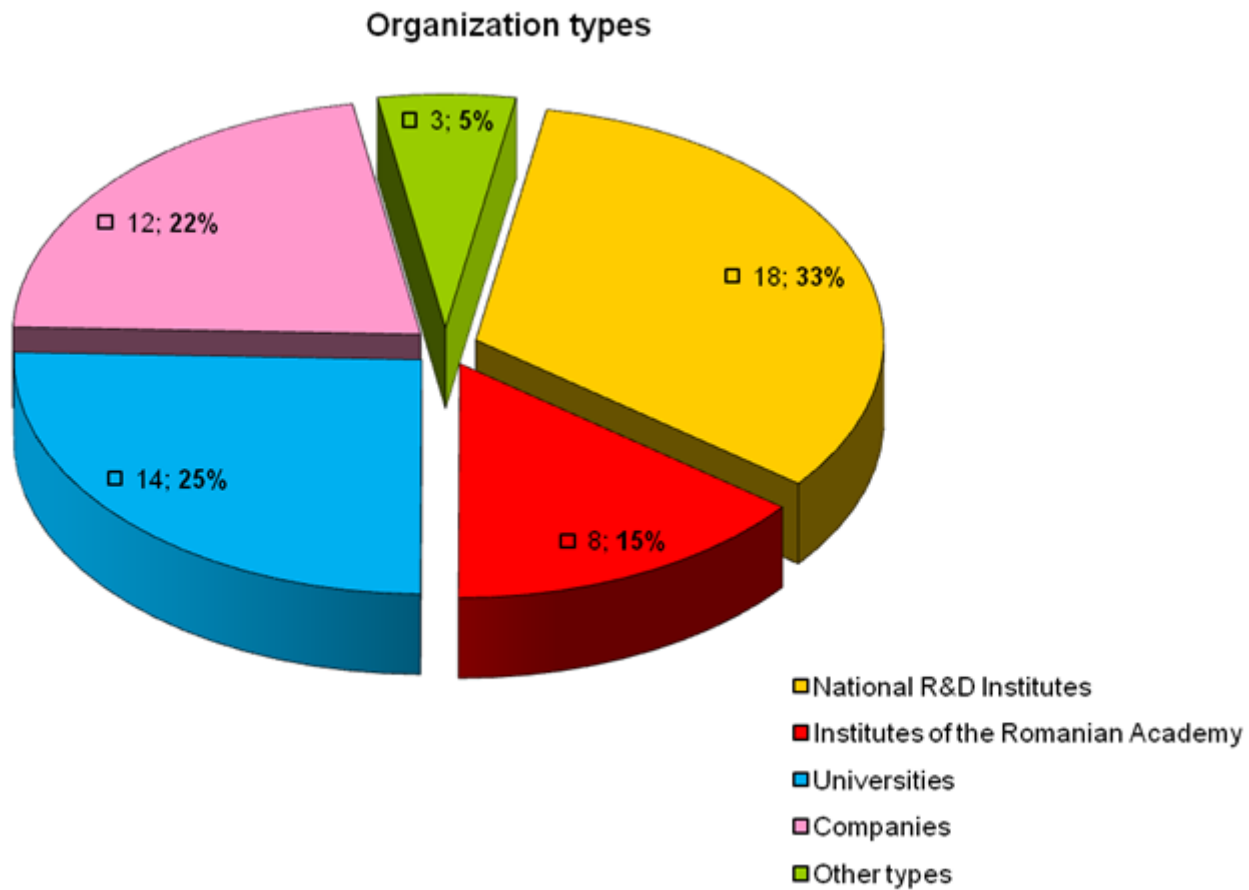


Research areas of projects with Romanian participation (FP7)
NMP -2008-4.0-13 ERA-NET on nanomedicine
NMP-2008-4.0-3 Nano-technology enabled applications for integrated, cost-effective volume production
2004-3.4.3.1-4 Roadmapping and foresight studies on the future of manufacturing (Manufuture)
NMP -2007-2.1-1 Nanostructured polymer-matrix composites 3
NMP-2008-1.1-1 Converging sciences and technologies (nano, bio, info and/or cogni)
NMP -2007-1.1-1 Nano-scale mechanisms of bio/non-bio interactions 2
NMP -2008-1.2-1 - Pilot lines to introduce nanotechnology-based processes into the value chain of existing industries 2
NMP -2007-2.3-1 - Highly porous bioactive scaffolds favouring angiogenesis for tissue engineering 2
NMP-2009-1.3-1 Activities towards the development of appropriate solutions for the use, recycling and final treatment of nanotechnology-based products
NMP-2007-2.1-2 Nanostructured coatings and thin films
NMP-2007-1.1-2 Self-assembling and self-organisation
NMP -2007-2.2-2 Nanostructured materials with tailored magnetic properties 2
NMP-2007-3.1-3 - Integrated Risk Management in Industrial Systems
NMP -2007-2.1-3 Characterisation of nanostructured materials 2
NMP-2008-1.1-3 Examining capacity building in nano-bio-technology
NMP-2007-1.3-5 Coordination in studying the environmental, safety and health impact of engineered nanoparticles and nanotechnology based materials and products
ICT -2007.3.6 Micro/nanosystems; ICT-2007.8.1 Nano-scale ICT devices and systems
Knowledge-Based Bio-Economy (KBBE) KBBE-2007-2-3-06 Network for facilitating the implementation of high-tech processing at industrial scale
PEOPLE -2007-1-1-ITN Marie Curie Action: "Networks for Initial Training"
REGPOT -2007 Micro/nanosystems
SME -1 Research for SMEs
ENERGY .2008.8.1.1 Energy efficiency of industrial heat exchangers and boilers,03080203 Demonstration of hybrid systems combining different renewable energy source; ENERGY.2008.8.1.1 Energy efficiency of industrial heat exchangers and boilers

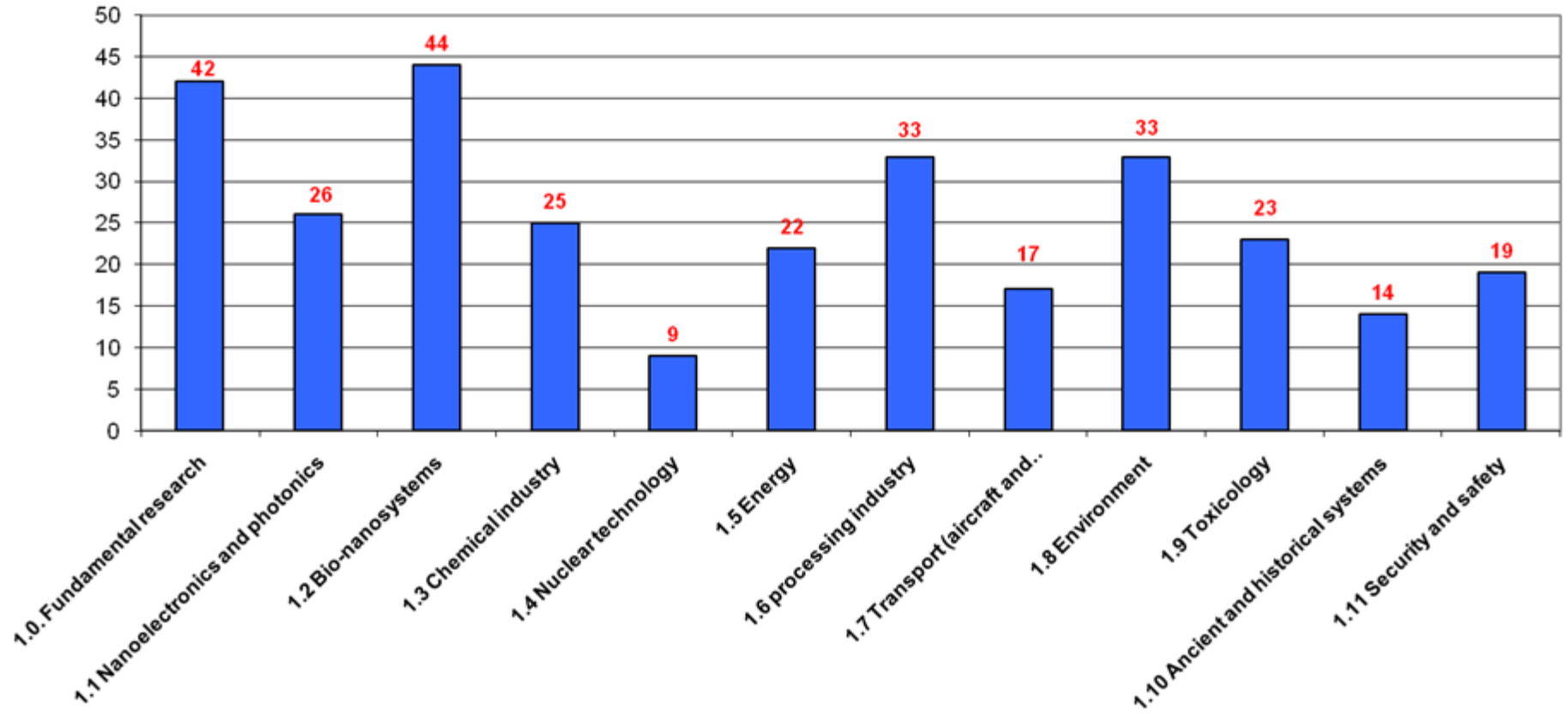
NANOPROSPECT: new data

- A flash analysis Nov.-Dec. 2010
- Simple, non interactive data base, open for 4 weeks
- 55 organizations registered
- They are representative for the potential of this country
- Broad interest for a large number of topics
- The human resources and equipments are also spread

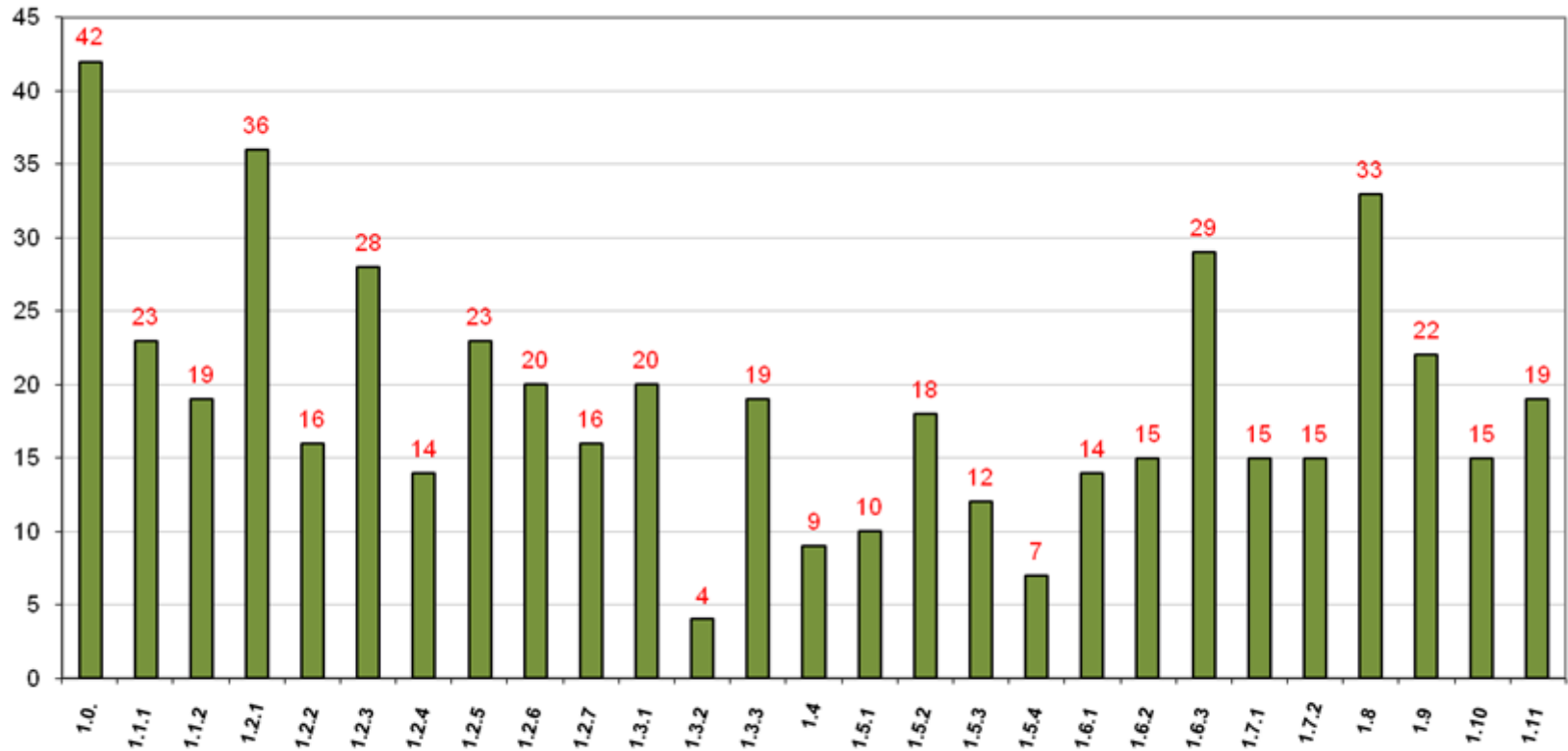
55 organizations active in the “nano” domain were registered in the NANOPROSPECT questionnaire



Number of registrations / domain



Involvement of registered organizations in the application domains of nanotechnologies



1.0. Fundamental research; 1.1.1 Nanoelectronics; 1.1.2 Photonics; 1.2.1 Medical science; 1.2.2 Dentistry;
1.2.3 Pharmaceuticals; 1.2.4 Cosmetics; 1.2.5 Agriculture; 1.2.6 Food industry; 1.2.7 Natural nanosystems;
1.3.1 Chemical industry ; 1.3.2 Petrochemical industry; 1.3.3 Catalysis; 1.4 Nuclear technology;
1.5.1 Energy production; 1.5.2 Energy conversion; 1.5.3 Energy storage and transportation; 1.5.4 Energy saving;
1.6.1 Metallurgy; 1.6.2 Ceramics; 1.6.3 Polymers and composites; 1.7.1 Transport - aircraft; 1.7.2 Transport - Automotive;
1.8 Environment; 1.9 Toxicology; 1.10 Ancient and historical systems; 1.11 Security and safety

Conclusions and recommendations for some application domains, based on the NANOPROSPECT questionnaire data

➤ Nanoelectronics

The Romanian researchers are involved in advanced research thematic with high impact in nanoelectronics: carbon nanotubes based nanoelectronic circuits, GaN for advanced communications or environment monitoring, solar cells and other methods for energy collecting and storage based in nanoelectronic circuits.

The majority of human resources and equipments for nanoelectronics are places in research institutes.

The reduced number of patents shows the importance of research in nanoelectronics domain in Romania, but in the same time the technological transfer and the Romanian companies active in nanoelectronics are not sufficient. This is a reason why the research institutes have important partnerships with European companies active in nanoelectronics (like Thales, NXP, Siemens AG , Alcatel) and few partnerships with Romanian companies.

Recommendations:

- Strengthen the links with ENIAC and EPoSS European platforms and participate to activities organized by these platforms
- Annual calls for proposals in nanoelectronics and constant investments in this domain until 2020 with regards to the following priority research domains:
 - carbon nanomaterials based nanoelectronics
 - nanoelectronics based in silicon wires, dots or monoatomic layers
 - high-frequency nanoelectronic circuits, above 100 GHz
 - nanosensors for constructions, aerospace industry, health, automotive industry

➤ **Energy**

The research activities published in 318 articles in ISI magazines during 1999-2010, reported by Romanian organizations, are oriented towards applications of nanotechnologies in the following sub-domains:

- 105 papers in “Energy production”
- 77 papers in “Energy conversion”
- 76 papers in “Energy storage and transportation”
- 60 papers in “Energy saving”

Romanian researchers developed applications of nanotechnologies in several research thematic areas: hydrogen storage and production, solar cells and photovoltaic devices, batteries and supercapacitors, energy transport and LED.

International collaboration with 30 countries was established in the energy domain.

➤ **Transport**

Recommendations for the development of research activities in the aerospace and automotive domains:

- Launch a national research plan for the structural nanocomposites domain, with applications in aerospace industry
- Raising the interest of Romanian automotive industry for the development of a programme dedicated to the use of nanocomposites in this industry
- Investigating the national possibilities to connect to European programs on nanotechnologies and nanocomposites with applications in automotive and aerospace industry in order to reinforce the industry areas in Romania

➤ *Environment*

The experience and results at national level are directed on the following main research areas:

- TiO₂ –photocatalysis;
- Sensors/biosensors
- Nanoporous membranes

The recommendations in the “environment” domain are especially related to nanomaterials:

▪ Synthesis:

- identifying and development new simplified technologies, friendly to the environment for nanomaterials synthesis
- orientation towards biodegradable nanomaterials synthesis, with reduced risk for plants and fauna
- focus on oxide metallic systems and carbon nanotubes

▪ Structural characterization, analysis and physical-chemical properties:

- Development of new specific methods for rapid characterization and standardization of nanomaterials
- Identifying and minimizing the risks associated with the development and production of nanomaterials
- Analysis of nanomaterials life cycle
- Determining nanomaterials toxicity on the air-soil-water ecosystem

▪ Applications:

- Identification and development of new nanomaterials based on solar energy functioning, with applications in air and water decontamination
- Developing research activities in sensors domain for detecting pollutants agents, reducing the devices and materials associated costs and improving the sensitivity (“lab-on-a-chip”)
- Development of mass production techniques and monitoring the nanomaterials life cycle since they enter into the natural environment circuit

Evaluation of Romanian institutions' capacity to participate in European programs for nanotechnologies

STRENGTHS

- Highly qualified human resource, validated by the number of papers in international publications, well represented in the domains with direct impact on nanotechnologies: materials science, physics, chemistry, biology, medicine, engineering, etc.
- Romanian schools recognized at international level, with a long tradition in the domains specified above.
- State-of-the-art equipments
- International cooperation at institutional level with main actors active in nanosciences and nanotechnologies
- Participation with remarkable results in European projects

WEAKNESSES

- Fragmentation and single field specialization of the human resource. A critical mass and multidisciplinary research groups are needed.
- Fragmentation of research objectives mainly due to financing distribution. The researchers or groups are financed from contracts with different topics.
- Instability of human resource, especially of post-docs, determined by the maintaining of high financial gradients and the uncertainty of a long and medium term prognosis.
- The absence of a national strategy for endowment with advanced equipments in order to avoid the multiple acquisitions of less performant equipments and to encourage the complementary endowments.
- Difficulties in stabilize the highly qualified technical personnel. A dedicated national program is needed, otherwise the access to state-of-the-art equipments by other research groups would not be possible.

OPPORTUNITIES

- The existence of European and American strategies in nanotechnologies for 2001-2020. Correlation of the national strategy in the domain.
- A relatively big number of post-doc young researchers returned to work in Romania or wish to return in the near future. The increase of young human resource involved in the research activities.
- Strengthening multidisciplinary research groups with opportunities to really develop interdisciplinary activities, including the nanotechnologies domain.
- The utmost endowments in Romanian research until nowadays.
- European programs devoted to Eastern Europe countries

THREATS

- Uncertainties regarding the financing possibilities of research activities in Romania
- Augmentation of the brain-drain process among young researchers (and not only) with experience in using new advanced equipments
- The delay in adopting coherent strategies for structuring string thematic consortia between universities and research units (see Germany example)
- The absence of an unitary national system for evaluating the research / institutions / researchers
- The lack of rules/legislation regarding the periodical individual evaluation of researchers (and professors), regardless of their title

STRENGTHS

- Highly qualified human resource, validated by the number of papers in international publications, well represented in the domains with direct impact on nanotechnologies: materials science, physics, chemistry, biology, medicine, engineering, etc.
- Romanian schools recognized at international level, with a long tradition in the domains specified above.
- **State-of-the-art equipments**
- International cooperation at institutional level with main actors active in nanosciences and nanotechnologies
- Participation with remarkable results in European projects

WEAKNESSES

- Fragmentation and single field specialization of the human resource. A critical mass and multidisciplinary research groups are needed.
- Fragmentation of research objectives mainly due to financing distribution. The researchers or groups are financed from contracts with different topics.
- Instability of human resource, especially of post-docs, determined by the maintaining of high financial gradients and the uncertainty of a long and medium term prognosis.
- The absence of a national strategy for endowment with advanced equipments in order to avoid the multiple acquisitions of less performing equipments and to encourage the complementary endowments.
- Difficulties in stabilize the highly qualified technical personnel. A dedicated national program is needed, otherwise the access to state-of-the-art equipments by other research groups would not be possible.

OPPORTUNITIES

- The existence of European and American strategies in nanotechnologies for 2001-2020. Correlation of the national strategy in the domain.
- A relatively big number of post-doc young researchers returned to work in Romania or wish to return in the near future. The increase of young human resource involved in the research activities.
- Strengthening multidisciplinary research groups with opportunities to really develop interdisciplinary activities, including the nanotechnologies domain.
- The utmost endowments in Romanian research until nowadays.
- European programs devoted to Eastern Europe countries

THREATS

- Uncertainties regarding the financing possibilities of research activities in Romania
- Augmentation of the brain-drain process among young researchers (and not only) with experience in using new advanced equipments
- The delay in adopting coherent strategies for structuring strong thematic consortia between universities and research units (see Germany example)
- The absence of an unitary national system for evaluating the research / institutions / researchers
- The lack of rules/legislation regarding the periodical individual evaluation of researchers (and professors), regardless of their title

The present status

We have

- Valuable human resources
- Up-to date equipment

We lack

- Coherent policies
 - Research>education>innovation
 - Interdisciplinary research
 - Education by research
 - Open innovation

Strongest enemies:

- Non-homogeneity
- Fragmentation
- Lack of coherence

The future

We expect from authorities

- A new legislation:
 - Quality of researchers and organizations
 - Importance of institutional funding providing continuity and avoiding fragmentation
- A diversity of National programmes (research, supporting young scientists, developing infrastructure)
- National scale long term priorities
- National strategy in nanotechnologies

What the high tech (multi-national companies?) industry can do:

- Invest in Romania, even in research
- Facilitating international cooperation

What we can do ourselves

- Long term internal and external partnerships
- Better exploitation of experimental facilities
- Better interaction between education and research
- Creating a friendly environment for open innovation