3. Institutional Development Plan for the Next 4 Years

3.1 Scientific SWOT analysis

The best way to make a critical analysis of the scientific research in the R&D National Institute for Optoelectronics - INOE is to undertake a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats). SWOT analysis helps in assessing the real status of a given situation, as successfully used in many international and national projects. It must be admitted that all the points listed under SWOT may not be complete, but the information provides an opportunity for in-depth study.

Strengths

• Availability of expertise in many research areas involved in our activities: physics, engineering, chemistry, optics;
• Research infrastructure facilities built to an acceptable level;
• Encouraging young scientists to pursue research in advanced fields;
• Access to high-quality infrastructure and library facilities with modern communication technologies;
• Capacity to quickly respond to a new challenge in the R&D field;
• Low overheads and a low-burden administrative staff;
• Satisfactory on-line presence of the institute;
• Abilities delegation to middle management in order to reduce the decision-taking period;
•Quality management system implemented in the institute in concordance with ISO 9001:2008 requirements.

Weaknesses

• Gap between the research performance and its transfer to commercially competitive products, processes and services;
• Inadequate facilities in some departments and insufficient links abroad;
• Not enough high priority for standard of research output;
• Insufficient financing from both the Government and private sectors during last 3 years;
• Cash- flow is deeply affected by the continuous changes of national legislation;
• A low significant market presence in order to turn to account the scientific results;
• Lack of awareness on quality research journals and on the impact factor analysis, citation index/frequency, etc.

Opportunities

• Participation in European research programs and implementation in the European Research Area;
• Increasing access to the global market trough ICT;
• Reorientation of research priorities according to the national strategy;
• Promotion of high scientific spirit teams;
• Acceleration of inter- or multidisciplinary research;
• Grant of rewards for quality work and results;
• A favorable framework to encourage proficiency growth through research and development (see the Horizon 2020 Program of EU) for applied feature of own research activity;
• Acquisition of latest knowledge and encouragement of the exchange with other research centers;
• Translation of research excellence into competitive performance;
• Romania has five main types of renewable energy resources: wind, hydro, solar, biomass, geo-thermal, with considerable documented potential.

Threats

• Gross Expenditure on Research and Development as % of Gross Domestic Product (GDP) has declined recently;
• “Research- a national priority” - a simple political statement without financial support;
• Exodus of brilliant brains to other countries; Human capital deficit (unlimited wants and needs in a world of limited resources) and the tendency for migration may affect the activity;
• New criteria imposed to the analysis of a past period of research activity;
• Increasing international competition;

The highest 'strengths', of the institute are represented by the expertise of the scientists, research facilities and output in the applied research.
The "weakness" is mainly associated to the relative high average age of the personnel.
As regards the "opportunities", there has been exemplary team spirit among scientists that brought forth good results in the field of optoelectronics research applied in new materials, cultural heritage preservation, environment assessment, alternative bio-fuels etc.
High quality work and the generation of valuable data should increase the amount of publications in renowned journals for highlighting the Institute image.
"Strengths" and "opportunities" are representing substantial indicators for the further enhancement of scientific efficiency.
Thus, SWOT shows that the existing potential available in the institute need to be guided and involved to reach excellence, considering the positive gradient established in the last few years.

Conclusion

The SWOT analysis pin-pointed some issues related to the scientific research scenario of the National R&D Institute for Optoelectronics, issues that are flexible and compliant, as the research system in Romania is continuously changing.
Analysis shows that high-quality scientific outputs could be produced in the near future, despite the external threats related to e.g. funds fluctuations.

3.2 Strategic scientific objectives and directions

The above presented competitive development context related to the current situation and SWOT scientific analysis, represent the starting point for elaborating the scientific strategy of INOE. However, the world is rapidly changing and the position of performant states in the R&D field is threatened by major investments made by existing and emerging economic powers. There is a real urgency – pointed-out by the global economic crisis and the present age of austerity – which reinforces ***the need for expenditure on research*** to successfully compete with other financial demands facing Romanian Government. There is a strong relationship between research (of all types) and impacts, whether be social or economic.
As part of the national system, the National R&D Institute for Optoelectronics is making its contribution to the effort Romania is doing to become a global player in the research domain.

General objectives

- increasing the scientific competitiveness in compliance with the world class standard;
- solving particular global challenges by deploying excellent cross-disciplinary research;
- increasing the research transferable outputs into economic and social benefits, which justifies public and private Investment (e.g.: technologies underpinning 21st century, contributions at solving major global problems - as climate change, alternative sources of energy - as bio-fuels, food security, healthcare and ageing of population);
- attracting R&D investment from the business sector;
- supporting the effort to create and develop a prosperous research community, enriched by working with and across different sectors,
- offering high-skilled entrepreneurial people to the labor market
- sustaining basic, applied research and technology development;
- increasing collaboration on different topics between research groups and different institutions;
- intensifying the science - society dialogue, with a view on: → what researchers actually do; → that research is a way of exploring what we do not know; → that it is dealing with uncertainty and → how science and research is part of our culture.

Specific objectives

- *Increasing the quality results of the research activity through →articles published in main stream scientific reviews; invited papers presented at prestigious conferences;*
- *Increasing the visibility through participation in international cooperation: projects, scientific events, public debates etc. , patenting at international/national level;*
- *Increasing the ability to attract the funding from international sources/ from private enterprises;*
- *Stimulation of the cooperation between research institute and enterprises;*

- *Promoting a portfolio of scientific results capable to be transferred to the economy and to ensure all necessary assistance;*
- *Entrepreneurial activity enhancement, to create start-ups and spin-offs.*

List of priority areas

► ***Optoelectronics and analytical instrumentation engineering***

In a framework defined by the growth of social issues and the standstill of economic performances, European Union launched The European Strategy 2020 with the object to straighten the European economy and transform it into a competitive, sustainable and inclusive one. Connected to this trend, in this priority area, the performers in research and innovation will be integrated in the general effort of solving the European issue "innovation crises". The goal is to fit-in the lasers, optical equipment, optical amplifiers etc., in integrated systems with applications in industry, health and defense. The analytical instrumentation and methods represent a support for increasing the capacity to perform high quality research.

The scientific activities will focus on the elaboration of new technological and constructive solutions in • **industry** including **defense** (→fiber optic sensors for smart mechanical systems; →new components such as: lenses for super Gaussian laser beam, grading of chalcogenic structures, photonic crystal writing using a femto-second laser, mirror for a single mode Q-switched Nd:YAG with unstable resonator; →equipment with laser to evaluate and monitor the landslide effects; →design and development of new types of analytical instrumentation; →modern, green analytical methods (extractive, purification, concentration), • **healthcare** (→optical imaging systems for early diagnosis of diseases; →methods to improve the health quality based on non-invasive action; → advanced methods to determine the traceability in food chain; → modern methods to determine the geographic origin and authenticity of food, environment samples, drugs, forensic; → analytical techniques for qualitative and quantitative determination of endocrine disruptors from environment factors)

► ***New Optoelectronic Materials, Thin Films and Surface Processing by Vacuum Technologies***

The future development is aiming to:

- extend the development of novel thin films for optoelectronic applications as: → growth of oxides films as graded or superlattice structures, → growth of epitaxial semiconductor films,
- surface engineered solutions in clean-tech applications like thermo-solar for energy generation.
- novel high energy density electric field pulsed engineering technologies, for water/air remediation technologies
- further development of novel biocompatible coatings.

Focus will be placed on developing thin films and surface functionalization on the nanoscale, by developing new films deposition techniques (HIPIMS, cathodic arc coupled with low energy ion implantation) and diversifying the characterization methods (electron microscopy, in-depth Auger electron spectroscopy, nano-corrosion)**.**

► ***Optoelectronics methods and techniques for cultural heritage restoration***

Cultural heritage is often unique and irreplaceable, which places the responsibility of preservation on the current generation. The area serves the community in charge with preservation, by scientific research, education and training programs, pilot projects, and the dissemination of the results of both its own work and the work of others in the field. In all its endeavors, the team researchers focus on the creation and delivery of knowledge towards professionals and organizations responsible for the cultural heritage preservation, scientifically enforcing all restoration strategies and decision making.

The values of this axis must be: ***excellence*** pragmatically evaluated; ***innovation*** understood in the broadest meaning sense - not strictly as "invention", but also developing novel approaches, pushing boundaries, and creating knowledge; ***leadership*** helping to shape and advance the profession, both technical and social dimension; ***in service*** to the preservation community.

The foreseen main directions in specific activity evolution are: ▪New perspectives of digital models exploitation – data processing for polyvalent use, data mining for prediction, and informational instruments; ▪ e-Smart Access to Infrastructure for cultural agents and not only; ▪Instrumentation and investigation research for underwater archaeology; ▪new material accelerated aging and contemporary art preservation issues.

► ***Optoelectronics Environment Assessment and Remediation Applications***

The direction provides coverage of laser remote sensing and complementary methods, technology and applications within environmental domain, where atmosphere, water and soil are considered as 3-dimensional dynamic systems in continuous interaction.

Our efforts focus on: (1) development and improvement of investigation methods (active and passive remote sensing, in situ and laboratory) for environmental assessment; (2) experimental and theoretical research for the physical, chemical and optical characterization of environmental components and parameters; (3) development of new effective methods and technologies for environment rehabilitation.

The **main research activities** will be oriented towards: improvement of remote sensing instrumentation, techniques and retrieval algorithms; → modeling and experimental retrieval of atmospheric pollutants' properties during transport, interactions and modifications influencing air quality and climate; → assessment of aerosol, greenhouse gases and precursors contribution to radiative processes; → investigation of aerosol-clouds interaction; → improvement of weather modification techniques → development of automatic early warning systems for aviation safety; → survey of multispectral methods for land cover change analysis; → impact of atmospheric pollution on European land ecosystems and soil; → effects of natural environment for human health and well-being, vulnerabilities and adaptation capacity; → new techniques for environment quality bio-monitoring, decontamination and reconstruction; →creating new interfaces between the scientific community and decision makers; →establishment of strategic partnerships.

► ***Alternative fuel technologies and the science of environmental impacts***

The main goals for the next 4 years aim at:→ 3rd and 4th generation bio-fuels; → assess the impact of the used bio-fuels on biodiversity; →Develop the green pre-treatment technologies to improve the lignocellulosic biomass potential; → Increase the efficiency of the biogas production technology; →Develop secondary products from biofuel; →Develop innovative photovoltaic cells; →Inventory and determination of green-house gases on biofuel chain; →Understanding the long-term fate of geologically stored CO_2; →Optimising the integration of CO_2 capture into power plants; →New CO_2 storing methods; →New methods for obtaining and capture bio-hydrogen.

► ***High performance complex systems based on hydraulic and pneumatics actuation***

Research activities will be directed to: development of digital hydraulics to optimize the energy consumption; tribology of mobile seals and mechanical couplings; improving dynamic performances of hydraulic-mechanical systems using servo-equipment; modernize the pneumatic drive systems; optimized mobile equipment operation using mechatronics, based on hydraulic drives, sensor science and electronics; increasing working pressure in hydraulic systems, using new materials; electro-hydraulic equipment with central intelligence agency for learning repetitive movements or performed in some default parameters.

► ***Technology transfer***

The National Institute of Optoelectronics is part of Romanian Network for Innovation and Technology Transfer. This was established by the National Authority for Scientific Research in response to the growing importance of technology and innovation. As part of this national network our institute will: • promote scientific expertise; • consolidate the innovation; • effectively inform the policy-makers and leadership.

3.3 The human resource strategy

The institute guides the policies on the human resources based on the European Commission's European Chart for Researchers and the Code of Conduct for the Recruitment of Researchers. The guiding principles are applied to both researchers and employers, to ensure the best possible balance between the attributes and responsibilities of each party. Researchers benefit of *Research Freedom, Dissemination, Exploitation of results and Continuing Professional Development,* steered by *Ethical principles and Professional responsibility and attitude,* in the frame of *Contractual and legal obligations, Accountability, Good practice in research, Public engagement, Supervision and managerial duties.* Our Human Resources Strategy (HRS) require the Employers and Funders to provide the Researchers with *Non-discriminative Research environment,* good *Working conditions and Recognition of the profession, Stability and permanence of employment, Funding and salaries, Gender balance, Career development, Value of mobility,*

Access to research training and continuous development, Access to career advice, Intellectual Property Rights, Co-authorship, Supervision, Teaching, Evaluation/appraisal systems, the right to *Complaints/appeals, Participation in decision-making bodies,* and fairness of *Recruitment*.

In compliance with the national rules and regulations, all general principles and requirements that should be met by employers and/or funders on appointing or recruiting researchers (*Recruitment, Selection, Transparency, Judging merit, Variations in the chronological order of CVs, Recognition of mobility experience, Recognition of qualifications, Seniority, Postdoctoral appointments)* are included in own Vacant Jobs Occupation Statutes, a document approved by Board of Administration, which enables the efficient management of the staff in terms of size and composition. In order to ensure that Romania and our institute may benefit from the very best researchers' work, a significant effort should be invested in people stimulating and supporting their creativity. This is more important than trying to predict the most promising topics or areas into the future. Investment in the best people – those capable to work in the leading line of research – is a crucial investment for the future.

The key strategic priorities of our Human Resources Strategy over the next four years are:

- To lead an Institute wide approach to the support, reward, development and management of staff so that consistent levels of high performance are the norm.
- To build institutional capacity to achieve successful changes in the short and long term providing support for and building the leadership capabilities of managers.
- To establish and maintain actual relations with staff, individually and collectively and with their recognized trade unions to achieve high levels of employee involvement.
- To develop an environment that protects employee well-being, respect the diversity and difference and in which there is no tolerance of unfair discrimination.
- To develop a workforce plan, in terms of size, composition and competence, integrated with financial planning, that underpins the Institute's strategic aims
- To stimulate greater flexibility and mobility of researchers, in particular between academic area and the business and public sectors;
- To stop the brain drain, an emigration of large groups of individuals with technical skills and knowledge and to promote the brain gain initiative.

In essence, the aim of Human Resources Strategy is to deliver a culture and working environment which values: • high performance; • fairness of treatment; • respect for difference and diversity; • excellence in leadership, management and supervision; • innovation, creativity and adaptability in changing circumstances; • team working; • effective and significant employee engagement and involvement; •organizational learning and development through the giving and receiving of constructive feedback .

3.4 Mechanisms for stimulating the appearance of new research directions

❖ **Good Practice Exchange** – a resource for helping researchers and the institute become more competitive in the field of scientific research.

Having access to practical examples of what others have done is very useful and we have collected an extensive range of case studies available. The case studies are updated regularly and we would welcome to any suggestions on the types of case studies. Sharing of information and best practice make easier the support of the social and financial effort to the research activities.

❖ **Working visits** - give the opportunity to researchers to study any agreed kind of activity or subject (operational, technical, strategic, policy level) within the scope of the program and more specifically, related to the Strategic Work Program of the institute. The working visit is considered as the most flexible tool under the programs and allows reasonable quick reaction to national needs. From this point of view, there are two possible types of working visits, namely incoming and outgoing working visits.

❖ **Participation at international prestigious conferences** – is an incentive mechanism in order to keep well informed all scientific researchers, to create the possibilities for appearance of new research directions and to generate new consortiums capable to prepare high quality scientific proposals projects.

❖ **Researchers' participations at world events of scientific equipment companies**;

❖ **Round table** – for open debates regarding new trends in the scientific approached fields.

❖ **Common scientific experiments –** monitoring of each participant from its own workplace

3.5 Financial SWOT analysis

SWOT analysis identifies the status of the institute and to where it should develop. SWOT evaluations often provide a flash image of the status of the institute and the basis for a road map to help management plan future direction. The worldwide financial crisis, with very strong effects on Romania, created a climate that made a SWOT analysis even more important. According to the economic specialists forecasts the entire period between 2012 and 2015 is still susceptible to the effects of the financial crisis especially on the European level.

Strengths

The financial crisis identified some surprising strengths in our activities. During such period down economies reward companies that exhibit creativity, expense control, boldness and confidence. Common strengths that are valuable during a financial crisis include: ▪ quality work, ▪ accessing of external financial sources, ▪ correct and carefully expenses, ▪ professional assistance and a ▪ brand of trust.

Weaknesses

SWOT identifies both internal and external weaknesses. Unfortunately, during a financial crisis, internal weaknesses of the institute are not only exposed, they are often magnified having in view: ▪ decreasing of SME' number, activities and capital investment; ▪ cutting down the research budget and, as a consequence, the budget of all active research projects affecting the planned objective ; ▪ the effort to access funds to support ineligible expenditure in the frame of international programs, without the domestic national authority support ,in order to keep on a positive cash flow; ▪ large gap between national research program calls (2008 → 2011) with negative effects concerning the future medium- and long-term decisions; ▪ the brain drain phenomena. Weaknesses during a financial crisis involvement: too much debt and too low cash reserves. Identifying these weaknesses the institute could have the ability to take the proper actions that could sustain and make the best use of the opportunities during a financial crisis.

Opportunities

The SWOT analysis points out external opportunities, sometimes hidden, during financial crises. Opportunities to target a different group of funds organizations, ▪create **new products and services applying the scientific results** and ▪create **new markets** often "magically" appear during down economies. People still need products and good and performed services and that is why they will turn to other companies to fill the gap. This period offers a good opportunity to ▪render profitable many of our scientific and technological portfolios. Romanian economy is still labor intensive and therefore in need of capital infusion in order to increase its competitiveness within the EU (see Revealed Comparative Advantage – Balassa index). A real support is offered to all companies by the Sectorial Operational Program "Increase of Economic Competitiveness", axes 1, 2 and 3. Based on this financial support the interest in purchasing of patents and research activities for commissioning and manufacturing new products, is growing.

Threats

Down economies generate multiple threats to the financial activities of the institute. Identifying and minimizing the negative impact is critical. ▪Inability or ▪reserve of possible beneficiaries of our scientific results during a financial crisis is the most dangerous threat. Understanding the real cause of this threat can help our possible beneficiaries to survive and prosper. During this period all ▪economic operators conserve cash for emergencies and ▪decrease all investment expenses. ▪The direct involvement of industry in research activities is limited and decreasing.

Expert position

The 2008 recession with its current effects and in future, was so deep that many units reverted to an old mentality, thinking only of cutting costs and surviving the threat. A SWOT analysis showed that, along with the many threats (external) and exposed weaknesses (internal), the financial crisis also forced units to acknowledge their strengths (internal) and identify new opportunities (external) to help them, not only to survive, but to prosper.

For our research institute the challenge is: →to promote performed scientific projects in the frame programs with national or/and international financing; → to promote the portfolio scientific results capable to be transferred towards the economic operators and to assure all necessary assistance to give life of these ideas.

3.6 Infrastructure: investment plan and strategy

During 2007-2008, in response to the need to bring more strategic direction investment in research infrastructure, National Authority for Scientific Research supported and encouraged acquisitions of performed scientific equipment. In the same time was sustained all activities regarding buildings rehabilitation and modernization's workspaces. Having in view this start in 2011 a plane was developed by management committee following extensive consultation with the research community and stakeholders traditional partners in own research activity.

The objectives of this strategy program are to:

- Provide major research infrastructure that is national, strategic, collaborative and world-class;
- Promote a sustained cultural change towards investment attitudes that are national, strategic and collaborative;
- Develop research activity that is collaborative and world-class.

Scientific and Management Committees were appointed to advise and respectively follow the management on the implementation of the investment plan like an instrument of own strategy. The key principles underpinning the investment strategy reflect the Committees' advice and are as follows:

- INOE' investment in research infrastructure should be planned and developed with the aim of maximizing its contributions of the research to economic development, national security and environmental sustainability;
- Infrastructure resources should focus in areas where INOE is or has the potential to be competitive and could provide international leadership;
- Major infrastructure should be developed on a collaborative, national, non-exclusive basis.
- The Strategy should be able to assure the participation of INOE' researchers in the international research system.

Vision 2015 of research infrastructure in INOE

In order to retain world-class researchers, the institute should continue to focus its own efforts on development/creation research infrastructures and to contend for recognition on the European level.

The general objectives are:

1. Development and promotion the existing infrastructures:

- Romanian Atmospheric Observatory – RADO;
- Research Centre for Advanced Surface Processing and Analysis by Vacuum Technologies **ReCas**t ;
- Centre of Excellence for Restoration by Optoelectronic Techniques
- Infrastructure for characterization and diagnosis by optical and complementary methods **-INDICO**
- Environmental analysis laboratory -LAM
- Laboratory biofuels quality for certification, CABIO

2. Support of the exiting ones

3. Creation new research infrastructures

- Laboratory for control of chemical residues in food products

4. *e-Infrastructure*

1. DEVELOPMENT AND PROMOTION THE EXISTING INFRASTRUCTURES

► Romanian Atmospheric Research 3D Observatory – RADO.

Operational activities (monitoring): monitoring of greenhouse gases and suspended particles, measurement of meteorological parameters (vertical profiles of water vapor, humidity, temperature and wind)

Scientific activities (studies, analysis): synergetic analysis of polluting particles and gases, studies of impact on radiative processes in the atmosphere leading to climate change, building 3D atmospheric scenarios, simulation of national scale atmospheric chemistry, impact studies, forecast

Education for science and environment: post graduate training for MSc and PhD Students, educational programs (demonstration, hands-on training, multimedia) for children and high school students.

The infrastructure is part of ACTRIS (Aerosols, Clouds, and Trace gases Research Infra-Structure Network), an European Project which intends to integrate all relevant European ground-based networks of stations equipped with advanced atmospheric probing instrumentation for aerosols, clouds, and short-lived gas-phase species. ACTRIS project will build the next generation of ground-based component of the EU observing system by integrating three existing research networks: EUSAAR, EARLINET, CLOUDNET, and a

new trace gas network component into a single coordinated framework. ACTRIS project is funded within the EC 7th Framework Programme under "Research Infrastructures for Atmospheric Research".

Development of RADO has in view:

→completion of laboratory, in situ and remote sensing instrumentation in order to: ▪increase the quantity of the datasets; ▪ensure a safer and quasi-autonomous operation; ▪ widening the area of possible application; **→development of personnel professional and complementary skills**

Coordination: Working group led by Dr. Nicolae Doina

Development phase: 2012-2013; Operational phase: 2014

Estimated costs: **1336000** €, out of which: ▪building upgrade: **155000** € (Stand alone power generator; Motorized roof openings); ▪scientific instruments: **905000** € (Wind lidar; Ceilometer; Mini radar; Condensation particle counter (CPC); Differential Mobility Analyzer (DMA); Atomizer; Detection head sunphotometer; AMS module for carbonic particles; Aetholometer; Particle Characterization with Raman Chemical ID; Specialized IT equipments & software); ▪new employees (2 PhDs + 3 PhD Students, full time for 2 years): **276000** €

► Research Centre for Advanced Surface Processing and Analysis by Vacuum Technologies – ReCAST;

The ReCAST activity is mainly related to: ♦thin film Physical Vapor Deposition techniques with associated characterization methods; ♦plasma diffusional surface treatments (ion nitriding); ♦high vacuum (HV) and ultrahigh vacuum (UHV) technologies, including leak detection by He mass spectrometry; ♦ion sources (i.e. Kaufman, Penning, ECR type) for ion assisted surface processing.

Further development of the infrastructure aims to extend: ***thin film deposition capabilities by*** ♦up-grading the existing deposition systems, adding a plasma immersion ion implantation option to the new HIPIMS magnetron method and by new pulsed vacuum arc configurations combined with advanced automated process control to ensure a high reproducibility of the coatings, ♦purchasing of a new deposition system dedicated to complex plasma characterization, and ***in-house films' characterization*** by ♦up-grading the existing Auger electron spectroscopy system 'in-depth" measurements ♦purchasing of a table-top SEM.

Coordination: Working group led by Dr. Braic Viorel

Development phase: 2012-2014; Operational phase: 2012

Estimated costs: 1,450,000 €: new equipments acquisition (1.175.000 €) and employment of 3 young people - PhD degree

► Centre of Excellence for Restoration by Optoelectronical Techniques – CERTO

Research activities are generated by the new demands from restorers and conservators practice. A significant experience was accumulated in multidisciplinary research projects, including from various on site collaborations. After more than 10 years of promising national and international research, CERTO activity is now focused on: ▪Integration of non-contact, non(micro)-invasive investigation methods, particularly, with fast response for polyvalent applications, conservation status evaluation, prediction of monument/artwork conservation dynamics; simulations; ▪ Long-term on-line monitoring of microclimate, air quality and stress factors on monuments via wireless network of specialized sensors; ▪ Development of open-laboratory for on-line access to infrastructure (for different purposes: training, education, common experiments, expert advising etc.); ▪ Development of open-restoration workshop (mobile laboratory Art4Art) for on-site monitoring of certain parameters, campaign duration prolongation (extended effective working time), experts collaborations.

Development of CERTO has in view:

Coordination: Working group led by Dr. Radvan Roxana

Development phase: 2012-2014; Operational phase: 2015

- Estimated costs: 850.000 € for new acquisition: ▪Monitorized high precision linear stages; ▪Monitorized high precision rotation stages; ▪ Motor controller (3 axes); ▪ Internet satellite antenna and receiver; ▪ Portable RAMAN; ▪ IT equipments; ▪Veloxy system (decontamination installation); ▪ Copter system for radar antenna lifting; ▪ Laser scanner for interior volumes; ▪ Ultrasound inspection system and 350000€ for new employees (3 PhDs + 3 PhD Students, full time for 2 years).

► Infrastructure for Characterization and Diagnosis by optical and complementary methods – INDICO

The goal of the laboratory is to characterize, measure and test the optical parameters specific to optoelectronic applications, in a unitary frame, so as to allow the evaluation of the different production

stages – from fundamental to applied research and to technological transfer. This infrastructure accomplishes specific measurements concerning laser devices and optics, laser radiation output parameters determination, laser beam characteristics determination, optical fiber propagation characteristics determination, measurement, determination of opto-mechanical characteristics of optical components and thin films characterization. Our facility includes various laser sources, like argon CW laser with multiline selectivity, He-Cd UV laser, YAG:Nd Q-switch laser, femtosecond Ti:Sapphire tunable laser and other specific equipment for the laboratory's purpose.

Development of INDICO has in view:
Coordination: Working group led by Eng. Sorin Miclos
Development phase: 2012-2014; Operational phase: 2014
Estimated costs: 252000 € for new acquisition: ▪ up-grade of femto-second Ti:Sapphire tunable laser; ▪beam propagation analyzer with M^2 for specific applications; ▪clean box with accessories and 116617 € for new employees (3 PhD Students, full time for 2 years).

► Environmental analysis laboratory (LAM)

The contamination of land and groundwater in post-industrial regions, as a result of anthropogenic activities has given rise to numerous impacts resulting in unfavourable end points. In many cases, pollution has affected both land and water sources utilised by local populations. There is a need to establish priorities for remedial action which can take into account all of the factors involved. Decision makers responsible for environmental and health policies therefore need access to a range of information about the extent of dereliction, the levels of pollution - current and projected - to which they are subjected, sources of funding for restoration, legislation and planning requirements. They require information on the population at risk, its condition and vulnerability. In addition they need to be aware of the types of remediation available, with an assessment of their relative merits and costs. The main topics of *environmental* activity deal with determination of environment quality, organic pollutants, heavy metals and other inorganic pollutants in environmental samples, environment pollution control. One has been developed appropriate methods of sampling and analysis, including procedures for quality control in order to estimate the measurement uncertainty.

Development of this infrastructure has in view:
Coordination: Working group led by Bela Abraham
Development phase: 2012-2014; Operational phase: 2014
Estimated costs: 400.000 € for new acquisition (Portable analyzer for total organic compounds (TOC) determination from gaseous effluents; Portable combustion gas analyzer, with temperature and humidity sensor; Air samplers with variable air flows; Sampling device for particulate matter PM10 and PM2.5; Portable pumps for gases with ml / min flow; Automatic equipment for soil sampling; Portable infrared ambient analyzer; IRMS – Isotope Ratio Mass Spectrometer; Microwave plasma-Atomic Emission Spectrometer) and employment 2 young people doctor's degree.

► Laboratory for biofuels quality certification, CABIO

The increased awareness regarding the depletion of energy sources in the context of a significant climate change due to greenhouse gas emissions, lead to the escalation of the number of those calling for the implementation of sound policies in order to achieve sustainable development at both national and European level. Promoting energy from renewable sources is a timely must. Romania is a country where the agriculture and rural space plays a very important role both from economic and social point of view. Therefore, the development of new industries/technologies for the valorification of agricultural and human existing potential is very important. Romania has a remarkable potential regarding the biofuels production, being placed on the first places in Europe.

The main topics of *Biofuels* activity deal with the bio-fuel quality certification, performing biodiesel analyses, according to the European standard EN 14214 and bio-ethanol analyses, according to the European standard SR EN 15376 and characterization of the by products.

Development of this infrastructure has in view:
Coordination: Working group led by Adriana Gog
Development phase: 2012-2014; Operational phase: 2014

Estimated costs: 800.000 euro for new acquisition (Bidimensional gas chromatography system with FID detector for diesel / biodiesel mixtures analysis; Fermenter (bioreactor); GC/MS pyrolysis (Py-GC/MS); RMN Bruker 400 Spectrometer; FT-NIR spectrometer) and employment 3 young people doctor's degree.

2. SUPPORT OF THE EXISTING RESEARCH INFRASTRUCTURES

► Romanian Atmospheric research 3D Observatory – RADO.

Estimated costs per year jest for equipments: 42500 €, out of which: - equipments maintenance (consumable materials; metrology, calibration and technical services); - utilities (electrical energy, water, internet etc.).

► Research Centre for Advanced Surface Processing and Analysis by Vacuum Technologies – ReCAST;

Estimated costs: 296400€ for consumable materials (210,000 €), metrology and calibration systems (60,000 €), utilities (24000€ - electrical energy, 2400 € -water etc.).

► Centre of Excellence for Restoration by Optoelectronic Techniques – CERTO

Estimated costs: 120.000 € out of witch ▪ consumable materials: →Kit 3D printer; →Pigments, resins, mediums, varnishes& restoration materials; ▪ metrology and calibration systems (climatic chamber, 5 laser, 3D printer, spectrograph, thermo-camera, microscope, colorimeter, 3D scanner, vibrometer, mustispectral camera); ▪ utilities (electrical energy, water, Internet etc.).

► Infrastructure for Characterization and Diagnosis by optical and complementary methods – INDICO

Estimated costs: 50000 € for consumable materials, metrology and calibration systems, utilities (electrical energy, water, internet etc.).

► Environmental analysis laboratory -LAM

For existing facilities already presented, necessary costs for providing their utilization in perfect conditions supposed: utilities, consumable materials, and services for metrology and calibration.

Estimated costs: 105.000 € for consumable materials, metrology and calibration systems, utilities (electrical energy, water).

► Laboratory for biofuels quality certification, CABIO

For existing facilities already presented, necessary costs for providing their utilization in perfect conditions supposed: utilities, consumable materials, and services for metrology and calibration.

Support of existing infrastructure has in view:

Estimated costs: 90.000 € for consumable materials, metrology and calibration systems, utilities (electrical energy, water).

3. CREATING NEW RESEARCH INFRASTRUCTURE

►**Laboratory for control of chemical residues in food products -** determines chemical compounds naturally present in food, pollutant (PAH, pesticides) and additives (preservatives, synthetic colorants and sweeteners); Future objectives proposed: ♦to improve the existing analytical methods and to develop new ones for broadening the domain of pesticides, dyes, hormones and antibiotics which can be analyzed in REZALIM, ♦to develop new modern extraction methods which are more reliable, faster and cheaper than the traditional methods, ♦to acquire new equipment which will allow: a quick analyze of food contaminants, to test the product's authenticity, to evaluate the distribution of the compounds in food structure and to characterize the food from chemical perspective.

Creating and developing of this infrastructure has in view:

Development phase: 2012-2014; Operational phase: 2014

Estimated costs: 500.000 euro for new acquisition (ELISA, DTG, Confocal Raman Microscope) and employment 3 young people doctor's degree.

4. e-RESEARCH INFRASTRUCTURE

Much of the research carried out around the globe is now conducted with the assistance of ICT tools and services. Researchers can now reach out to each other from opposite ends of the country, even the globe, sharing data, ideas and instruments or equipment. Entirely new fields of research are emerging as researchers can now collect, move and manipulate large amounts of data, enabling new and much more complex problems to be addressed. The main purposes of this approach are:

→ Infrastructure that enables new research and new forms of research, including high performance communications networks, high performance computing facilities, data storage, and resource access and authentication systems.
→ Researchers will be able to participate in real-time in complex research experiments that amass the collective knowledge, most recent analysis, and the latest facilities of peers in other institutions or locations.
→ Improved expertise to ensure that personnel with the necessary skills and experience is available to drive and deliver these and tools / equipments.
Strategic Impact - Today's research challenges are complex and global, including problems such as climate change, sustaining ecologies and the environment, predicting and living with extreme geological activity, managing disaster reduction and security, improving the health of our population and containing infectious disease. Such problems demand profound understanding of complex systems that cannot be achieved by isolated efforts or real world experimental means alone.
Challenges and Assumptions
→Transitioning from research to e-Research Infrastructure is challenging to researchers and our research organization. Research is traditionally competitive and researchers have limited capacity to share, in the sense that their funders, institutions and disciplines may have structures or mechanisms in place that impede the levels of collaboration needed to advance research. Institutions are also often unable to provide the level of general and discipline-specific ICT support to meet research needs.
→Another challenge in developing e-Research Infrastructure is to ensure it can engage other investments and capabilities in a way that meets their needs and brings about highly developed solutions. The success of e-
Requirements Infrastructure- Enabling Components provide the infrastructure landscape that is essential and pervasive: ▪*resource access and authentication systems*, ▪*data storage*, ▪*a range of high performance computing facilities*, and ▪ *high performance communications networks*.
→*Access Management*: to allow organization to reliably and easily grant access to resources given a researcher's identity, and limit access or use of resources to those for which a researcher has been given permission. This component will build on the work of the The Agency for Administration of the National Network for Education and Research, which is developing the core components of such an infrastructure to facilitate collaborations locally, nationally and internationally.
→*Data Storage*: to provide data storage facilities (the hardware component) and data management plans (the principles for storage and long term preservation) to assist research. This national data grid would provide seamless unstructured storage as well as collaborative storage spaces, particularly *on* but *not limited* to active research projects and researches.
→*High Performance Computing*: to meet the needs of advanced in computing science and data analysis needs of complex system sciences. Special facilities are necessary to provide real-time processing or visualization.
→*High Capacity Communication Networks:* to enable effective research and research collaboration by connecting research organizations, research activities and researchers.
The first task regards two priorities fields to apply the facilities of e-Research Infrastructure:
►Optoelectronic methods and techniques for restoration/preservation of artifacts: a challenge in harmonizing other investments in data generation from instruments and a variety of imaging and sensing deployments; digitization of existing collections; wise advanced experimental data interpretation with international know-how participation; a smart elaboration export of services (education, control, antifraud, simulation, prediction etc – are the foreseen new branches).
►Environment assessment: Build bridges between research infrastructure and research investments already existing in Europe and reduce policy impediments to collaboration; the infrastructure includes systems that allow the easy capture, pre-processing and visualization of data from shared instrumentation (e.g. LIDAR systems, sun-photometer, radiometer, aerosol mass spectrometer, and remote access to sensor networks or the easy integration of outputs from ecological observational platforms.

3.7 Technology transfer and attraction of non-public funds

The technology transfer and innovation infrastructure, namely the organizations specialized in the dissemination, transfer and valorization of R&D results in economy in still poorly developed.
An essential structure of the activity of our research institute is the technology transfer. This activity completes the purpose of every research establishment, which is to capitalize on the results obtained in the

R&D activity and by this to contribute to the process of the social-economical development by science and technology.

The strategy of technology transfer of the establishment is structured on two main parts: ▪ technical and ▪educational

THE TECHNICAL COMPONENT CONTAINS:

- ***Transfer towards the industrial area –*** has in view the capitalization of the research results by their implementation to potential beneficiaries
- ***Certification and capitalization by patent assignment –*** protection by certification of the intellectual property with the two aspects: the industrial property and the copyright as an essential element for the institute. The element of intellectual property is defined in a strategy regarding the activities of technology transfer.
- ***Advising – Organization of technical assistance activities for the technology transfer, destined to SMEs***
- ***Creation of spin-offs –*** There is no secret that the present trend of the most companies from the Western World is to employ manpower from the Far East, India and China, due to the very low wages and the high-skilled workforce. The countries from Eastern Europe are still aimed at for the same reasons, having, in addition to that, culture and traditions similar to the Western World. But once these countries in the European Union, the salary level will continuously increase up to levels likely unattractive for the management of multinational companies. This phenomenon will have a serious long-term impact upon the unemployment for all the categories of employees and the idea of having a "stable and safe job" is to become a pure utopia. Most of the European countries started to take measures against this phenomenon laying more and more emphasis on the transfer of innovating and high-tech knowledge from market research institutes, by creating companies in the top fields. As a result, a "sea" of small and medium enterprises saw the light in the last five years, most of them in IT, telecom, biotech, nanotech, pharmaceutical. Romania laid the foundation of some support programs for the small and medium enterprises, such as the construction of scientific parks and business incubators. These became places where the spin-offs from the technical and research institutes are implemented during the "seeding" phase, i.e. the development period of the product (or services) offered by these companies. After that, once the product is released on the market, the companies increase their team and move in a housing office, which will allow them the logistical and economical expansion. This process must be stimulated and the secret is to be found in the ability of the educational and research systems to innovate and to stimulate the young graduates and the researchers to find new needs on the market and to create the products and the services that will answer to these needs. On one hand, there must be research strategies in the high-specialized fields with direct application on the market (industry, agriculture etc.), strategies generally decided in the research institutes and universities. On the other hand, it is necessary to have some promotion and real support programs for the students, the researchers and the professors from these institutes in order to find the market opportunities and needs, and the creation of new companies that will become sources of employment in that area.
- ***The presence of specialists in the technical board of certification of some companies –*** for the promotion of modern and advanced solutions in the fields of competence.

THE EDUCATIONAL COMPONENT aims at the increase of the interest for the fields approached and developed by the institute. The main dissemination form of the advanced knowledge obtained within the institute is the continuous education by training sessions, both in the industrial and academic fields. The activity is organized on three main directions and is mainly sustain by CENTI:

- courses and tutorials – Consider the cooperation with different institutions in order to establish the programs and the duration function of the approached subject and the profile of the audience.
- seminars – the practical way by which the students are presented the situation of the field as well as the research subjects that are approached or could be approached. Complementarily, people from the academic or industrial field will be invited at seminars.
- support for the education university programs – for many years the institute established traditional relationships with the universities and their structures, which are materialized by:
  - laboratory activities with students that take place in the laboratories of the institute;
  - graduation theses, master dissertations and PhD theses achieved in the institute laboratories**.**

STRATEGY IN THE FIELD OF TECHNOLOGY TRANSFER

	Strategic objectives	Measures	Deadline
MEDIUM TERM STRATEGIC OBJECTIVES	**TECHNICAL COMPONENT**		
	1.1. Technology transfer towards industrial areas in the fields: ➢ Environment protection; ➢ Medical equipment; ➢ Agriculture - Food; ➢ Biofuel - biomass; ➢ Cultural patrimony - restoration/ conservation/preservation ➢ Processing industry	▪ Inventory of the latent technology capital existing in the company ▪ Creation of a database regarding the latent technology capital ▪ Dissemination of latent technology capital by web pages, flysheets, round tables with participants from the fields of interest etc. ▪ Presentation campaigns of the technical and social-economical advantages by the application of the advanced technologies	30.03.2012 30.09.2012 15.12.2012 2nd and 3rd terms 2012
	1.2. The use of the intellectual property rights	▪ Inventory of patent portfolio; ▪ Assignment by OSIM (Romanian State Office for Inventions and Trademarks) of patents towards the potential beneficiaries with the purpose to capitalize them	30.02.2012 permanent
	1.3. Consultancy - Organization of technical assistance activities for the transfer of technology, destined to SME	▪ Enhancement of the activity of CENTI - certified entity of technology transfer; ▪ Trained specialists in: →use of intellectual property rights; →implementation of market and feasibility studies; →evaluation of the risk factors; →juridical, accountancy ▪ Development of infrastructure: spaces arranged and equipped according to the requests of the E.U., which allow for the organization of conferences, workshops and presentation and/or specialized courses	permanent 2013 2012
	1.4. Creation of spin-off and start-up	▪ Scientific and technology park established on the Platform of Cluj-Napoca with involvement of local authorities	2012-2013
	EDUCATIONAL COMPONENT		
	1.1. Courses and tutorials	▪ preparation of courses in the fields of competence requested by the organizers	2012-2014
	1.2. Seminars	▪ seminars with the participation of the representatives from industrial and academic fields	yearly
	1.3. Support for the University educational programs	▪ listing of the institute topics of interest in order to be approached as graduation dissertations, master dissertations and PhD theses	3rd term yearly
LONG TERM STRATEGIC OBJECTIVES	**TECHNICAL COMPONENT**		
	2.1. Transfer of technology in/from European Union in the fields: ➢ Security of the environment ; ➢ Biofuel; ➢ Agriculture-Food ➢ Cultural patrimony - restoration/ conservation/preservation ➢ Processing industry	▪ **Expansion of the activity of technology transfer by:** ✓ National Centre for Biofuels – established in 2009 (ICIA – UT Cluj-Napoca); ✓ CRAIM – Regional Center for the Prevention of Major Industrial Accidents (ICIA-UBB Cluj-Napoca ✓ CENTI – technology transfer entity certified by MEC (Ministry of Education an Research); ✓ Focal Point IRC Romania with the headquarters ICIA-CENTI – certified to perform E.U.-Romania technology transfer ✓ Scientific and technology park established on the Platform of Cluj-Napoca	2012-2014
	EDUCATIONAL COMPONENT		
	1.1. Courses and tutorials	▪ organization of courses in the fields of competence, in the institution ▪ establishment of the working conditions of the courses	2012-2015
	1.2. Seminars	▪ establishment of organizing conditions for interactive on-line seminars ▪ organization of interactive on-line seminars with national and international participation	2012-2015 2013-2015

3.8 Strategic partnerships and visibility: events, communications, collaborations.

Communication is a prioritized area in the activities of INOE in the several forms:

Publicizing the Environment

INOE publicizes the own initiative, progress and achievements, in an effort to build awareness and stimulate outreach. The web site for INOE can be found at: http://inoe.ro and in World rank of research centers by country the institute is placed on 7Th position (see http://research.webometrics.info/rank_by_country.asp?country=ro)

Scientific Publishing

The research from INOE must provide new and high quality PhD Theses (24in the start-up period), publications, cited research publications. We should publish in world-leading journals in the fields off materials science, cultural heritage, physics, chemistry, manufacturing science and engineering and IEEE. It is our goal that the most significant results to be published in high-impact journals. Beginning with 2012 all PhD Theses of our staff will be printed by **I**ntegra **N**atura **O**mnia at A**E**terna (INOE) publishing house.

Personal mobility

Common work in large and performed teams with international participation during work-stages in reputed laboratories from abroad and in our institute; sabbatical stage in the institute of foreign professors; youth personal training in the frame international courses; an active presence of the researchers at scientific conferences, symposiums etc.

Education

→We communicate our results also during our courses accredited by Ministry of Culture and National Inheritance; → RADO Science Center will host also ***events for students and scientists from other fields of activity***, in the attempt to bring young people closer to the science, and to strength links inside the extended scientific community for physics. We have in view to host bi-annual "Science Café" events open for the physicists, various educational events (focused on thematic such as "Optics", "Atmospheric phenomena", "Earth observation systems", "Green energy", etc.) for elementary school and high-school students, and workshops, summer schools and hands-on training sessions during field campaigns for undergraduates and MSc students.

Conferences and Workshops

The institute is very active both in terms organizing meetings (local, national, international) and

- participating in symposia. During 2012/2015 the Institute will organize the following events expected to be promoted and disseminated with the support of the main track organizer of the special session *e-CULTURE and Digital Society* of the well known IEEE Conference Development of Sensors Engineering. As a very positive appreciation of the group contribution the 2012 edition will take place in Bucharest. Satellite events will be organized and will support the direct meeting between scientist and practitioners in several domains. Exhibitions of good practice, workshops and round tables for advanced research topics debate will be organized. Suggested topics also include but not limited to: e-Systems Design and Modelling, eLearning, e-Systems and AI, e-Business and Management, e-Government systems, development and evaluation, e-Health and e-Medicine, eScience and Technology, e-Entertainment and Creative Technologies, eSecurity and eForensics, eBuilt Environment, system usability, human factors, reliability issues and eSystem Evaluation.
- INOE will organize the 4th Symposium of Balkan Arheometry Network, a biannual event that joins representatives of all research centers, universities, museums, libraries and galleries from region and that also invite well-known specialist from other countries.
- Due to the very positive appreciations after previous editions, the annual ConSCIENCE event organized by the National Village Museum „D.Gusti" from Bucharest is inviting INOE as co-organizer of one day workshop ConCERTO. As a real tradition now, this workshop is concluding important remarks and initiates new partnerships for certain applications.
- Large exhibitions will be organized in association with ICOMOS, Artists Plastics Union National Art University on modern monuments restoration approaches, on paintings investigation methods, respectively on

very modern topic of contemporary art conservation. All exhibitions will be hosted in special galleries and will have a large national and international visibility.

- We will continue to organize the annual International Workshop ***"Optoelectronic Techniques for Environmental Monitoring" - OTEM***, as well as ***partnership meetings*** for various international consortia, for practical and scientific debates, aiming to convince the users of data to consider this new infrastructure as an important factor in GEO.

Interaction with Society and Awards (2012-ogoing)

- developing strong links with almost all the institutes and university centers in Romania and abroad acting in the same field of interest during national and international projects. Also, links with national authorities and end-users were developed and there are efforts developed to improve the connections and collaborations with them.
- increasing the activities of groups to international networks (LACONA, EARLINET, AERONET, MWRNET), databases and to COST actions and international committees (ICLAS, ISO, EUFAR);
- continuing and intensifying (during 2012-2013 period), the trans-national access to infrastructure (ACTRIS project, and participating to specific networking activities; on a bilateral basis, collaborations with Greece, Austria, Switzerland, South Korea, Russia, Bulgaria, France, Norway , within common scientific programs;
- extending the partnership by setting up new collaborations with institutions from ▪South East Europe (Croatia, Serbia, Hungary, Bulgaria, FYRoM etc); ▪ West Europe as well (University of Cologne- Germany, University of Reading- UK, Technical University of Delft – Netherlands, University of Birmingham, Cranfield University, Imperial College–UK etc.); other countries from all the world (Russian Academy of Sciences - Kurnakov Institute of General and Inorganic Chemistry, JINR – Dubna, Russia, Sejong University-Korea, University of Wellington-New Zeeland), as to be more involved in world-class research;
- continuing to participate to various ***exhibitions*** (Research Fair, Lacona Fair, ROMENVIROTEC, Researchers Night etc.).

Bibliography

1. Frascati Manual – The measurement of scientific and technological activities, "Proposed standard practice for surveys on research and experimental development" - OECD, 2002
2. Oslo Manual – The measurement of scientific and technological activities, "Proposed guidelines for collecting and interpreting technological innovation data"- OECD, third edition, 2005
3. Article 11 of Decision No 624/2007/EC of the European Parliament and of the Council of 23 May 2007 establishing an action programme for customs in the Community (Customs 2013). OJ L 154, 14.06.2007, p. 25.
4. Article 9 of Decision No 1482/2007/EC of the European Parliament and of the Council of 11 December 2007 establishing a Community programme to improve the operation of taxation systems in the internal market (Fiscalis 2013), OJ L 330, 15.12.2007, p. 1.
5. National Strategy in the field of Research, Development and Innovation
6. National Plan of Research, Development and Innovation – implemented instrument of National Strategy
7. "Horizon 2020" - European Framework Program for Research and Innovation
8. Europe 2020 Strategy
9. Innovation Union - one of the seven flagship initiatives of the Europe 2020 strategy for a smart, sustainable and inclusive economy.
10. Information Society – Digital Agenda for Europe