

Institutional development plan for the next 4 years

3.1. Scientific SWOT analysis.

SWOT framework distinguishes between two features of the *internal environment* (Strengths and Weaknesses) and two features of the *external environment* (Opportunities and Threats). We generated a list of what we perceive to be scientific INCDCP-ICECHIM strengths, weaknesses, opportunities, and threats (SWOT), in relation with the three main tasks of a research-development institute: (i) production of results relevant to the scientific community and knowledge development; (ii) production of results relevant to society and (iii) training and formation of new researchers. In tab. 1 we summarize the most relevant items connected to the internal environment features.

Tab.1. Main strengths and weaknesses indentified on the scientific activity of INCDCP – ICECHIM.

| Most prominent | Moderately prominent | Less prominent |
|--|--|--|
| Strengths | | |
| <ul style="list-style-type: none"> • Established European and National partnership and co-operations with significant results, especially on area of Polymers, Bioresources, Analytic chemistry • Inventive achievements, demonstrated by a large number of patents and patents applications • Proven expertise on niche applied scientific area, some of them with lower scientific competition, like new bioresources from brownfield development, methods for cultural heritage protection, new inputs for sustainable agriculture, etc. • Equal genre opportunities strongly implemented | <ul style="list-style-type: none"> • Number of well-qualified researchers • Implementation of quality insurance system and of managements standards on scientific teams • Number of PhD students • Historical role in chemistry R&D in Romania and ICECHIM brand recognition on National level | <ul style="list-style-type: none"> • Motivation of young researcher to stay in Romania and /or INCDCP - ICECHIM • Analytical laboratory functioning on ISO 17025 accredited systems • Newly developed research equipment and infrastructure • Proactive policy for protection of Intellectual Property at National level |
| Weaknesses | | |
| <ul style="list-style-type: none"> • Low-medium level of post-doc personnel and aging of senior scientists • Underdeveloped mechanism for stimulation of the appearance of the new research directions, including innovation driven by demand • Limited international patents numbers and lack of actions for exploitation of the Intellectual Property at European level | <ul style="list-style-type: none"> • Fragmentation of research topics among team • Low-medium international visibility of some researchers | <ul style="list-style-type: none"> • Heterogeneity in scientific quality of published papers • Insufficient international mobility for some young Ph.D. students and researchers |

The analysis of the external environment of INCDCP – ICECHIM, related to scientific area, is presented in the form of two matrices (Tab. 2), in which identified opportunities / threats are related to their probability to occur and their impact on INCDCP - ICECHIM.

Tab.2. Opportunities and threats matrix for external scientific environment of INCDCP-ICECHIM.

| Opportunities matrix | | |
|-----------------------------|---|--|
| <i>Probability high</i> | <ul style="list-style-type: none"> • “Green chemistry” as a top priority for sustainable development • RDI entities as a core of the knowledge based economy in the EU’s growth strategy 2020 | <ul style="list-style-type: none"> • Nanotechnology and biotechnologies included among scientific areas with particular impact on knowledge based economy • Existing framework for integration into European Research Area |
| <i>Probability low</i> | <ul style="list-style-type: none"> • Increased public acceptance of “green chemistry” products, included those developed by a “nano” approach | <ul style="list-style-type: none"> • Development of a clustered network of enterprises interested in “green chemistry” |
| | <i>Low Impact</i> | <i>High impact</i> |
| Threats matrix | | |
| <i>Probability high</i> | <ul style="list-style-type: none"> • Increased scientific competition on some area of competence | <ul style="list-style-type: none"> • Increased competition for qualified human resources (researchers, managers, entrepreneurs) / talents |
| <i>Probability low</i> | <ul style="list-style-type: none"> • Evaluation of the research results also by transfer to innovation processes and product development | <ul style="list-style-type: none"> • Higher requirements for transformation of knowledge development into knowledge based creation |
| | <i>Low Impact</i> | <i>High impact</i> |

This internal evaluation of INCDCP - ICECHIM current strengths and weaknesses support us to benchmark to others research entities active in chemistry areas, in the following positions (chosen among Leader, Powerful, Favorable, Acceptable, and Low). INCDCP-ICECHIM is positioned between **Leader** and **Powerful** in Romania level and could influence in a positive way the performances of other research entities through knowledge transfer and good practices. At European level ICECHIM can currently be positioned as **Favorable** (because it has some competitive advantages compared with average RDI entities in the same domain). The overall strategy of the institutional development plant aim to bring INCDCP – ICECHIM, at the end of the period of 4 years, to a sustainable **Leader** position at National level and **Powerful** position at European and International level. This strategy was developed from scientific SWOT analysis, as exemplified on table 3, and used the following concepts: use strengths to take advantage of opportunities; overcome weaknesses by taking advantage of opportunities; use strengths to reduce and mitigate threats; minimize weaknesses and reduce threats. Using this approach we back-grounded the strategic scientific objectives and directions, the human resource strategy and the mechanisms for stimulating the appearance of new research directions.

Tab. 3. Scientific and human resource strategies development from SWOT analysis.

| | | Strengths - T | Weaknesses - W |
|----------------------|--|---|--|
| SO Strategies | Use strengths to take advantage of opportunities | Established European and National partnership and co-operations with significant results | Low-medium level of post-doc personnel and aging of senior scientists |
| WO Strategies | Overcome weaknesses by taking advantage of opportunities | Proven expertise on niche scientific area | Underdeveloped mechanism for stimulation of the appearance of the new research direction |
| ST Strategies | Use strengths to reduce threats | Inventive achievements, supported by a large number of patents and patents applications | Limited international patents and lack of actions for exploitation of the results at European level. |
| WT Strategies | Minimize weaknesses and reduce threats | | |
| | Opportunities – O | SO Strategies | WO Strategies |
| | Nanotechnology and biotechnologies included among scientific areas with particular impact on knowledge based economy | Promote interdisciplinary research excellence and disseminate results at Regional, European and International level | Measures to improve the mentorship activity of senior scientists and to attract post-docs |
| | Existing framework for integration into European Research Area (ERA) | Act as a National node of spreading “green chemistry” research and integration to ERA | Organization of high quality scientific events focused on knowledge sharing and stimulation of appearance of new research directions |
| | Development of a clustered network of enterprises interested in “green chemistry” | Strengthening core research on niche area, especially on topics of interest for SMEs | Development of industry-driven innovation through an improved partnership with enterprises clusters |
| | Threats - T | ST Strategies | WT Strategies |
| | Increased scientific competition on some area of competence | Enhanced visibility on the niche area of competence, by improving both publishing and patenting activities | Recruitment of experienced researchers with strong international relationships |
| | Increased competition for qualified human resources (researchers, managers, entrepreneurs) / talents | Trans-national two-way secondments of young research staff between ICECHIM and strategic partner entities | Enhance the collaborative links with leading companies of industry, including exchange of personnel |
| | Requirements for transformation of knowledge development into knowledge based creation | Improve both research and innovations skills in the identified niche area | Strategic Intellectual Property development plan at European level |

3.2. Strategic scientific objectives and directions.

On each of the scientific strategic objectives established through SWOT analysis directions our institutional development plan detailed directions and actions/ measures.

Promoting interdisciplinary research excellence and disseminating results at Regional, European and International level (permanent). Interdisciplinary research excellence and results dissemination will be promoted by a framework which will include measures for: (i) clustering INCDCP-ICECHIM research teams; (ii) encouraging the multi- and interdisciplinary research, and (iii) stimulating complementary partnership. The potential institutional financial support will be directed primarily for development of these interdisciplinary research directions. Research must primarily be accomplished according to the bottom-up principle, as initiative of the individual scientist / research groups. Bottom-up initiatives are usually directed by selected priority areas imposed by specific calls of Financing Research Authorities. In order to streamline the activities of the research teams several strategic/priority research areas will be selected at the level of the institute in agreement with each team (top-down principle) and supported by the (potential) institutional funds. This selection will be done in agreement to proved research excellence and international visibility and will develop new directions of interdisciplinary research. Clustering of INCDCP-ICECHIM research teams will minimize also some of weaknesses (like fragmentation of research topics among team, heterogeneity in scientific quality of published papers, low-medium visibility of some of the team / team members) and will support a homogenous development of scientific team on the directions specific to Institute niche research area. Details of the measures are following.

✓ Internal cluster directions adequate to the actual research activities (based on research interests and existing results) and will result from the interaction and cooperation between the research groups. Example of such internal clustering are: polymers from bio-based monomers (teams of Biotechnology and Bioanalysis, Heterogeneous Systems); new composites including new biopolymers from alternative sources (teams of Alternative Bioresources and Biorefinery, Eco-friendly Advanced Materials); increased technological properties and use of some new bio-degradable nanocomposites (teams of Heterogeneous Systems, Biotechnology and Bioanalysis); new microbial and biochemical plant bioeffectors obtained from new bioresources (teams of Alternative Bioresources and Biorefinery, Bioproducts, Biotechnology and Bioanalysis); new materials and processes for nano-encapsulation of new biological active ingredients from renewable resources (teams of Heterogeneous Systems, Biotechnology and Bioanalysis, Bioproducts, Biofuels), new types of molecularly imprinted polymers for bioanalysis (team of Advanced polymer materials and polymer recycling, Biotechnology and Bioanalysis), new biological compounds for photodynamic therapy (Alternative Bioresources and Biorefinery, Nanomedicine, Multifunctional Materials for Advanced Technologies); synthetic aviation fuel (teams of Alternative Bioresources and Biorefinery and Biofuels); Increase of commercial polymers performances by producing new nanocomposites (teams of Heterogeneous Systems, Polymer Composites and Nanocomposites); new materials with tailored properties for multifunctional human friendly products (Multifunctional Materials for Advanced Technologies; Nanomedicine).

✓ Enforcing existing partnership and developing new ones for encouraging the multidisciplinary research, especially at the borders between chemistry, physics, material science, nanosciences, biology / agriculture / (bio)medicine, economy, etc.

✓ The partnership will be done especially with complementary institutions, which will provide additional skills for new products and technology development (National and European research entities from field of biomedicine, cultural heritage protection, sustainable agriculture, nanotechnology / material sciences), new methods for products and technology characterization (National and European research entities with cutting-edge infrastructure) and new opportunities for knowledge sharing (European research entities recognized as Leaders on their field). Optimal concentration of human resources and scientific infrastructure will be assured by INCDCP-ICECHIM on every collaborative project, in order to maximize the scientific outputs

✓ Dissemination of the results at Regional, European and International level will be accomplished first-of-all by publishing articles with high influence score. Yearly evaluation of the researchers will include the influence score of published articles. “Open Access” model of scientific publication of research publicly funded, promoted by European Commission, in accordance with OECD guidelines and with higher benefits for visibility, will be encouraged by INCDCP-ICECHIM, including by supporting from overheads of additional payment required usually for making papers freely available on-line. For dissemination of the scientific results we will use also specialized conferences and workshops in the selected topics of INCDCP-ICECHIM research directions.

Act as a National node of spreading “green chemistry” research results and integration to ERA (permanent). The measures included into this strategic direction is related to the interest of INCDCP-ICECHIM on technological platforms like Sustainable Chemistry or Biofuels and to the participation of Institute researchers to the present and future COST actions related to “green chemistry”. These measures are:

✓ Intensification of Institute activity as contact point for European initiatives of interest for “green chemistry”, stakeholders networking, organization of events at National level, networking at European level, development of existing and new partnerships;

✓ Communication of new sustainable chemical products and technologies, in order to improve public confidence in the chemical industry;

✓ Active participation of the Institute representatives and the staff at national scientific events, scientific and technological discussions / debates, etc.

✓ Stimulation of the participation of Institute staff in International and National expert panels, peer-review panels, editorial boards of ISI scientific journals, professional organizations, by supporting these activities, when is necessary, from institutional funds;

✓ Participation in supplying central or local public administration with knowledge, know-how, data, technologies, services or strategic studies and analyses in the area of sustainable chemistry.

Financing of the above mentioned measures will be done from eligible expenses of research project related to dissemination, communication and networking, from forecast and technological studies contracted with central or local public administration and from institutional funds. Indicators related to these measures will be included into staff institute internal evaluation.

Strengthening core research on niche area, on topics of interest for SMEs. This direction aim to bridge at the level of INCDCP-ICECHIM the gap between research and innovation and include a series of measures aimed to strengthen the research capacity related to SME:

✓ Development of a Roadmap for INCDCP-ICECHIM technological research, development and Innovation (*month 1- months 24*). It involves a series of meetings with experts from industry and central public Authorities, in which will be identified the most promising and compelling research directions, related to SME, to be pursued. Examples of research topics which will be presented to the SMEs representatives include: molecular imprinted polymers for separation of active ingredients from plant extracts; advanced material for electronics and optoelectronics; functional advanced material for miniaturized unconventional energy sources (solar cells, batteries and accumulators); tailored materials for mechanical engineering and industrial buildings; chemical recycling of PET wastes and their use with renewable chemicals as plasticizer or for polyurethanes; multifunctional eco-friendly materials made by melt processing techniques; new technologies for production of renewable diesel and 3rd generation biodiesel; new catalysts and process for producing aviation bio-based fuel; use of unconventional media, such as the organic solvents microemulsion systems and the ionic liquids, for design of new analytical devices; new nano-drugs for cancer therapy (natural and/or synthetic drugs), whey proteins as a potential source of naturally derived antioxidants; compositions for enhanced crop pollination, biochemical effectors for plant nutrition and plant protection. The Roadmap will include a policy for exploitation, in partnership with SMEs, of the opportunities offered by specific ERA programmes (SMEs benefits FP7 and Horizon 2020; Entrepreneurship and Innovation Programme – EIP; European Regional Development Funds for enhanced economical competitiveness), EUREKA and National programmes for innovative clusters and competitiveness pole.

✓ Elaboration of a technology survey in sustainable chemistry (*month1- month 24*). This will focus on the selected priority areas of FP7 / Horizon 2020, new COST Actions etc., for a comprehensive understanding of current state of the art and identification of trends and topics of interest for SME in the area of interest (Romania and neighboring EU countries like Bulgaria and Hungary).

✓ Strengthen INCDPCP-ICECHIM research relationship and increase its visibility by interactions with experienced industry specialists to exchange experience, good practice, and important topics for future applied research (*permanent*).

Enhanced visibility on the niche area of competence, by improving both publishing and patenting activities (permanent). Researches done on INCDPCP-ICECHIM are usually subject for both patenting and publishing. It is not a choice between publishing and patenting, but timing of publishing shall be done correctly in order to not jeopardize patenting. Institute interest is to own as much possible patents, which are representing the main instruments for technological transfer and commercial exploitation of scientific results. Researchers (and Institute) interests are to have a higher visibility through publication in high score journals. Measures presented bellow aim to balance all parties' interests and to maximize production of quality papers and patents. The measures of this objective include the following.

✓ Publishing articles only after submission of a statements, from the main author from Institute, related to the fact that either (*i*) the published results are not representing an inventive new solution susceptible for industrial application and not undermine the patentability of an invention, either (*ii*) the results which are subject of patenting were previously protected by a Patent application;

✓ Yearly evaluation of scientists separately for patents / patents application and papers, with further avoidance of aggregated index, which are including on a final measure both / all results indicators;

✓ *Malus* for researchers which fill an application patent and then do not publish the relevant results protected by patent;

✓ Incentives, at the maximum allowed by the law, for authors of patents sold (by licensing or cession) or included into the social capital of spin-off companies incorporated by institute on public-private partnership.

Strategic Intellectual Property development plan at European level. INCDPCP-ICECHIM proved a significant inventive activity, which generated an important number of patents and patents applications. Only few patent applications were done at EU / third country level. The coherent set of measures, included into this development plan aim to update the existing procedures in INCDPCP-ICECHIM to the good practices existing at European level related to Intellectual Property (IP). The measures presented bellow will be financed from the (potential) institutional funds.

✓ Upgrade existing IP policy on INCDPCP-ICECHIM as part of the long-term strategy and mission of a public research organization, and largely disseminate it, while establishing a single responsible contact point (*months 3*).

✓ Upgrade the rules and procedures regarding in particular the disclosure of new ideas with potential commercial interest, the ownership of research results, record keeping, the management of conflicts of interest and engagement with third parties (*months 3*).

✓ Promote the identification, exploitation and, where appropriate, protection of intellectual property, in line with the strategy and mission of the Institute and with a view to maximizing socio-economic benefits (*permanent*).

✓ Provide appropriate incentives to ensure that all relevant staff playing an active role in the implementation of the IP policy. Such incentives should not only be of a financial nature but should also promote career progression, by considering intellectual property and knowledge transfer aspects in internal evaluation procedures, in addition to criteria related to scientific papers (*permanent*). (Efforts will be made to upgrade the existing National legal framework related to minimal standards for promotion of scientist to the CS1 and CS2 degree; these standards are not including IP related achievements for the evaluation on results in the field of chemistry and chemical engineering).

✓ Training of the staff responsible for the management of IP (*permanent*).

- ✓ Raise awareness and basic skills regarding intellectual property and knowledge transfer through training actions for research staff (*permanent*)
- ✓ A coherent portfolios of intellectual property will be created by the Institute, in order to establish a framework for an ease exploitation (*permanent*)
- ✓ The IP protection activity and related achievements will be monitored and the monitoring report will be published (*yearly*).
- ✓ On collaborative research project IP-related issues will be clarified at management level, as early as possible, ideally before it starts (*on each project*). IP-related issues include allocation of the ownership of intellectual property which is generated in the framework of the project (“foreground” IP), identification of the intellectual property which is possessed by the parties before starting the project (“background”, „pre-existing”) and which is necessary for project execution or exploitation purposes, access rights to foreground and background for these purposes, and the sharing of revenues.

3.3. The human resource strategy

The SWOT analysis revealed the strategic directions for human resource development on INCDCP-ICECHIM. Here we detailed the measures included on each strategic direction

Measures to improve the mentorship activity of senior scientists and to attract post-docs (permanent). Mentoring, defined as a partnership in personal and professional growth and development, is a core component of research carrier success. However, mentoring efforts are challenged by high research and administrative demands on the mentors. Besides that, at INCDCP-ICECHIM level the mentor pool is rather low, which is resulting in fewer possibilities to attract post-docs financed by projects from Human Resource Programme (both National and European). The measures for this direction will be financed mainly from institutional funds and are presented bellow.

- ✓ Explore all possible strategies to increase the critical mass of mentors, including redefinition of the roles and responsibilities of senior scientists. Mentorship activities will be included into yearly evaluation of senior scientists; the indicators for mentors’ performance evaluation will be related to mentee scientific results.
- ✓ Improvement of mentorship skills. Better skills are necessary to establish and sustain fruitful and mutually beneficial on professional level mentor-mentee relationships. Formalized mentorship relationships will be encouraged, by a diversification of the scope of mentoring activities to include research ethics, professionalism, research results publishing and patenting, dissemination and communication. The Scientific Council members should get involved in the continuous improvement and promotion of effective mentoring skills.
- ✓ Support for mentee. Mentee which are also Ph.D. students will receive from Institute a limited financial support (up to 1000 EUR) for faster achievement of better scientific results.

Recruitment of experienced researchers with strong international relationships (months 1-months 24). Here are considered both Romanian researchers from Diaspora with significant results, willing to return, and international experienced researchers who are interested in a contract, eventually for a limited period. These experienced researchers shall provide sustainable support for research collaboration at national, international or EU level. The measures for implementation of these directions are the following.

- ✓ Human Resource Office will make a report related to the specific requirement of the European Code of Conduct for the Recruitment of Researchers and Romanian legislation in force which apply to the situation;
- ✓ A Plan for personnel recruitment and hiring will be implemented, including above mentioned Code and Romanian regulations, effective job postings (also on Euraxess portal), gathering CVs, organize interviews, criteria of selection.
- ✓ A Special Committee of Scientific Council will be organized, to support the Human Resource Office of the Institute during the entire process of selecting and hiring experienced researchers.

Financing of the recruited experienced researchers will be done through specific projects, resulted from applications to various National and International Programme, including those related to returning and re-integration or to a FP7 REGPOT 2012-2013.

Trans-national two-way secondments of young research staff between ICECHIM and strategic partner entities, to exchange know-how and experience (permanent). This direction aim to expose young researchers to an international environment and to give them the opportunity to exchange research ideas and approaches with staff and young researchers from other research entities. Expected results of these directions are common papers and publications, increased visibility of the ICECHIM research results and a stimulating environment where young research can successfully develop an academic career. The measures included into this direction are:

✓ Development of strategic partnerships with research entities from EU and joint application to projects which are supporting mobility of young people, including two-way secondment (bilateral co-operation projects, Coordination and Support Action projects like FP7 REGPOT 2012-2013, Networking Excellence less-intensive R&D country of the Union, etc.)

✓ Joining of INCDCP-ICECHIM researchers to the new / emerging COST Actions and use this to support, through Short Term Scientific Meeting and Early Stage Researchers (< PhD+8 years), the mobility of young researchers;

✓ Including into National research projects of acquisition of high-tech services and right of access to cutting-edge research infrastructure and use this to support secondments of young researchers.

Enhance the collaborative links with leading companies of industry, including exchange of personnel (permanent). The collaborative links with leading companies of industry are resulted from direct research-development contracts and collaborative research project publicly co-funded. These links will be used also for exchange of personnel, either by secondment either for transfer. Specific measures for this direction are listed below.

✓ Establishment and permanent upgrade of a list of the leading companies of industry interested in cooperation related to human resource development;

✓ Defining the requirements related to legislation in force and European good-practices, including the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers.

✓ Identification of young researchers, more willing to continue their carrier in industry area and of technologists ready to enter in a secondment related to technological transfer.

Improve both research and innovations skills in the identified niche area (permanent). The research and innovation skills of the entire Institute staff, senior and young researchers, especially on the niche scientific area of INCDCP-ICECHIM will be done by the following measures, which will be supported from institutional funds, from eligible expenses related to dissemination and communication included into research projects and from Conference grants accorded in the framework of various Programme and COST Actions.

✓ Development of a mechanism for internal dissemination (e.g. seminars) of the research results within the Institute with a special emphasis on PhD students and young researchers. This action will be combined with the activities of the team research clustering and could result in synergistic effects on the research and innovation skills;

✓ Participation of ICECHIM staff to scientific and networking events, especially to those types of events which are identified as being significant to strengthen the research skills of our human resources, like specialized conferences and workshops in the selected topics of ICECHIM.

✓ Encouraging of the young members of the INCDCP-ICECHIM teams to participate to summer schools in the field of interest.

3.4. Mechanisms for stimulating the appearance of new research directions.

Two main mechanisms are considered for stimulating the appearance of new research direction, one more academic focused and involving knowledge sharing and network building with research entities recognized for their excellence, and the other one related to development of user-driven innovation, which involve cooperation with industry and especially SMEs.

Organization of high quality scientific events focused on knowledge sharing and stimulation of appearance of new research directions (permanent). A series of high quality scientific exploratory workshops will be organized, to facilitate knowledge sharing and stimulation of new research direction. These events will include the participation of: experienced and young researchers from ICECHIM, research staff from the strategic partnering institutions, as well as invited researchers from other bodies (universities, companies) relevant to the development of ICECHIM. These scientific exploratory events will be organized with the support of specific programme funded by financing Authorities, Exploratory Workshops from UEFISCDI and Scientific Events from ANCS. The measures included in this direction are presented bellow.

- ✓ High quality application for exploratory scientific events, at least twice per year, by the representatives of research team / team research cluster with the highest international visibility;
- ✓ Knowledge sharing and stimulation of appearance of new research directions for INCDCP-ICECHIM teams participating to the scientific exploratory events;
- ✓ Establishment of future partnership for collaborative projects and two-way secondments of young research staff during the exploratory scientific events.

Development of industry-driven innovation through an improved partnership with enterprises (permanent). This mechanism for stimulating the appearance of new research directions involve formation of a network of SMEs interested in the development of an emerging technology (e.g. advances materials for solar energy capture and storage, fine chemicals from carbon dioxide emissions). Such a network of SME could accelerate knowledge development, knowledge diffusion / knowledge exchange due to system functions interacting and reinforcing each other over time. Measures of this direction, which will be supported by institutional plan, intent to seed long-lasting partnerships for applied research projects.

- ✓ Networking of SMEs interested in development of emerging technologies, with the support of the Chamber of Commerce and professional associations;
- ✓ Use of technological transfer events, from examples those organized in the frame of Romania-Bulgaria Cross-Border Project RINNO, for knowledge diffusion and knowledge exchange with SMEs representatives;
- ✓ Organization of in innovation targeted workshops and seminars, involving actors with different background (innovation happens only where actors of different backgrounds interact).

3.5. Financial SWOT analysis.

In tab. 4 we summarize what we perceived as the most relevant items connected to the internal environment financial features, understood on a broad sense and including also infrastructure investments and technological transfer.

Tab. 4. Main financial strengths and weaknesses of INCDCP – ICECHIM

| Most prominent | Moderately prominent | Less prominent |
|---|--|--|
| Strengths | | |
| Implementation of quality management system and of control standards in the administrative departments | Success in the attraction of research funds from National Programmes | Potential for analytical services on laboratory functioning according SR EN ISO /CEI 17025:2005 and EN ISO 9001:2008 standards |
| Accreditation of the INCDCP-ICECHIM Technological Transfer Center, as a component of National Technological Transfer Infrastructure | Marketing advantage of ICECHIM brand recognition on National level | High quality research equipment and infrastructure in some laboratories |

| | | |
|--|--|--|
| Innovation potential, supported by a large number of patents and patents applications | Implementation of specialized software on financial department | Success in the attraction of research funds from European Programmes |
| Weaknesses | | |
| High dependency of public fund and potential cash-flow issues related to delay of reimbursements | Aging of some equipment related to technology / products development and lack of some cutting-edge equipment for products and materials characterization | High personnel cost of aging of senior scientists |
| Lack of actions for exploitation of the Industrial Property at European level. | Lack of engineering and feasibility studies for the patented technologies and products | Low funds for international mobility for some young Ph.D. students and researchers |
| Infrastructure facility not-fully upgraded and safety measures implemented at the limit in some laboratories (no showers, not enough second exits) | Lack of a software system integrating ERP, payrolls and project management | Not fully developed marketing and technological transfer activities |

The analysis of the external environment of INCDPCP – ICECHIM, related to financial aspects is presented bellow in the form of two matrices (tab. 5), in which identified opportunities / threats are related to their probability to occur and their impact on the financial stability of the Institute.

Tab. 5. Financial opportunities and threats matrix

| | | |
|-----------------------------|--|--|
| Opportunities matrix | | |
| <i>Probability high</i> | Reformation of the financing system of RDI activities in Romania | Strategic increased support for RDI activity, which should reach 2% of GDP (1% public and 1% private) till 2020 |
| | Existence of a competitive system for the financing RDI activities, including capacity building and infrastructure upgrade | Higher funds for research Programme (like PN2 P4 Partnership, SMEs oriented FP7 calls) which are associated with production of results relevant to society |
| <i>Probability low</i> | RDI entities as a main core of the knowledge based economy in the EU's growth strategy 2020 | Possibilities for entrepreneurial activities, including jointly incorporation of <i>spin-off</i> companies with private partners into innovative clusters |
| | <i>Low Impact</i> | <i>High impact</i> |
| Threats matrix | | |

| | | |
|-------------------------|--|--|
| <i>Probability high</i> | Restructuration and/or closure of the industrial units which are potential partners in technological transfer of beneficiaries of research activities | Fiscal legislation related to National R&D institute modifications, including modification of flat rate on salary taxation |
| <i>Probability low</i> | Potential upgrade of the work safety regulations which will involve upgrade of heavy infrastructure (hoods for example) required for some laboratories | Budgetary restrictions which could generate decrease of the granted value of research projects |
| | <i>Low Impact</i> | <i>High impact</i> |

Based on the above presented SWOT analysis we established the following strategic actions:

- 1) Quality project applications to various Programme supporting capacity building and investment for infrastructure upgrade / improvement, like PN2 P2 Capacities and similar one for 2014-2020 period, Sectoral Operational Programme related to increased RDI capacity building (including administrative one), Capacities / Support and coordination actions for EU converge regions, like REGPOT 2012-2013 and similar ones on “Horizon 2020”; project related to PN2 P6 Support for the institutional performance (action intended to reduce weaknesses, synergize / enhance strengths, and utilize opportunities);
- 2) Enhance technological transfer, including the technological transfer to clustered SMEs, which could use restructured industrial platform for development of chemical parks; (action which transform threats into opportunities and utilize opportunities);
- 3) Leverage of the relationship with national and European research (and education) entities, developing strategic partnerships and dramatically widen INCDCP-ICECHIM existing research network (action intended to transform weaknesses into strengths and to enhance strengths)

The overall strategy related to these actions is illustrated in fig. 1, each strategic action being further detailed into the following parts of the Institutional development plan.

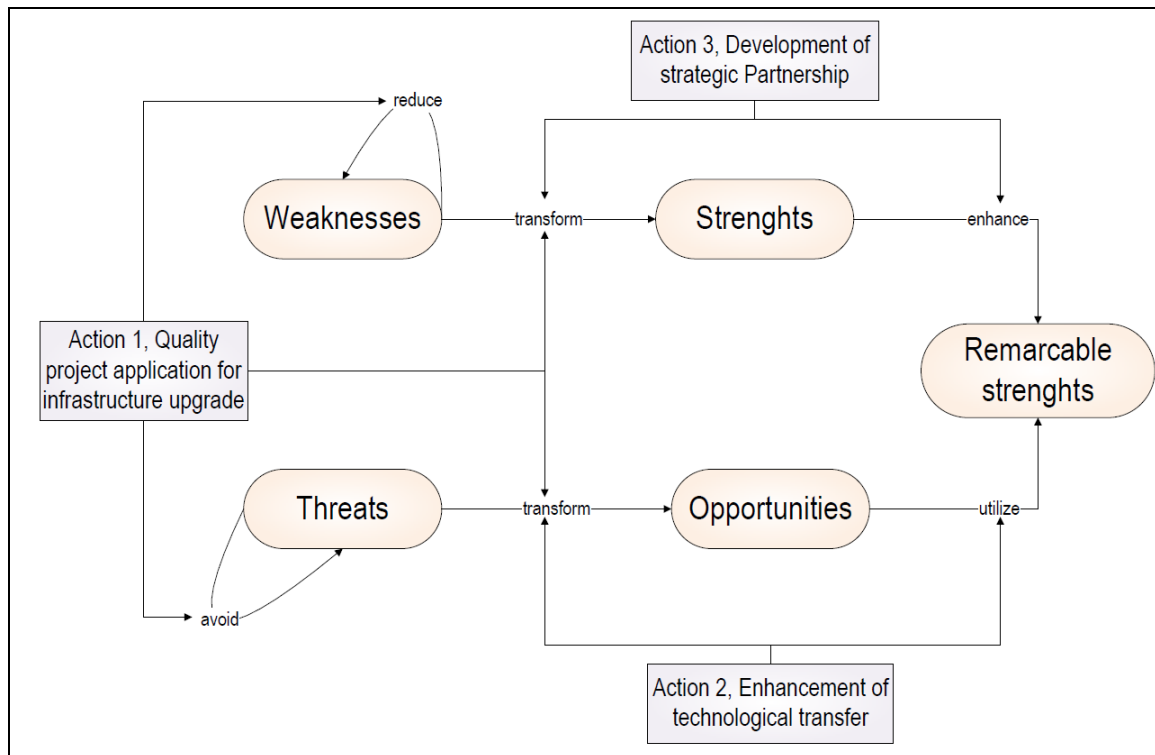


Fig.1. Strategy resulted from financial SWOT analysis.

3.6. Infrastructure: investment plan and strategy.

The investment plan aim to reduce several of the existing weakness already identified (tab.3), respectively: (i) aging of some equipment related to technology / products development and lack of some cutting-edge equipment for products and material characterization; (ii) lack of engineering and feasibility studies for the patented technologies and products; (iii) lack of a software system integrating ERP, payrolls and project management; (iv) infrastructure facility not-fully upgraded and safety measures implemented at the limit in some laboratories (no showers, not enough second exits). Also these investments will enhance the inventive capacity, which is supporting the innovative potential and will assure a better utilization of the opportunities resulted from strategic increased support for RDI activity, which should reach 2% of GDP (1% public and 1% private) till 2020 and higher funds for research Programme (like PN2 P4 Partnership, SMEs oriented FP7 calls), which are associated with production of results relevant to society / technological transfer.

Technological equipments which are included into investment plan are:

- ✓ Fluid bed granulator; for product volumes of up to 1 kg batch sizes; vertical machine tower; compact design; automatic commands; electronic display. Needed for products and/or technology development which are requiring a complete process of granulating / agglomerating in a fluid bed, especially for formulation of new biochemical and microbial effectors for plant protection and/or nutrition.
- ✓ Capillary rheometer; for determination of dependence extensional viscosity/shear viscosity as a function of the shear / extensional speed. Needed for studies to estimate the processability of the melted materials and flow instability.
- ✓ Rotational rheometer; for determination of flow curves, creep tests, stress relaxation tests, the stress amplitude in sinusoidal oscillatory tests. Allow studies on the influence of molecular structure (molecular mass, molecular mass distribution) on the melt flow properties.
- ✓ Double Screw compact laboratory extruder with diameter 12-20 mm and $L = 30 D$, 5.7 to 12 KV, for research and development of new nanocomposite material based on polymers and for recycling of plastic materials waste
- ✓ Laboratory spray dryer with max. drying capacity of 1.0 kg water/h; with inert loop for spray-drying of organic solvent applications in closed loop conditions using N_2 and/or CO_2 and ultrasonic nozzle. For development of new products / new materials by micro-encapsulation and coating, modification of particles size, agglomeration of nanoparticles
- ✓ Multifunctional plate reader, high performance with 4 detection modes: Fluorescence intensity (inclusive FRET); Fluorescence with a temporary resolution (inclusive DELFIA[®] - Dissociation-Enhanced Lanthanide Fluorescent Immunoassay – immunodosages with an increased sensitivity through dissociation fluorescence of the lanthanides); High performance luminescence (flash or glow); Absorbance UV/VIS; Range of fluorescence wave: 200 – 800 nm; absorbance: 200-1000 nm; Sensibility fluorescence: < 0.1 fmol/microwell; Sensibility of reading in luminescence < 0.1 fmol/microwell; Accuracy of absorbance reading $\pm 0.7\%$, reading domain: 0-5 OD; supervised temperature $\pm 0,2^\circ C$, temperature domain between $20^\circ C$ and $50^\circ C$; linear and orbital excitation; Compatible with microplates of 96 – 364 microwells. Build-in injector of 500-1000 μl . Multiple reading possibility of in a single microwell, end-point kinetic individual injection of the volumes in each microwell: (3...350 μl); Variable injection speed (100 ... 500 $\mu l/s$); Software for the reaction kinetics monitoring. Necessary for high throughput screening of biological active ingredients, included into activities for development of nano/drugs, biochemical and microbial effectors for plant nutrition and protection, new microbial bioresources (algae, cyano- and eu-bacteria fixing CO_2).
- ✓ Dual Channel Surface Plasmon Resonance (SPR) System, with high sample capacity (up to 768 samples), temperature control from $10^\circ C$ below ambient to $70^\circ C$, fast data sampling rates (up to 10 Hz); large refractive index range (1.32 to 1.52); minimal maintenance requirements and low life cycle costs. Necessary for high throughput screening of biological active ingredients included into activities

for development of new antioxidant from biological resources, molecular imprinted polymers for biotechnological use, biochemical and microbial effectors for plant nutrition and protection.

The cutting-edge equipment for compounds / products and materials characterization includes:

✓ RMN spectrometer, up to five RF channels, four receivers, range of gradient amplifiers and other options for bio-liquids, bio-solids, small molecules, polymers and materials, and microimaging experiments. timing resolution 12.5 ns; minimum event time 25 ns; phase resolution (0.0055°); frequency resolution (0.005 Hz). Necessary for characterization of new material, new polymers, new biological substances, accumulation of fine (bio)chemical by alternative biological resources, lingo-cellulose degradation.

✓ Confocal Raman microscope, spectral resolution done to 0,02 wave number, multiple laser sources inter-changeable, high-throughput spectrometer, high sensitivity back-illuminated spectroscopy, vacuum sealed cooling system. Necessary for characterization of new materials, especially those based on nanocomposite polymers.

✓ Scanning electrochemical microscope. *Nanopositioner*: X, Y, Z resolution: 1.6 nm with Piezo positioner; 4 nm with stepper motor positioner; X, Y, Z total distance: 5 cm. *Bipotentiostat*: Probe Potential: ± 10 V; Substrate Potential: ± 10 V; Compliance Voltage: ± 12 V; 3- or 4-electrode configuration; Reference electrode input impedance: $1e12$ ohm; Current Sensitivity: 10-12 A/V to 10-1 A/V; Maximum Current: ± 250 mA; External signal recording channel; ADC Resolution: 16-bit @ 1 M Hz. *Galvanostat*: Current range: ± 250 mA; SECM Imaging (SECM) : constant height, constant current, potentiometric and impedance modes; Probe Approach Curves (PAC) Probe Scan Curve (PSC) : amperometric, constant current, potentiometric and impedance modes; Surface Patterned Conditioning (SPC); Surface Interrogation SECM (SISECM); Cyclic Voltammetry (CV); Linear Sweep Voltammetry (LSV); Tafel Plot (TAFEL), Staircase Voltammetry (SCV); Chronoamperometry (CA); Chronocoulometry (CC); Differential Pulse Voltammetry (DPV); Normal Pulse Voltammetry (NPV); Differential Normal Pulse Voltammetry (DNPV); Square Wave Voltammetry (SWV); AC Voltammetry (ACV); Second Harmonic AC Voltammetry (SHACV); AC Impedance (IMP); Impedance versus Potential (IMPE); Impedance versus Time (IMPT); Chronopotentiometry (CP); Chronopotentiometry with Current Ramp (CPCR); Multi-Current Steps (ISTEP); Potentiometric Stripping Analysis (PSA). Requested by studies related to topography and diffusion of the electrochemical active ingredient on the membrane done from new material, on different steps involved on biomass conversion during biorefinery processes, on fine chemical biosynthesis.

For *in silico* scale-up and simulate patented technologies and products, necessary for basic engineering and feasibility studies we intent to acquire a chemical design and process simulation software with the following characteristics: Models for over 140 unit procedures / operations; rigorous reactor modules; material and energy balances; extensive chemical component and mixture database; Extensive equipment and resource databases; equipment sizing and costing; thorough process economics; scheduling of batch operations; throughput analysis and debottlenecking; resource (utilities, raw materials, and labor) tracking as a function of time; waste stream characterization; environmental impact assessment.

For improvement of research and administrative management we will acquire a software system which will integrate ERP accountancy, payrolls and project management (include project time sheets, project activities tracking, risk management and project outputs monitoring). The main characteristics of this software is; different level access, records keeping, timesheet correlation per project with payrolls, project indicators (articles, patents, technologies / products / services, etc.) monitoring, expense monitoring per project, cumulative reports of the project indicators, top-down budgeting of administrative activities and monitoring of the expenses, decision support analysis.

A back-up plan for building (heavy) infrastructure related to work safety and limitation of the carbon footprint is included into institutional development plan and will be considered if the needed resources will become available.

Strategy of the investment plan considers the following objectives:

✓ promote clustering of INCDCP – ICECHIM scientific teams, by acquisition of equipment necessary for several teams;

- ✓ support interdisciplinary research development by acquisition of the equipment with various applications;
- ✓ assure the Leader position of INCDCP – ICECHIM by acquiring cutting-edge equipment which are not existing on others Romanian research centers;
- ✓ attract SMEs for technological development and technological transfer.

3.7. Technology transfer and the attraction of non-public funds.

For the next four years, INCDCP - ICECHIM strategy on the technological transfer will be focused on the enhancement of technological transfer, including to the clustered SMEs (which could use restructured industrial platform for development of chemical parks). This strategic action transforms threats into opportunities and utilizes opportunities. The technology transfer will be done by INCDCP - ICECHIM - Technology Transfer Center (CTT-ICECHIM), founded in October 2010, according to the provisions of GD 406/2003 and accredited for a period of five years by The National Authority for Scientific Research (ANCS) according to the Certificate of Accreditation No.: 58/02.12.2012.

The measures include into this action will be financed from funds resulted from technological transfer and specific project dedicated to technological transfer activities; these measures are presented bellow.

- ✓ Application to specific projects dedicated to technological transfer centers, for CTT-ICECHIM institutional development (*permanent*)
 - ✓ Training and development specialists in technology transfer through participation in specialized courses intellectual property, technological transfer, brokerage, marketing (*permanent*) including to the courses organized in the framework of the project “Programme for development of human resources in the entities from National Network for Innovation and Technological Transfer, co-funded by European Social Fund through the Sectoral Operational Programme Development of Human Resources, POS-DRU/81/3.2/48531(*month 1 – month 18*);
 - ✓ Establishment of yearly Technological Transfer Roadmap, which will consider all possible exploitation mechanisms (such as licensing or spin-off creation) and all possible exploitation partners (such as spin-offs or existing companies, other public research organizations, investors, or innovation support services or agencies), and select the most appropriate ones (*permanent*).
 - ✓ Assessment of technologies / products / services resulted from research project according to a pre-feasibility study and promotion of the most valuable project outputs in accordance with updated market studies (*permanent*)
 - ✓ Development and adoption of a licensing policy, in accordance with the good practices at European level, which will ensure fairness in all deals (*month 1- month 6*). In particular, transfers of ownership of intellectual property owned by INCDCP-ICECHIM will be yearly assessed. Granting of exclusive licensing will be avoided, since to INCDCP-ICECHIM research and development results could have several possible application fields. Licenses for exploitation purposes will involve adequate compensation and will preserve adequate rights to facilitate dissemination and further research.
 - ✓ Establishment of clear principles regarding sharing of financial returns from knowledge / technological transfer revenues between INCDCP-ICECHIM and the inventors (*month 3*);
 - ✓ Participation of CTT-ICECHIM to the Technological Transfer meetings, aiming to increase national and international visibility (*permanent*)
 - ✓ Strengthening existing partnership and development of new one for the transfer of products / innovative technologies and formation of consortia in national and international projects (*permanent*)
 - ✓ Integration of CTT-ICECHIM on the network of Technological Transfer Center from European Union (*permanent*)
- Attraction of the non-public funds will be done using the following measures:
- ✓ marketing of the ICECHIM brand for attraction of direct research contracts and of analytical services in ISO17025 accredited laboratories (*permanent*)

- ✓ development of partnership with innovative companies for joint application of quality projects to various National and European Programmes oriented SMEs, involving private co-financing also for the institute (*permanent*)
- ✓ creation of spin-offs according to the existing legal framework (*permanent*). At institute level it will encourage research staff to engage in the creation of spinoffs where appropriate.

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

Leverage of the relationship with National and European research (and education) entities, for developing strategic partnerships and dramatically widen INCDCP-ICECHIM research network it is an action intended to transform INCDCP-ICECHIM weaknesses into strengths and to enhance strengths. The measures included into this action, presented below, will be financed from project on co-operation, European, Bilateral or National.

- ✓ Enhancement of the existing strategic partnership at National level (Bucharest University, Politehnica Bucharest University, National Research and Development Institute for Physics of Materials, Institute of Macromolecular Chemistry “Petru Poni”, etc.) and European level (Aalborg University; Università degli Studi di Verona, Austrian Institute for Technology; University of Nottingham; Helmholtz - Zentrum Geesthacht Institut für Polymerforschung / Institute of Polymer Research; Université catholique de Louvain, Université de Marseille, Université de Toulon, Università di Pisa, Université de Strasbourg; University of Patras, etc) will be strengthened.

- ✓ Development of new strategic partnership, for new European, bilateral and National research projects.

Visibility of INCDCP-ICECHIM will be increased by the following activities involving organization of scientific events, communication and collaboration:

- ✓ Yearly will be organized, at the end of October, the International Symposium PRIOCHEM-Chemistry priorities for a sustainable development. The priorities of this symposium will continue to the dissemination and promotion of scientific research results and presentation of Romanian scientist results, as well as the maintaining contact and integration activities of Romanian specialists within the international scientific community. PRIOCHEM will continue to be structured on following sections: Bioresources and biomaterials; Multifunctional materials and nanocomposites; Chemistry in medical and pharmaceutical applications; Protection and Environmental Engineering. In frame of the symposium various workshops/round tables and exhibitions related to the research results will be organized.

- ✓ Twice per year will be submitted quality projects for Exploratory Workshops, aiming to contribute to knowledge sharing and identification of new area of research.

- ✓ Co-operation with Universities for researcher formation, including by supporting M. Sc. And Ph. D. thesis

- ✓ The researchers from ICECHIM will continue their activity as members in various international and national professional organizations, such as: Polymer Processing Society, PRESUMO ITALIA, American Chemical Society, European Federation of Biotechnology, Romanian Chemical Society, etc.

- ✓ It will be increased the existing number of senior researchers which are reviewers for prestigious ISI-quoted journals such as: J Appl Polym Sci, Enz Microb Technol, Process Biochem, Eur Polym J, J Polym Env, Polym Eng Sci, JFCA, NOx, etc.

- ✓ Institute representatives and the research staff will actively participate at national scientific events, scientific and technological discussions / debates, etc.

- ✓ Participation of Institute staff in International and National expert panels for evaluation of research projects will be stimulated.