2. Open Innovation Policy in Asturias

Over the last years Innovation has become a crucial issue for companies and their business strategies. Commitment towards a model of Innovation Management so-called "Open Innovation" is growing; this model bases on the idea that companies are able and also obligated to use both external and internal ideas. This type of innovation is related both to the product and the Management Model, and the flow of knowledge is interdepartmental: between companies and with universities, institutes, the public sector and users.

Companies of the chemical and process sector in Asturias develop these main activities: manufacture of fibers and plant protection products, nitrogen fertilizers, active substances for medicines, carbochemistry, cleaning products, wood pulp, iron and steel industry products…. This sector is more and more committed with an innovation related not only to products and processes, but also to management, purchasing, logistics or human capital.

Most of companies of this sector, grouped together around AIQPA[1] and IQPA[2], are public limited companies or limited companies, family business in some cases. There are two types of companies: those with one or more workplaces all located in the region and national and multinational companies with at least one workplace located in Asturias, but having their headquarters outside the region. In this last case, Strategic Planning Centres are not always in Asturias and main actions of Strategic Planning are defined and managed according to the global policy of parent companies. However according to the general tendency towards opening innovation, ideas can emerge at any level and conversion of these ideas into projects is increasingly performed in a structural way, instead of vertically. Commitment is with an innovation "coming from employees" and towards continuous improvement, having in mind not only workers but clients and suppliers as well.

In addition future basis commitment of those companies with workplaces and headquarters in Asturias is clearly towards an open R&D&I that encourage companies to improve competitiveness and access to new markets.

[1] Asociación de Industrias Químicas y de Procesos de Asturias: Association of Chemical and Process Industries of Asturias

[2] Cluster de la Industria Química y de Procesos de Asturias: Cluster of the Chemical and Process Industry of Asturias

As already mentioned, companies whose experiences are herein reported, are members of IQPA. Such companies especially highlight the open and promoting attitude of the Regional Government, research centres and the University of Oviedo towards R&D&i; however most of them agree that, even if their relationship with those institutions is fluid, it should be more active and open. The common and ultimately purpose of this sector is to satisfy the needs of society and, in order to do so, knowledge coming from the University and support of the Public Administration are needed: that is, support for the sector as well as monitoring compliance with regulations.

Companies of the sector often collaborate with the University of Oviedo in joint projects and studies, in particular with departments of the Faculty of Chemistry, Mining and Industrial Engineering; also, interns from the University are hired by companies and researches are carried out by companies and supervised by the University.

Collaboration with the Administration usually differs and based, not on the development of specific projects, but on regulatory compliance. Companies like DuPont normally collaborate supporting the IDEPA[3] raising funds in Asturias, meeting potential investors and sharing its positive experiences with the regional government.

Companies of the sector increasingly tend to collaborate together and with other related companies, as well as with suppliers and clients, in developing joint projects for product improvement, creation of new products, and process and organization improvement (SAP, Call Centres). An example, the collaboration between DuPont and Chupachups in the bio-processing plant: the purpose of this joint project was to use high-glucose waste materials of the candy manufacturer to treat sewage waters at the multinational's facilities.

By grouping companies of the chemical and process sector, IQPA tries to lay the basis of future collaborations between companies for improving the competitiveness of the whole sector.

3. Idea Generation

3.1. Interviews

Companies of the sector periodically meet other leading innovation companies and institutes in order to keep up to date with the latest tendencies and technological developments. They attend conferences organised by entities such as AIQPA, Innovation Club of Asturias, Quality Club of Asturias or Federation of Employers of Asturias on issues related to R&D. Most of the companies are members of these organizations and participate in the preparation of discussion forums.

[3] Instituto de Desarrollo Económico del Principado de Asturias: Economic Development Agency of the Principality of Asturias

Meetings are arranged with leading institutes:

i. INCAR[4]
ii. ITMA[5]
iii. Other international Institutes: in Germany, Poland or England, among others.

Specific meetings are also arranged with:

iv. Clients and suppliers related to their specific activities, e.g. collaborations between Ence and its suppliers or Technologists: Metso, Andritz, BMH or Salasti.
v. Fairs and conferences about specific productive activities where tendencies and novelties are shared.
vi. National and international consulting companies and strategy consultant's offices.

3.2. Creativity Sessions

Many companies of the sector also organise creativity sessions (in their own facilities) for encouraging entrepreneurs, at a structural way, to think without restrictions about new products and market opportunities. For example:

i. Interdepartmental meetings: potential problems are openly presented and any solution and/or improvement proposal is considered.
ii. Interdepartmental meetings on consumption, energy efficiency or new products, opened to all divisions of the companies (Management, R&D, Production Department, Environmental Department, Security …)
iii. R&D&i Committees with several participants: shareholders, Management, technicians…
iv. Scientific Advising Board in Industrial Química del Nalón
v. R&D&i Management encourages joint work of company's research personnel with distinguished researchers of several organisms for creating coordinate research groups. Research agreements are signed between research public centres and universities.
vi. Teams on Substantial Improvement focused on obtaining Substantial Improvement Targets in Ence.
vii. Teams of Specific Analysis focused on improving concrete areas or teams in Ence.
viii. Task force: work groups within the company for evaluating concrete problems in Ence.

3.3. Workshops

Companies of the chemical and process sector in Asturias participate actively in AIQPA's Work Commissions, in which work groups meet periodically to discuss issues of common interest on matters like Security, Environment, Technical Implementation….Emerged proposals and ideas are then analyzed in Discussion Forums.

[4] Instituto Nacional del Carbón: National Institute of Coal

[5] Instituto Tecnológico de Materiales: Materials Technological Institute

Members of the sector also participate in other work groups created by The Federation of Employers of Asturias or FEIQUE[6].
Companies also create collaboration groups between their own branches in order to evaluate their improvements on processes, products and new developments.

3.4. Dedicated workshops

Regarding the creation of work groups developing concrete innovation projects, some companies of the sector centralize these activities on their headquarters, near to their Strategic Planning Centres. For this reason specific groups working on future innovation projects do not exist in regional branches; however this is a routine practice in other companies where the following work internal groups are created:

i. Innovation Committees or Technology Director working on a routine basis and on several projects.
ii. Specific groups are created for concrete innovation projects; Ence created a group for a project dedicated to measuring wood volume through 3D scans.
iii. Collaborations with research centres, engineering companies and suppliers for improving processes, products and new developments.

3.5. External Business Developer

Most of the companies do not consider the option of working with external specialists experienced in helping companies and institutes in converting projects into concrete innovation projects, i.e. external "Business Developers". However it is true that companies usually have big Strategic Planning Centres in other facilities with specialist personnel on the sector.
Nevertheless some member companies of IQPA commit seriously with this type of innovation, based on the product as well as on management, purchasing, logistics, human capital… therefore in each specific case, and depending on the "type of innovation", these companies turn to appropriate specialists looking for help for ending projects. Examples:

i. Collaboration between Fertiberia and the University of Oviedo regarding one specific issue related to the improvement of sulphate nitrate production at a local level.
ii. Collaboration between Industrial Química del Nalón and Renaul Consulting for optimizing production: lean manufacturing.
iii. Ence developed a Plan for improving the availability of dry wood pulp in the area.

3.6. Feasibility studies

Feasibility studies, used for supporting the development of projects and checking and fixing expected results, are usually prepared internally within the companies of the same group and together with contractors, suppliers and research centres like ITMA or INCAR. Those

[6] Federación Empresarial de la Industria Química Española: Business Federation of the Spanish Chemical Industry

companies investing permanently in R&D&i prepare technical and feasibility studies for each project and in some cases also get the support of collaborative organisms like CDTI.

3.7. Innovation vouchers

The use of Innovation vouchers, understood as fast searches for answers at technology questions, presents differences among the companies of the region. In order to find solutions to specific technological issues that may arise, most of the companies rely on their own Technical Departments of factories and headquarters, made up of experts on R&D&i. Although this is a major tendency, specific alliances also exist with experts of a particular area and for a concrete project. For example: a project on biotechnology that a priori has been completed, and for which an external expert shall be hired at a later date to take a step forward to the solution initially proposed.

3.8. Innovation scans

Innovation scans or structural scans for innovation possibilities within a company are one of the main pillars of this sector Business Strategy. Companies of the chemical and process sector in Asturias are really committed with structural innovation, as innovation activities can be performed at any company level. Although vertical strategy innovation still exists in some cases and in specific areas such as nanotechnology, most companies are committed with an innovation "coming from employees".

Examples:

i. Industrial Química del Nalón has developed a working system -**Nalón Pro- System-** for achieving excellence in value chain. Constant improvement of competitiveness is one of the pillars of its Business Strategy, so the system was created as a dynamic element of continuous improvement in all business processes. Nalón Pro-System considers people as the mainstay of an organization in which team working is a priority.
As it is considered the system of reference within the company and it is totally aligned with the defined business strategy, Nalón Pro-System has the following objectives:

- Quality and service in every sense of the word: products, processes and management, through the best available technology and a culture of prevention and innovation.
- Profitability, regarding stability of margins and profitable business.
- Sustainability, by guaranteeing a long-term future through honesty, business solvency and respecting environmental requirements.
- Security of people, facilities and environment, through modern facilities, employees' training and pro-active approaches in Work Safety Prevention.

ii. In the Pharmaceutical Chemistry field Bayer has established an initiative called **"Operational Excellence"** with the purpose of improving and continuous innovation in

order to assure the company's competitiveness. Periodical meetings are planned for generating improvement and innovation ideas among employees, ideas that once implemented make success possible.

iii. Ence (Navia) has organised the following work teams:
   a. Teams on Substantial Improvement focused on obtaining Substantial Improvement Targets.
   b. Teams of specific analysis focused on improving concrete areas or teams.
   c. Task force: company work groups for evaluating concrete problems.

iv. Ence uses two fundamental methods for internal innovation: the Ishikawa diagram of cause-and-effect following the 4M's model (men/people, materials, method and machinery) and the PDCA diagram for continuous improvement.

4. Business feasibility

4.1. Joint business development

Companies of the sector located in Asturias often developed joint business, i.e. collaborations between different parts of the business –clients, suppliers, competitors-, with a specific objective, sharing both risks and results and profiting from each other's experiences. Some examples of joint business:

i. Fertiberia collaborates with many producers, agricultural cooperatives, professional associations and agricultural companies; this increases chances of success of projects and their application field, and makes easier transferring the generated knowledge to final users.
   A concrete example: the creation, together with a client, of the company AGRALIA.
ii. Bayer: standardization of suppliers agreeing quality assurance for specific products.
iii. Asturquimia: analysis and development of a security plug in collaboration with a plug manufacturing company.
iv. DuPont: Sontara® and Novatex®
v. Industrial Química del Nalón: wind business with a German group (ABO Wind AG); has a holding in ENTRECHEM, a biotechnology spin-off company created by the University of Oviedo; it also develops projects with many national and international clients and companies. This company does not develop joint projects with competitors but it takes part in national and international associations defending the sector's interests.
vi. Ence: collaborates with clients in adapting quality parameters depending on each client's needs (custom-made wood pulp orders). This company also collaborates with its suppliers -TAELPO, RAUMASTER, BHM o IBERIMPRO- preparing bio-mass.

4.2. R&D services

Companies of the chemical and process sector in Asturias do not usually offer R&D services to third parties; they share their built-up experiences and know-how only with clients and suppliers, but never as a formal business.

However some companies have a holding in other companies that offer this kind of services to third parties: Fertiberia for example owns 50% of INCRO, an engineering company that commercializes technology of the fertilizing sector in several countries.

5. Development and innovation of products

5.1. Licencing in

Licensing in is used to obtain IP that is interesting to develop new business, incorporating innovation from external organizations (technological companies and research centres) in the form of ideas, patents, technologies and products. This is an innovation measure that companies of the sector exploit occasionally. Examples:

i. DuPont: licences for product/ process version in Sontara®
ii. Fertiberia: process simulator of a nitric acid plant (computer development)
iii. Industrial Química del Nalón: works with its own patents but also purchases when necessary.
iv. Ence: generation of dioxide through HPA process.

5.2. Licencing out

License granting or technology transfer: it entails commercializing the innovation generated by the R&D Department or using IP to create strategic and financial value. Most of the companies of this sector located in Asturias do not commercialize the innovation generated within their R&D departments, although they sometimes used it to create financial and strategic value. There are some exceptions to this fact: the above mentioned case of Fertiberia and its subsidiary INCRO which is in fact dedicated to technology sale within the fertilizing sector in several countries.

5.3. Venturing

This option (investing in start-up companies, having an interesting fit with companies' technologies or markets, with the aim to shorten the time to market and absorbing specific technologies or opening new markets) is not commonly used in the region. However there are some significant examples:

i. Fertiberia set up AGRALIA and nowadays holds 100% ownership. This company - AGRALIA – sells all liquid fertilizers in its different versions as well as solid fertilizers of other factories of the same group.

ii. Industrial Química del Nalón has a holding in the following companies:
   a. Entrechem: a biotechnology company created as a spin-off company at the University of Oviedo.
   b. Anes Innovación: promotes research and development of new knowledge and new technologies in the field of chemical and biological based processes.
   c. AMURA wind farm: set up by the German group ABO Wind and Nalonchem, a company specialized in carbochemistry.

iii. Ence coordinates its forest management in Spain through its subsidiaries NORFOR and SILVASUR. IBERSILVA, an agro-forest and environmental services company, was also created for carrying out external forest services.

6. Regional Policy of Innovation

6.1. Spin in.

Small investments made in start-up companies that have been sold off by other companies or which have been identified because of their special interest technology or market. This option of investment is not widely spread in the region, either by the fact that Strategic Planning and Decision-Making Centres are located out from Asturias or that companies are SME's with little investment in this sense. However there are some exceptions to this general tendency such as the presence of Industrial Química del Nalón in the Pharmaceutical Business through the company Entrechem.

6.2. Spin out

After the development phase of a project, a start-up company is established to develop the business further, since it is easier for a start-up company to come out into the market and to develop the product than for its parent company.

In our region this practice is not common either, as a technique for speeding up businesses; however again some companies like Industrial Química del Nalón are exceptions and commit with this kind of investment (Industrial Química del Nalón has set up Anes Innovación for participating in the business of waste materials and sustainability).

In this sense Ence also has developed its forest division through the companies NORFOR and SILVASUR, and has created an agro-forest and environmental services company for carrying out external forest services: IBERSILVA.

6.3. Acquisitions

Acquisitions of other companies for fixing business and strategies are made with the purpose of increasing the value of the acquired company, although financial and strategy purposes are different. Acquisitions can be made within companies of the same sector,

competitors, for gaining more market power, for entering into new market segments or for geographical reasons. Some examples existing in the region:

i. Acquisition of ADP by Fertiberia following the international expansion strategy initiated with the acquisition of Argelina Fertial; this means opening a new market, the Latin-American market.
ii. Industrial Química del Nalón has entered wind business supported by the German group ABO Wind AG.
iii. Acquisition of Danisco by DuPont for increasing its offer in applicated biosciences and health and nutrition sectors. Danisco has facilities in Spain.

6.4. Divestments

Regarding divestments and loss of assets: in Asturias Industrial Química del Nalón left the potassium permanganate business and, at a national level, Fertiberia closed some factories –Cartagena and Bilbao- due to a restructuration of the fertilizers sector. Also Ence sold TECFOR, a company dedicated to forest techniques.

7. Own capacities

Asturias is a region situated in the north of Spain that is characterized by its diversified industrial network and the historical presence of big companies.
The chemical and process sector is highly recognised for contributing to sustainable development as well as for being an undeniable reference of diversification and generation of high added value in the region, with an international future-basis approach.

Activities of the chemical and process sector in Asturias could be classified as follows:

- Carbochemistry
- Fertilizers and manure products
- Pharmacy
- Agar production
- Plastics
- Paints and explosives
- Advanced fibers
- Iron and steel industry
- Wood pulp sector

Chemical and process companies in Asturias are grouped together around AIQPA and IQPA: the aim of these organisations is to agglutinate all companies of this sector, and other related sectors, for defending their common interests, increasing sectors' competitiveness, creating discussion forums and laying the foundations for future collaborations between companies and related organisms.

Asturias has an important University Campus with recognised research groups that collaborate with the R&D&i departments of the companies located in the region; there are also specialized institutes and research centres such as INCAR, ITMA, SERIDA[7] or IPLA[8].

As for the financial structure of the region in regard to companies, financing comes mainly from the private sector although public aids, European funds and subsidies are also granted for developing specific projects.

[7] Servicio Regional de Investigación y Desarrollo Agroalimentario: Regional Service for agro-food R&D

[8] Instituto de Productos Lácteos de Asturias: Dairy Products Institute of Asturias

BEST PRACTICES

Improving the crystallization of ammonium sulphate nitrate fertilizer

Starting date: May 2011

Collaboration: Studies, pilot-tests and industrial implementation of new additives for improving quality.

Participants: Fertiberia, Universidad de Oviedo

Improving Nomex® Production Process

Starting date: 2006

Collaboration: high-investment project with several purposes in technological improvement. Several companies of the Group, suppliers, research centers and University departments take part in this project.

Participants: DuPont Asturias S.L., Research Center DPT Geneva, DuPont de Ne, Engineering, Fluor Engineering, Siemens, BarcelonaTech (UPC), Terrasa School of Textile Engineering, Itma, Incar…etc.

Scientific Advising Board, Industrial Química del Nalón

Starting date: October 2010

Collaboration: Industrial Química del Nalón, in collaboration with several companies, scientists and research centres, is developing R&D&i projects in the following fields: advanced carbon materials, nanotechnology, biotechnology and chemical technology.

Participants: This Board consists of six professional scientists unrelated to the company: José Barluenga, Avelino Corma, Mario Díaz, José Luis Jorcano, Carlos López Otín and Rosa Menéndez. All of them have been invited due to their knowledge, experience and prestige within this business and/or chemistry industry and its foreseeable future.

The President, Vice-President, Director, General Manager, Assistant Manager and Technology and Research Director of Industrial Química del Nalón take part in the meetings.

Industrial Química del Nalón, S.A.
NalónChem

Evaluation of Waste Materials

Starting date: January 2011

Collaboration: viability of using ash for manufacturing specific cements and absorbers of organic compounds, and pelletizing it to be used as a substitute for manure.

Participants: Ence, FICYT, INCAR

CENRAMICS

Starting date:

Collaboration: validating the use of ashes in ceramics.

Participants: Ence, Annes Innovación, Universidad de Oviedo (Mining Engineering)

	sector/main activities					
Best practices	carbochemistry	Pharmaceutical products	fertilizers	Synthetic fibres	pulp	Cleaning products
Idea generation:						
Interviews	×	×	×	×	×	×
Creativity sessions	×	×	×		×	
Workshops	×	×	×	×	×	×
Dedicated workshops;	×			×	×	×
External Business Developer:	×		×		×	
Feasibility studies	×		×	×	×	
Innovation vouchers	×		×		×	×
Innovation scans	×	×	×	×	×	
Business feasibility:						
Joint business development	×	×	×	×	×	×
R&D services:			×			
Development:						
Licensing in	×		×	×	×	
Licensing out			×			
Venturing	×		×		×	
Scale and validation;						
Spin in:	×		×			
Spin out:	×		×		×	
Acquisitions	×		×	×		
Divestments	×		×		×	
business cooperation						
with another company	×			×	×	×
cluster (with several companies)	×			×	×	
company /university	×	×	×	×	×	
company/regional goverment		×	×	×		