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Knowledge driven clusters for innovation in Latin American and Caribbean region

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Abstract

The following paper is aimed to explain policy makers how knowledge-driven clusters and organizational innovation initiatives at country level create the environment to leverage competitive advantage of SMEs, through combining skills and competences from different members and beneficing of economies of agglomeration without losing the flexibility and dynamism of SMEs. In order to successfully build a knowledge-driven cluster, competence mapping is a key tool that will allow to diagnostic the strengths and weakness of the regional players, enabling to build joint products based on the core competencies of each member and tackle the shortages by training and multiparty projects.

This approach fits into the Uruguay effort on building an Automation and Mechatronics industry around CAIME center in the frame of "*Advanced Technology Foresight in Latin American and Caribbean region*" project, supported by several UNIDO services (such as Country Independent Evaluation and Technology Foresight) and potentially by the Collaboration Mechanism for Science and Technology between Brazil and Uruguay.

The recommendation in order to continue the implementation of advanced technologies in the region is to initiate a knowledge-driven cluster to promote innovation in Mechatronics and Automation fields, starting by performing a competence mapping of potential SMEs cluster members, in order to identify strengths and weakness, and in a second step to perform training on those skills detected as necessaries in collaboration with local academia partners and to initiate joint projects to create added value products.

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1. Organizational innovation and knowledge-driven clusters

1.1. Organizational innovation

Technological innovation has become one of the most important sources of competitive advantage nowadays. While some high-tech industries are characterized for heavy R&D investments, dynamic product management and continuous improvements on production processes (H. Armbruster, 2008), usually performed by disruptive start-ups or resourceful multinationals, some Small and Medium Enterprises (SMEs) found difficult the access to a critical mass of specialized resources, providers, markets and technology; thus making the relative cost of innovation higher than for large firms. They could be also affected by greater uncertainty and risk-adverse attitude.

In addition to technical improvements, companies can also benefit of internal processes advances, the organizational innovation, which are a prerequisite for other technical improvements and that already constitute an immediate impact on business performance. Some of these organizational innovations are usually labelled as process reengineering, agile enterprise or lean manufacturing and could be implemented in the way of changes into the organizational structure of the company or to the procedures and operations.

The same approach could be applied into a country level, promoting the collaboration between companies in a dynamic approach in a similar way these techniques change the internal organization and processes. The diagram below illustrates how organizational innovation starts on the way each employee works and finish with the entire environment surrounding the organization.

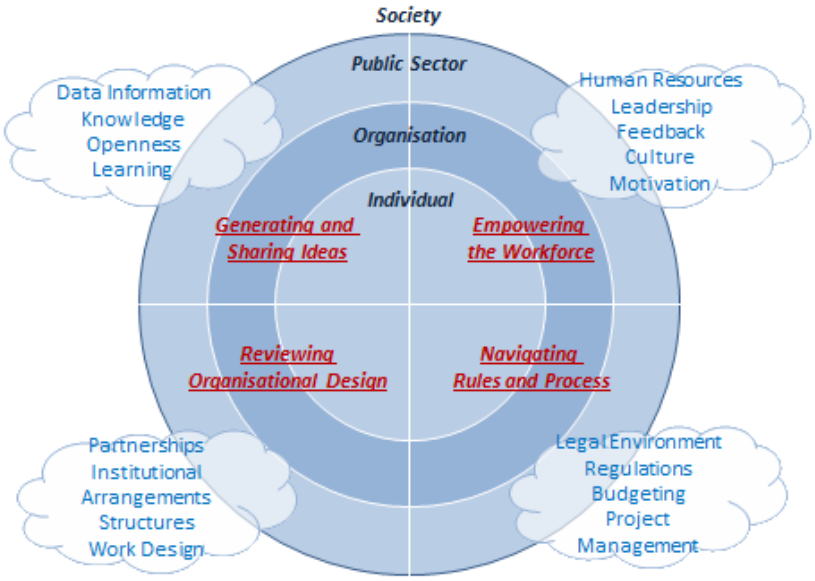

Figure 1. Organizational Innovation framework (OECD, 2014)

Moreover, in many low and medium technology industries the use of non-R&D resources, such as external consultants, new staff and external partnerships constitute the most important source of innovation for the firm (L. Santamaría, 2009), so reorganize the regional innovation framework in a way SMEs benefit constitute a key element for the regional development.

Being the capacity to innovate dependent of the technological infrastructure (M. P. Feldman, 1994), as some researchers illustrate (Molly J. Burress, 2008) combining associative models with organizational innovation techniques allow SMEs to benefit of lower transaction costs joining networks and regional clusters (Laforet, 2013).

1.2. Knowledge-driven clusters and the innovation gaps

Clusters are "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also cooperate" (Porter, 1998) which allow to profit from economies of scale and achieve goals beyond their individual reach without sacrificing the flexibility of a smaller organization.

For the last two decades, they have been intensively promoted by policy makers in order to obtain a competitive advantage and increase the productivity of Small and Medium Enterprises (SMEs), boost innovation and create new businesses profiting from economies of agglomeration. This model is especially effective when taking into account manufacturing logistics and transport costs (Krugman, 1991) and explains why population and economic growth are usually concentrated into certain specialized regions.

UNIDO approach to clusters promotion is based on the Inclusive and Sustainable Industrial Development (ISID) principles for pro-poor growth of the involved communities, providing technical assistance in order to formulate, implement and monitor the cluster initiatives (UNIDO, 2013).

The development of a new economic paradigm based on quick technological changes, innovation and knowledge changes the concept of geographical proximity, since other factors such as technology closeness play a more important role than logistics or transport cost, which are not influencing as much as they would do for supply chain or internationalization activities.

In the case of Knowledge Clusters, or Cluster of Innovation (Engel, 2014), they focus on the development of high technology products mobilizing resources (employees, capital, know-how and technology), encouraging entrepreneurs to stablish in the region and providing them the strategic perspective (access to new markets, global supply chains, etc.), and thus integrating a regional innovative system (P. Cook, 2003).

In this framework, knowledge-driven cluster are used in order to jump over the seven innovation gaps that SMEs face (G. Lindqvist, 2013):

- Collaboration between firms.
- Manage joint R&D projects with research centers.
- Create and develop institutions to train talented employees with specific skills.
- Deal with government and administrations.
- Approach venture capital and finance institutions.
- Access the global market.
- Collaborate with similar clusters.

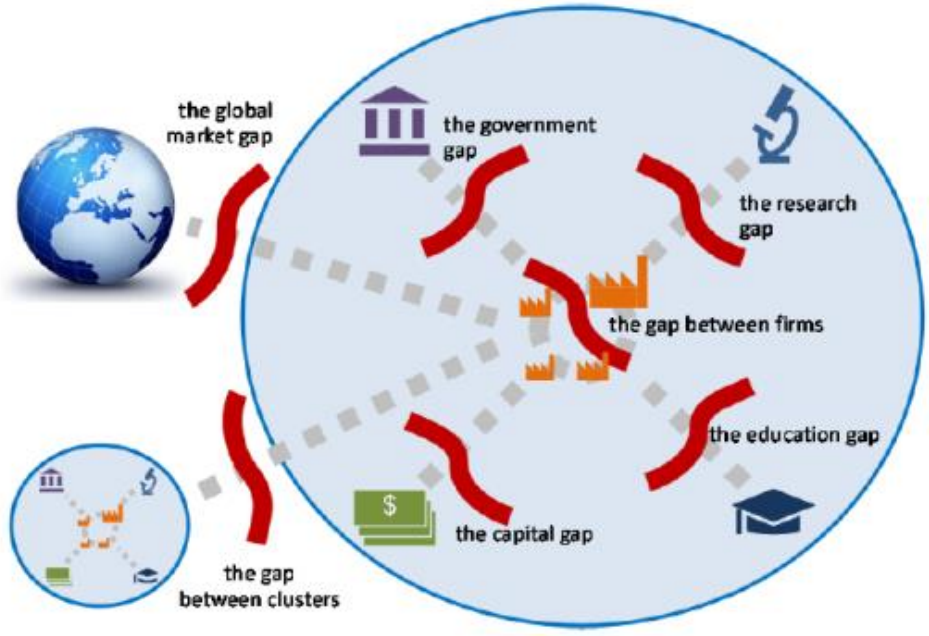

Figure 2. The Innovation Gaps (G. Lindqvist, 2013)

In addition, the concept of regional proximity could be nowadays enlarged due to the increase of high speed and affordable transport availability and the use of ICT solutions for knowledge sharing, which increase long-distance collaborations between firms (Torre, 2011) even if geographical distance is still an important factor according to several recent analyses "the highest impact on the probability of generating inter-firm knowledge exchanges is found when we consider the technological proximity between firms, rather than geographical proximity" (Stefano Usai, 2013).

In the following paper, we will analyze how knowledge-driven clusters foster organizational innovation within SMEs, exposing the process of cluster creation with several examples (on regional, country and province level) and tools to put it into the practice provided by ecoPlus, the agency for business and cluster management of Lower Austria, and used during the implementation of several clusters in the region.

2. Cluster development

Experience shows that many of the successful cluster initiatives implemented by governments focus on improve overall business conditions (training, supply chain and finance access, etc.) and build clusters based on existing region strengths rather than starting from scratch (Ketels, 2008).

In the following chapter we will discuss the recommended steps to diagnose and assess the existing environment to find out the strengths and weakness, in order to fit them with the region technological strategy, following UNIDO's best practices on cluster development (UNIDO, 2013). We will also introduce the competence mapping tool, whose outputs are usually the best way to identify the first activities that would serve as a base for the knowledge-driven cluster formation (Hagenauer, 2015).

2.1. Cluster selection

The first recommended step is to perform an identification of possible technological fields with present companies in the region and possible actors (supporting institutions such as business associations, banks, research and training centers, etc.)

A set of well-known tools mechanism are available to analyze it, from SWOT analysis to technology foresight.

Technology analysis

Some tools that may help to assess the key sectors to strength in a particular region are the Technology S-Curve, which analyze in which step of the technology life cycle (starting in the innovation stage where the technology exists mainly in R&D labs, diffusion and finally substitution stage)

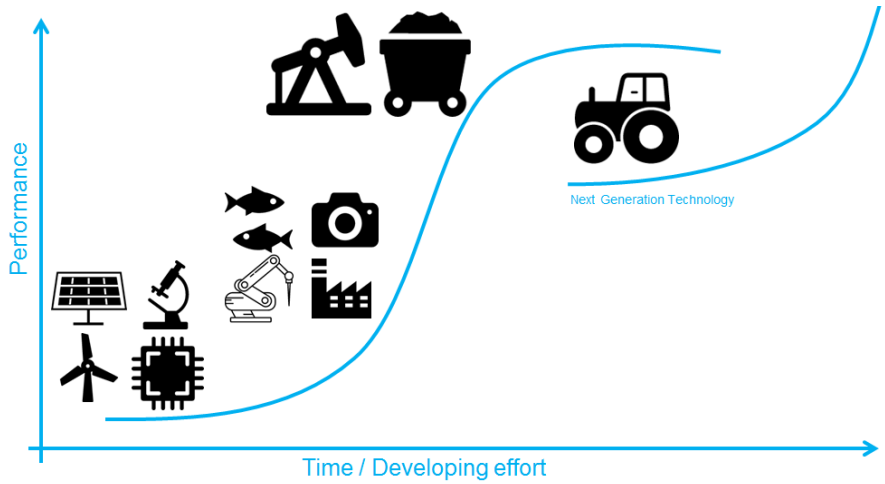

Figure 3. Technology S-Curves

In addition, Growth-Share Matrix (or Boston Consulting Group Matrix) assesses which product and technologies have the best market growth related to the market share, thus revealing

which are "cash cows" (i.e. sectors in which the region is very competent but which won't grow any further) and the "starts" (those sectors still not mature enough but with great expectations both in growth and market share).

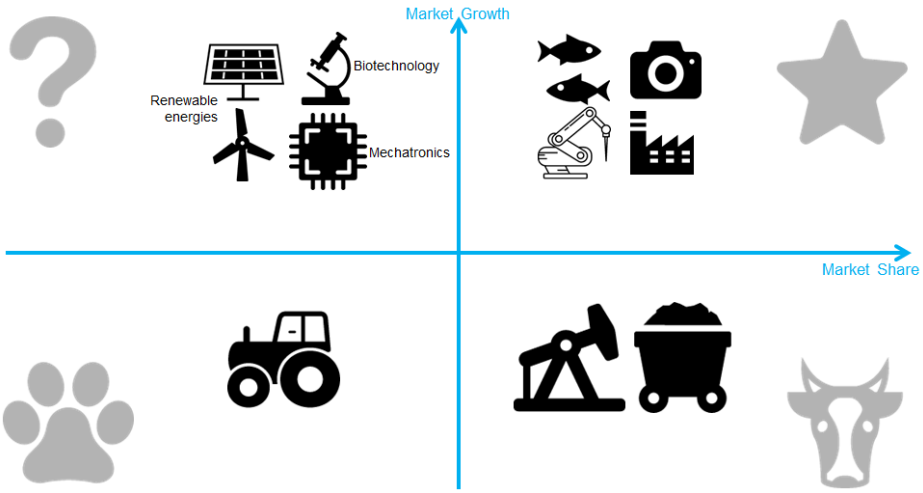

Figure 4. Growth-Share Matrix

Finally, clusters strategy is very related to smart specialization especially when they focus to create a regional transformation around knowledge-intensive industries. Although with their differences, cluster can become the mean to implement S3 into a region (European Comission, 2013).

Technology Foresight

Technology foresight the vision on how science and technology would evolve in the future, thus providing the information needed to develop technology policies and strategies in order to lead to growth and enhanced competitiveness, and also methodologies to promote

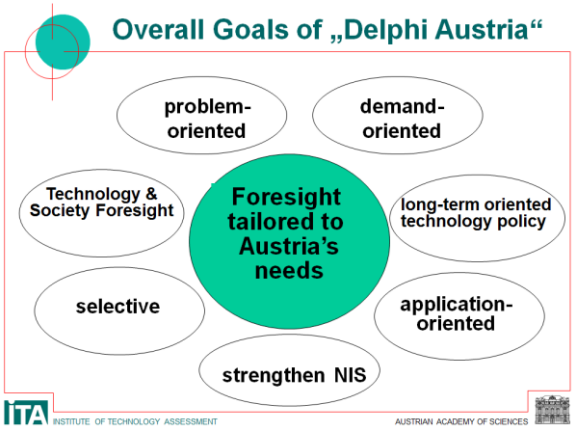

Figure 6. Goals of Technology Foresight in Austria (Aichholzer, 2013)

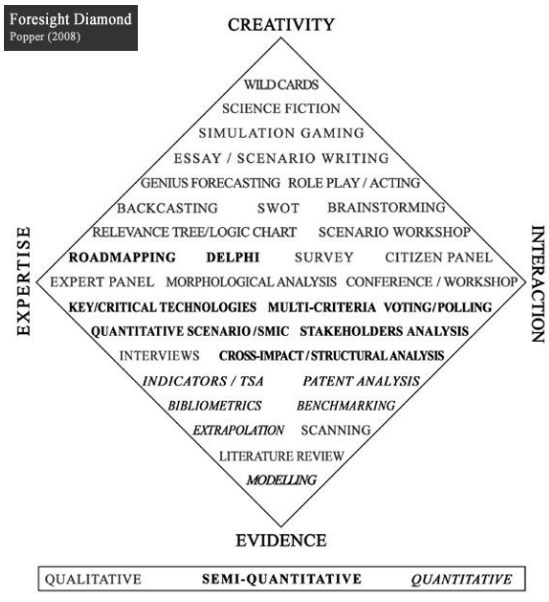

Figure 5. Foresight diamond (Popper, 2008)

sustainable development and innovation.

Being a common practice in developed countries, which perform it periodically, UNIDO created a specific program in order to support technology foresight initiatives for Inclusive and Sustainable Industrial Development that has already created technology foresight basis for Latin America region (UNIDO/ICS, 1999).

On a country level, Austria set a periodic program to create technology foresight, aiming to prepare their industrial policy to those needs that the country would have in the future.

In order to perform technology foresights Delphi surveys are usually carried out with a panel of experts. It consist of two or more rounds of questions asked to all members, in which the answers are shared anonymously between rounds in order to encourage the revision of the answers and incorporate other views on it.

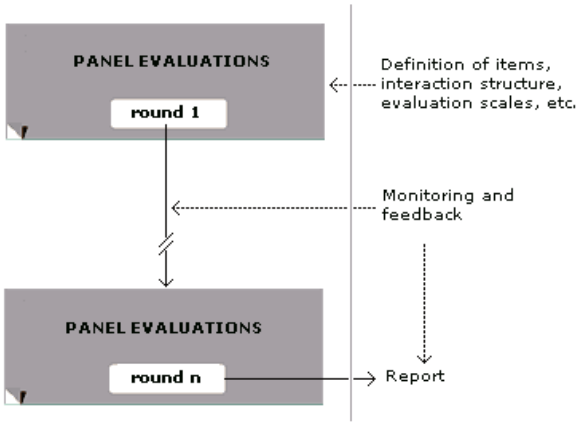

Figure 7. Delphi surveys rounds (Wikipedia, 2015)

Another benefit of Delphi surveys is that since all actors could be involved and participate on the foresight, it leaves no space to disagreement on the result and better commitment on the conclusions on it, compared to a reduced expert commission.

2.2. Diagnosis. Competence mapping

Once the potential stakeholders are identified, the recommended action is to complete a competence mapping of the cluster members. Based on interview to their managers, the competence mapping seeks to build the strengths and weakness regarding knowledge and skills of each cluster member.

With this analysis result, it is possible to identify those priorities that may be concreted on a specific action plan, which may be approved by cluster members, and will also set the objectives and goals to be measured for Monitoring and Evaluation (M&E).

UNIDO offers technical cooperation for cluster creation and development and provides contact information on related expert in several regions and fields, for more information on local

contacts and documentation please check Cluster for Development portal (www.clustersfordevelopment.org).

Competency mapping

Competency mapping is the process of identify knowledge, skills and attitudes or an organization and classify them into a comprehensive way, that allows to obtain the specific strengths and weakness.

For a cluster manager, it is a precious source of information to identify which topic could be improved with joint activities and cooperation between members, and to pursue an specific strategy in order to leverage the strengths found.

The mapping should cover not only potential cluster members but also other supporting institutions such as R&D centers and academia, other clusters and nearby technopols. Outcome from a competency mapping should be analysis by an external expert in order to find out possible cross-industry new applications opportunities.

Competences found during each company workshop could be classified depending on their potential to be transferred to new markets and products and the level of proficiency on each of them, to focus on those with the highest ratio which constitute the core competences. The following chart shows different approaches to leverage cluster member competences based on their proficiency and market effect:

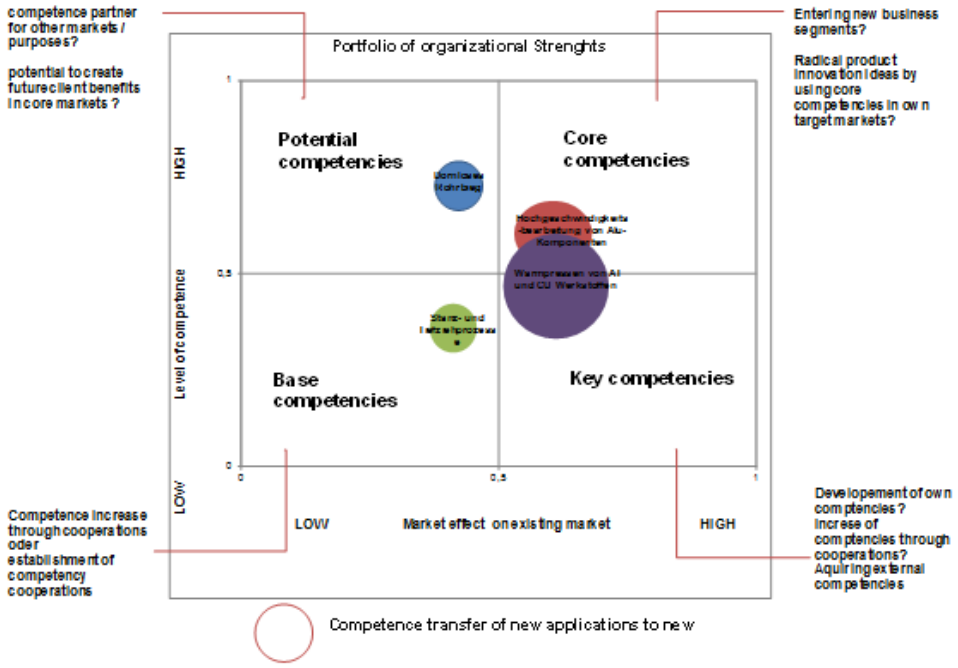

Figure 8. Competency map (ecoPlus, 2009)

Core competences are a source of competitive advantage for the company such as the ability to operate in certain markets, quality and exceptional product perception by customer, potential for differentiation for their products, ability to transfer those to other markets or other company specific skills. In addition, individual strengths (e.g. experience of certain employees, specific processes, mastery of a process) should be also considered as long as company strengths.

The result of this process should consist on a competence map accompanied by a SWOT analysis based on it indicating potential applications, possible joint projects for new product developments, opportunities of collaboration with other partners and institutions and action plan to solve the weakness and lack of skills found during the diagnosis.

Example – Workshop agenda (ecoPlus, 2009)

During the creation of Mechatronics cluster in Lower Austria a Competency Mapping workshop was held with each potential member in order to assess their skills and knowledge base. An example of agenda and instructions follows.

A full day workshop is planned (09:00 – 17:30). In addition to the internal participants 2 external consultants as well as 1 representative of the Mechatronics-Cluster will attend. The following agenda is planned:

09:00 – 09:30 Methodical introduction: mapping of competencies
09:30 – 12:00 Discussion: company-specific competency profiles
13:00 – 14:00 Definition of the potential competency offer for other companies
14:00 – 15:00 Identification and analysis of future technologies and key technologies
15:30 – 17:00 Initial search fields / ideas for innovations regarding competencies / need, demand for competencies
17:00 – 17:30 Summary & feedback

2.3. Cluster organization

Every cluster will need a permanent organization of experienced professionals working at full time on the organization, which is most usually structured as a separate legal entity. Professional profiles are usually divided as Project assistant (from 0 to 5 years of experience), Project manager (experienced profile from 5 to 15 years) and finally Cluster manager (who usually have more than 15 years in the sector, and at least 3 to 5 years working with cluster initiatives).

Multidisciplinary profiles within the cluster organization also foster link building and collaboration between different institutions, since each employee will also bring its contacts and expertise in an area (G. Lindqvist, 2011).

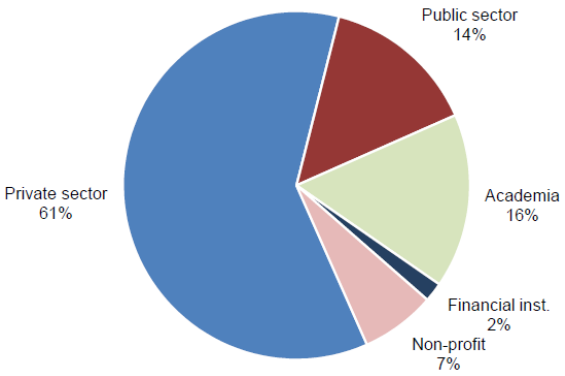

Figure 9. Sectoral composition of main governing board (G. Lindqvist, 2013)

2.4. Public-Private funding

Cluster initiatives could be both initiated by public and private organizations, combining in the midterm a mixed source of funding but usually depending more on public sources at the beginning and becoming more autonomous with funding from members and sponsors once established, keeping around a 50% of their funding from local, national or international public institutions. Other sources of income include member fees (25% of clusters earnings) and consulting and sales services provided (around 20%).

Depending on the environment, cluster may finance most of their projects with its own budget or fund each project with several partners' agreements, becoming less dependent to fluctuations on their source of income.

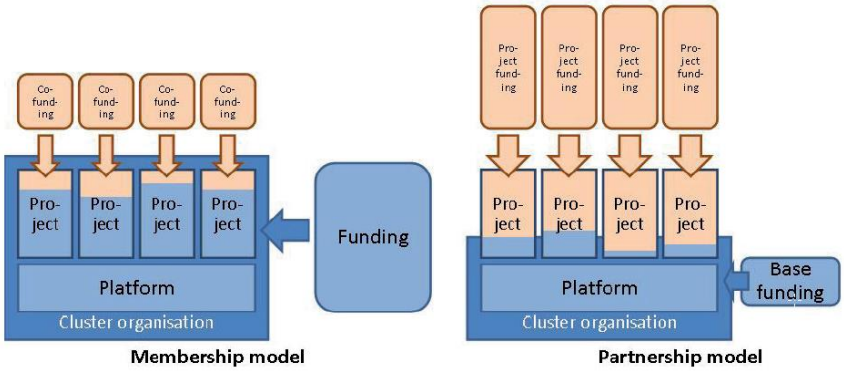

Figure 10. Funding models for clusters (G. Lindqvist, 2011)

2.5. Initial activities

The competence mapping interviews will provide useful information to complete the next steps on the cluster implementation.

Training

Training activities allow building new capacities amongst cluster members and enhancing their current skills. Additionally, it could be used as a first joint activity for networking between cluster members.

Training topic should be obtained from the analysis resulting from the competence mapping, addressing common weakness or taken advantage of potential strengths to be exploited. Usually, common industry certifications or legal issues affecting most of the cluster companies could be addressed on trainings. Also, if competence mapping detects a lack of general management knowledge this could be solved with related trainings.

Example – Cluster initial training

Network of 30 partners including companies, universities, training providers, research facilities led by the competence center (research facility Wood K plus)
Duration: 24 months, 1.10.2014 to 30.9.2016
Budget: 548.904€
Objectives: Improve skills of employees of companies working with pinewood through technical and scientific know-how transfer (researchers to companies): approx.. 50 people
Development of new products and services (new applications of pinewood)
Activities:

1. Evaluation of training needs
2. Definition of training curriculum, development of training materials
3. Interactive training: presentations, group work, dialogues, best practices examples, study visits…
4. Evaluation and development of strategies for the future

Role of the cluster management: **coordination** (NO training)

Following a similar approach, training activities could also refer to stablish a regional center that would specialize on preparing employees with specific skills and knowledge for the cluster sector. This is the case of HTL Möedling (HTL Möedling, 2015), which teaches teenagers Electronics and Mechatronics systems, a sector were the region also makes a special effort in cluster in technopols.

Joint product development

In order to gain a competitive advantage joining skills and know-how from different companies it would be possible to combine those in order to develop a new (usually more complex, or for a different industry) product.

2.6. Monitoring and evaluation

Since the beginning of the cluster initiative planning, goals and impact expected on the region should be set, defined as indicators and frequently monitored, as long as the cost, size and nature of the initiative to be able to reach conclusions on the efficiency of the initiative.

Example – ecoPlus Balanced Scorecard

As many private companies, clusters could use a Balanced Scorecard to develop their strategy and deliver their result to stakeholders and members.

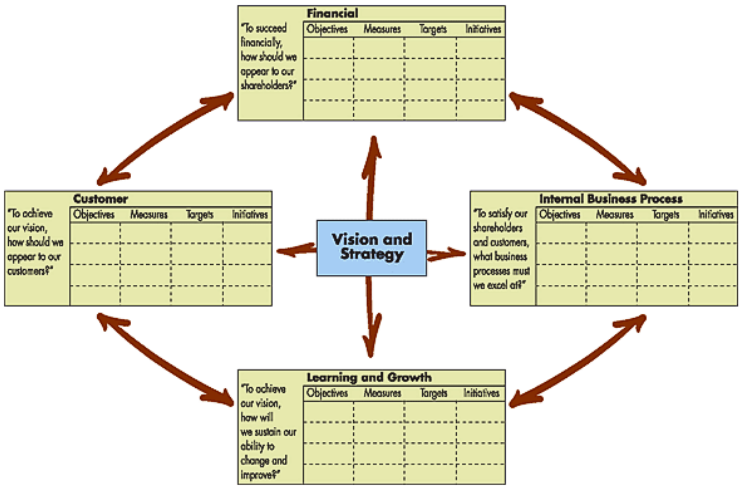

Figure 11. Balanced scorecard (Robert S. Kaplan, 2007)

Some of the parameters measured in the balanced scorecard are:

- Cluster partners
- Number of key projects
- Number of people involved in key projects
- Co-initiated product developments

A good and frequent (twice per year) evaluation at the beginning of the cluster creation may point out that the initiative is not adequate and be able to pivot using a different strategy or even to discard the initiative.

3. Case Studies

3.1. Province level. Mechatronics cluster in Lower Austria

For further reference, a use case of competence mapping for diagnosis of a cluster before creating will follow. In this case ecoPlus, the regional public agency charged of clusters, technopols, innovation and internationalization in Lower Austria, conducted a competence mapping amongst several prospective members and with the help of other local institutions and consultancy partners (ecoPlus, 2010).

The team noticed in the first phase that a previous analysis of the potential of the cluster was key for its success. Some of the questions to check before starting it include number of companies in the region, which sector are they specialized, added value to the region, collaborative environment, existing training and research facility and public sector willingness to collaborate.

During the execution of this mapping 30 interviews were performed and their data analyzed by a team of innovation consultants, with a total budget of 30.000€. The whole process from preparation to report presentation took 7 months.

Results showed clearly the need of a cluster initiative in the field of Mechatronics in Lower Austria, which was immediately taken in action. Early involvement of the cluster manager organization into the analysis would be useful once this action is taken (Hagenauer, 2015).

Finally, a Focus Group was formed in order to start recruiting companies into the cluster initiative, starting with a core group of 12 entrepreneurs and officially kicking-off the initiative six months later with a meeting of 180 business executives, which allowed to analyze in depth opportunities for collaboration and joint activities.

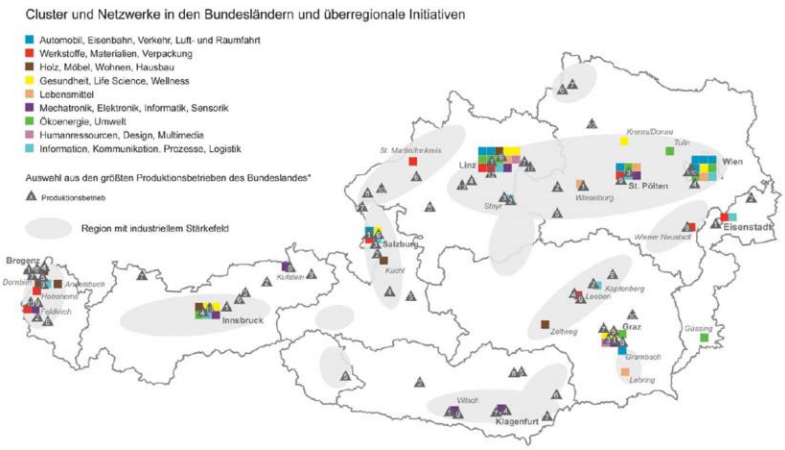

Figure 12. Austrian cluster map (Cluster Platform Austria, 2015)

On a country level, ecoPlus also promotes joint initiatives and holdings with similar organizations from other Austrian provinces to create nation-wide clusters with members in several regions of Austria.

This is the case of the Mechatronics cluster, which is a joint collaboration from Lower Austria (ecoPlus) and Upper Austria (Clusterland Upper Austria) governments and business agencies (Mechatronik Cluster, 2015).

3.2. Regional initiative. Cluster observatories

Regional cluster observatories provide useful information on cluster activities, mapping tools for coordination of initiatives and strategy advice on public policy. Cluster observatories take also their own initiatives to promote clusters in in those industries and regions where it is necessary, and to increase the efficiency of those existing initiatives.

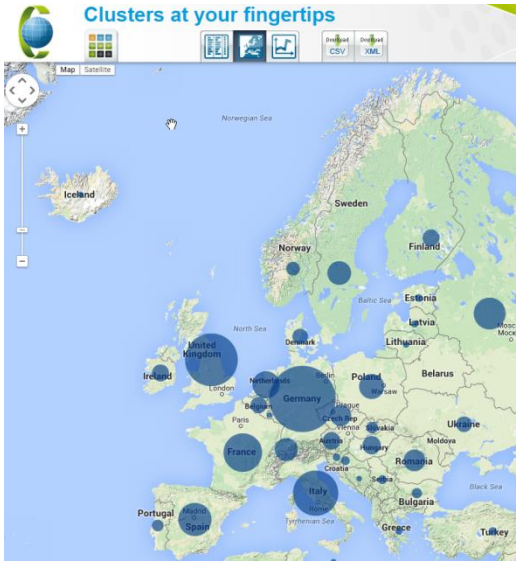

Figure 13. European cluster map (Cluster Observatory, 2015)

Figure 14. Federal clusters initiatives in USA (U.S. Small Business Administration, 2015)

Existing observatories partner with a leading organization on cluster studies and analysis. In Europe the initiative was led by the Cluster Observatory is managed privately by the Center of Strategy and Competitiveness of the Stockholm School of Economics. The Observatory is in charge of delivering excellence awards to those best-managed clusters and foster matchmaking and partnership between different clusters (European Commission, 2015).

On the other hand, in United States of America the U.S. E.D.A. (Economic Development Administration) partners with Harvard Business School (origin of the clusters and competitive advantage study) in order to analyze existing clusters in the USA (U.S. EDA, 2015).

In India, the initiative is managed by the Foundation of MSME Clusters, an organization created by UNIDO in order to foster innovation and enhance competitiveness of SMEs in India while promoting Inclusive and Sustainable Development in the region.

4. Uruguay's Mechatronics and Automation industry development

Despite most countries of Latin America and the Caribbean (LAC) are linked up directly or indirectly in intra-regional trade business as well as with different global value chains, overall the quality of insertion into manufacturing regional or global chains is still low. Most integration to productive chains occurs at stages requiring less qualification and lower productive integration, thus retaining the lower incomes from the generated product value across the entire global chain.

In this sense, the development of new technologies could bring some opportunities for a shift on the value addition and local/ regional integration; in particular for those technologies which main input is the knowledge.

Moreover, although clusters and business networks strategies have been already widely used in Latin American and Caribbean region, they have been usually focused on natural resources and traditional industries (Rodríguez, 2013).

In this context, Uruguay effort to build an Automation and Mechatronics industry could use some of the concepts previously exposed, with the support of UNIDO services for Inclusive and Sustainable Industrial Development.

Actually the use of cluster is already incorporated to Uruguay's industrial policy (Gobierno de la República Oriental de Uruguay, 2014) and extended into several sectors (from agro industries and automotive to design and creative arts).

Furthermore, a recently performed Country Independent Evaluation (UNIDO, 2015) recommends exploiting the development potential of ongoing projects, such as CAIME (Agro-Industrial Center for Automation and Mechatronics). This center could serve as a primary institution to drive a cluster centered on automation and mechatronics for agro-industrial applications.

Furthermore, in order to implement a mechatronics cluster, public administrations could count on the support of UNIDO (either extending the current support to CAIME or via a country program) and the Collaboration Mechanism for Science and Technology signed between Brazil and Uruguay government, which may allow the support of experts from Brazil to the initiative.

Additionally, in order to raise the competence and knowledge on mechatronics it is recommended to develop a joint academic program between LATU (Laboratorio Técnico de Uruguay), UTU (Universidad Técnica de Uruguay) and the cluster, that would train potential employees.

Due to the fact of the high dependence of the country in agro-industrial sector, applying the products derived from the cluster to it may add additional value to the whole country economy.

5. Conclusion

In this paper we have stablished the importance of knowledge-driven clusters to achieve economies of agglomeration for competence and knowledge transmission and acquisition amongst SMEs, and how this effect could boost innovation in the region.

Unlike traditional clusters, some tools such as Competence Mapping play a key role on assessing the strengths and weakness of the region in terms of abilities, skills and knowledge; and it is widely used now by the most successful institutions promoting innovation. Based on competence mapping outputs, cluster management would be able to implement initiatives building on already existing skills and knowledge and solving with joint activities those weaknesses that handicap the development in the region.

It is thus a much recommended approach for the case of Uruguay Automation and Mechatronics industry promotion, starting by performing the identification and competence mapping of the potential cluster members as a previous step of initiating joint activities or trainings, and that may lead to a great added value on agro-industry sector and, as explained with real examples and case studies, could create an improvement on sustainable development in the region.

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