Chapter 14

Overview of Past and Ongoing Experiences Dealing with the Environmental Management at Cluster Level

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Additional information is available at the end of the chapter

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1. Introduction

Small and medium-sized enterprises make up a large part of Europe's economy, representing some 99% of all enterprises and 57% of the economy's added value (COM (2005) 551 fin). Therefore they also play a primary role in shifting the European economy to more sustainable production and consumption patterns. SMEs can have considerable impact on the environment, not necessarily through individual pressure, but through their combined total impact across sectors. It is widely accepted that it would be too complex and burdensome for companies and public authorities to determine the detailed contribution made by SMEs to pollution (e.g. air pollution), in terms of the environmental load from different types of pollutants (e.g. CO2, SOx, NOx, etc.) in each Member State. Indeed, in many cases the data does not exist. Nevertheless, the often quoted rough figure of a contribution of 70% of industrial pollution in Europe seems reliable, and a number of studies attempt to provide 'insights' into particular environmental problems deriving from SMEs for specific countries. For example, a British report estimated that SMEs accounted for 60% of total carbon dioxide emissions from businesses in the UK and concluded that there was substantial room for improvement in energy efficiency and emissions reductions among SMEs. Again, estimates from the Netherlands and United Kingdom suggest that the commercial and industrial waste from SMEs represents on average 50% of the total. These studies further support the claim that SMEs can exert considerable pressures on the environment (SEC (2007) 907). Numerous regional and national studies show that the majority of SMEs have low awareness of their environmental impacts and how to manage them. Most SMEs are 'vulnerably compliant', since they do not always know enough about legislation to ensure that they are compliant. This is mostly due to lack of awareness of the environmental impacts of their own activities, ignorance of environmental legislation,

inability to tackle their environmental impacts, and sometimes the excessive administrative and financial burden of compliance. Compliance is further hindered by the perception that environmental protection is costly and has little benefit for the business (SEC (2007) 907).

This scenario shows:

- the potential threat to the environment and to the effectiveness of many Community environmental protection measures due to lack of knowledge and awareness;
- the potential risk for the health and safety of SMEs employees
- the potential advantages that an enhanced environmental management could bring to SMEs in terms of economic and/or financial benefits (of which SMEs may be unaware). The complexity of the issues involving the SMEs' environmental compliance and their environmental performance, other than their capacity to fully respond in time to the new challenges placed by environmental issues (which allows them to catch the benefits in terms of competitiveness and innovation) needs a multiple approach, capable of putting into action a set of complementary measures. These would include education and awareness raising, on-the-spot assessment and identification of problems, targeted consultancy, exchange of information and best practices, removal of administrative burdens, availability of shared tools.

Generally, the issues are related to the environmental impact of the SMEs production activities and services, involving all the environmental aspects (air, water, soil and sub-soil, biodiversity, noise, land, etc.) normally/usually disciplined by the EU and the national and local legislation. They also include crucial new challenges that the EU is facing, regarding global warming, energy efficiency, renewable energy sources, sustainable use of resources, waste reduction, re-use and recycling.

All these considerations have stimulated the development of the so-called "cluster approach" to manage the environmental issues of a large number of SMEs located in limited territorial areas. In recent years, the "cluster approach" has been mentioned in some important official documents of the European Union, such as:

- EC COM (2007) 379 "Small, clean and competitive - A programme to help small and medium-sized enterprises comply with environmental legislation" (ECAP Programme) which encourages the use/implementation of environmental management in industrial clusters or districts of SMEs, using specific cluster or supply chain approaches;
- the new Regulation (EC) no. 1221/2009 (EMAS III), which in article 37 mentions SMEs clusters applying for EMAS registration.

Networking and cooperation among organisations emerge from several studies and empirical evidence as some of the most important factors fostering the dissemination of formal EMS (such as EMAS). Many authors (inter alia:Biondi et al. 2000, Hillary 2004) emphasise that working with groups of companies is an useful and efficient way of adopting EMAS, particularly for SMEs. Moreover, the European Commission has recently confirmed the key role of networking for overcoming the constraints and barriers for EMS adoption among SMEs (European Commission 2007). In fact, the Commission has

highlighted its commitment to promote and encourage the use of EMAS in industrial clusters or districts of SMEs, using specific cluster- or supply chain- oriented approaches, since they can reduce consultancy and audit/verification costs for SMEs, and facilitate additional sharing of knowledge and exchange of experience among participants.

The effectiveness of the networking approach is clear among organisations operating in the same sector (such as the industrial sector, but also service sectors such as tourism or public institutions operating at different levels) and among organisations operating in the same region (or territorial area).

In the first case, enterprises can co-operate by identifying and assessing similar environmental aspects and by finding technological and operational solutions that can be applied to similar production processes and products, as well as by defining organisational structures suitable for the same kind of production cycles. In the second case, co-operation is facilitated by the 'physical contiguousness' and there are synergies both in improving the environmental impact on the same local eco-system, and in interacting and communicating with the same stakeholders (local population, authorities, etc..).

In some experiences, a network has been created among SMEs within a 'cluster', in order to foster information exchange and experience diffusion and to define and apply common solutions to similar environmental, technical and/or organisational problems, or to share environmental management resources (Iraldo & Frey, 2007). A specific kind of co-operation within a cluster of organisations takes place in the supply-chain: when a large customer is willing to support small suppliers in the EMS implementation process, then all the smaller organisations involved in the supply chain can benefit greatly from networking. This approach proved effective in some Member States such as Germany ("Konvoi" approach), Spain (co-operation in the tourism supply chain), Nordic Countries (Denmark and Sweden). In Italy it has shown a real effectiveness in promoting the environmental compliance of SMEs by means of the so-called APO "Ambiti Produttivi Omogenei".

This study aims at collecting and describing the most important international experiences concerning the cluster approach, with the following objectives:

- To analyse different types of inter-company dynamics in the cluster;
- To give information on the diffusion of the cluster approach at international level;
- To understand possible correlations between cluster approach and environmental issues management;
- To analyze some excellent experiences on shared and collective management of environmental aspects.

The structure of this chapter is organised in sections according to the different types of clusters considered. After a brief introduction on the methodological approach, each section analyses the various forms of cluster with the following structure.

The first section focuses on the identification and analysis of the definition of cluster to which we refer, outlining its key features and describing the cooperative dynamics that

consolidate within it. The second section explains the presence of the abovementioned type of cluster in Italy, describing its prevalence and relevance for the national economy. The third section aims at outlining the European framework and offers a comparison with the information applied to the national context. The last section identifies the elements that characterise the management of environmental issues (in a cooperative logic) in the type of cluster analysed,

This study is based on the results emerged from a research carried out within the ECCELSA (Environmental Compliance based on Cluster Experiences and Local Sme-oriented Approaches) Life project. For this reason the authors acknowledge all project partners1 who contributed to the results presented in this chapter.

2. The methodological approach

The first references to the "Cluster organizational model", as an approach that can develop synergies resulting in more efficient production than would occur within a single large plant, are found in Marshall at the end of the XIX century. In the first half of the XX century the benefits of agglomeration of economic activities were also confirmed by Austrian economist Shumpeter, who stressed the importance of the cluster system in terms of business competitiveness. In 1991, Michael Porter in his *Competitive Advantage of Nations* (1991), stated the "cluster theory" in which he identified the most potential for growth and development for industrial clusters as opposed to the single enterprises, thanks to the presence of vertical relations *[customer/supplier*] and horizontal relations *[common customers, technology, channels*].

At European level, clusters have been formally recognized and defined in the Final Report of the 'European Commission Expert Group on Enterprise Clusters and Networks which offers a first "census" of the phenomenon, and in communication No. 652, October 2008[2].

In those documents, clusters are defined as "geographic concentrations of specialized companies that have workforce with advanced abilities and skills, and "support" institutions that make possible the spreading of knowledge and indirect positive effects as a result of their proximity".

According to this definition, the elements that characterize the cluster concept can be identified in *geographic proximity, specialization in production* and *interaction among different actors* in the cluster. Therefore, the definition of cluster is not restrictive; it covers a wide variety of approaches in which those elements are more or less relevant. In fact, the concept includes the classical configuration of the industrial district and the geographically confined

[1] The authors specifically acknowledge Sara Tessitore and Valentina Toschi (SSSUP); Besides Sant'Anna School of Advanced Studies (coordinator of the project) the other partners are: Ambiente Italia – Istituto di Ricerca, ERVET - Emilia Romagna Valorizzazione Economica del Territorio, IEFE Bocconi - Istituto di Economia e Politica dell'Energia e dell'Ambiente, SIGE - Servizi Industriali Genova, Gemini - Innovazione Sviluppo e Trasferimento Tecnologico.

[2] Communication from the commission to the Council, the European Parliament, the European Economic and Social Committee and the committees of the region 'Towards world-class clusters in the European Union: Implementing the broad-based innovation strategy ".

industrial areas such as the environmentally equipped production areas "APEA", as well as industrial parks up to the interactions along the supply chain. While being characterized by the presence of elements linked to the cluster, these network systems show major differences that allow to distinguish three main approaches within which to investigate.

For example, the Industrial District is a local system with the presence of a prevalent production carried out by a group of small independent firms highly specialized in different stages of the same production process. Production Areas instead represent an organizational model characterized by the territorial element but, unlike the District, they are concentrated in areas more easily defined and circumscribed geographically, and do not necessarily show the presence of one or more specialised production sectors.

Another organizational model that meets the definition of cluster is the supply chain: a network involving all stakeholders in the production chain, from the company that produces raw materials to the processing company, from carriers to distributors, from wholesale to retail. The feature of the production chain is the interaction between SMEs involved in a process of production, among which the exchange of information can flourish and the development of projects and a relationships based on trust may be encouraged. Compared to Districts and Production Areas the less important aspect in this context is the territorial delimitation and the concentration of enterprises.

The distinction between different aspects of the concept of clusters led to the identification of three inter-organizational interaction models on which to focus the analysis, particularly emphasizing the organizational arrangements implemented to manage common environmental problems. In detail, the types of clusters in this study are:

- Industrial districts, closely related to production;
- Ecologically equipped productive areas APEA and Industrial Parks;
- Supply chain management which aims to produce stable benefits for the companies that are part of the supply chain (buyers and suppliers) through process integration and long term relationships.

3. Industrial district cluster

3.1. "Industrial districts" cluster: Definition and boundaries

In literature, the industrial district is represented by a local system characterized by a main production activity performed by a group of small independent firms, highly specialized in different stages of the same production process. This peculiar entrepreneurial organizational model can develop synergies that result in a more efficient production than would occur within a single large plant. At the end of the XIX century Marshall (1890) had already highlighted the benefits coming from the agglomeration of economic activities in terms of availability of skilled labour and high level of specialization. Similarly, the Austrian economist Schumpeter in the first half of last century stated the existence of competitive advantages deriving from a business cluster. A significant contribution to the study of industrial districts and of internal relationship mechanisms able to generate competitive

advantages for the cluster firms comes from G. Becattini who, in his article "From industrial sectors to industrial districts" introduced the concept of industrial district as a tool to support regional policies for territorial development.

Without any attempt to reorder the taxonomies in the field of industrial districts (which can be found in the literature according to the various configurations that such systems engage in), we mention some definitions and acronyms that have slightly different interpretation and, as a result, partially conflicting definitions of local systems with a high concentration of businesses: from industrial districts to system-sectors, from milieu to TPS (territorial production systems), to the RESS (regional economic and social systems). Connecting all the approaches underlying these concepts is the identification as the common element of the analysis of a system of usually small and medium enterprises operating in a homogeneous sector (or in sectors known as "auxiliary") and located in a limited socio-territorial area in which they have deep-seated social and economic relationships. The role which an industrial district can have in a competitive development of local production has stimulated in some national contexts the interest of policy makers. In Italy, Law 140, 1990, enacted to simplify and facilitate the set up of district areas, also fostered an institutional definition of the concept of Local Production System (LPS), which is an area characterized by:

- Homogeneous production contexts;
- High concentration of enterprises;
- Specific internal organization.

Based on that definition, the industrial district can be considered a specific LPS featuring:

- High concentration of industrial enterprises;
- Highly specialized production of business systems.

3.2. The "industrial districts" cluster in Italy

Law No 317 of 1991 “Action for innovation and development of small enterprises” introduced in Italy the concept of industrial district (art. 36) taken up and extended by Law No 140, 1999 with reference to the Local Production System. National legislation has given regional administrations the task to define criteria and procedures for the recognition of clusters and the legal form they should have once approved.

The Region of Lombardy under Regional Law (L.R.) 7 of 1993 and Regional Law 1 of 2000 regulates the procedures for the geographical boundaries of Industrial Districts, sets up the provision of development programmes in individual districts and the creation of innovative projects for the enterprises that belong to them. In 2000 Tuscany adopted Resolution No. 69 which defines districts as "monosectorial production systems with a high presence of small medium industrial manufacturers having a strong supply chain, social and institutional relationships also present in interprovincial areas". Italian Regions did not issue any rules to formally and rigidly acknowledge districts, so it remains a very flexible approach which is closely related to the characteristics of the area and primarily addressed to contexts consisting of SMEs.

The district approach has spread as a result of economic support programmes promoted at first at regional level (eg. I-C@AST programm - a textile project being reorganized - Lombardy 2006), and later by the Ministry of Economic Development (2003-2005 -2008)3. Art.3 of Law 266/1997 (so-called Bersani Law) for the first time establishes state funding for the Regions to be used in Industrial Districts identified on the basis of Law No. 317/1991, to fund programmes that improve service networks, in particular in the ITC sector.

Another important intervention of industrial policy in favour of Districts was carried out under the Decree for the liberalization of the electricity market, which envisaged the opportunity for those entities defined as "eligible customers" in Article 2 to sign supply contracts with any producer, distributor or wholesaler in Italy and abroad. Among those considered for this option are groups formed by companies whose total consumption reaches a value greater than 30 GWh, located exclusively in the same municipality or contiguous municipalities, or in areas identified with specific acts of regional planning. New policies to support technological development in the Districts were approved in 2001 and in 2005. The last supportive action took place under the 2008 Budget which included a call for bids to grant funding to districts also engaged in improving environmental performances at level of production area. Surveys by research bodies such as the "Districts Club" and the "IPI-Institute for Industrial Promotion" reported data showing a significant presence of the district system in Italy. Here is some information resulting from the last industry census carried out by ISTAT in 2000. In Italy there are 155 districts mostly located in the Northern regions. This model of production organization involves 4,929,721 employees and 1,180,042 businesses of the manufacturing, services and trade sectors[4]. The areas where this approach is prevailing are textiles with 45 districts, mechanics (38), household goods (35) and the tanning industry (20). Districts are less common in the production of paper and paperboard, in the food industry, chemicals and plastics.

The regions with greater presence of industrial districts (2001 data) are Lombardy (27), Marche (27), Veneto (22), Tuscany (15) and Emilia Romagna (13)[5]. Among the 27 districts of Lombardy the most important sectors are textiles and engineering, while in the Veneto and Marche regions districts are more present in the production of household goods. In Tuscany, along with textiles the most important districts are tanning and paper, while in Emilia Romagna the presence of districts in the mechanical industry is accompanied by the food industry and the production of household goods.

3.3. The "Industrial districts" in Europe

When comparing the characteristics of Industrial Districts as previously mentioned with the concept of cluster at European level, three important common characteristics emerge. Firstly, clusters are seen as *geographic concentrations* of specialized firms, of highly skilled

[3] Europe INNOVA Cluster Mapping Project: Report Italy Available in:
http://www.clusterobservatory.eu/upload/Policy_Report_Italy_20080116.pdf>
[4] Club Distretti, Map of Italian districts, 2005.
[5] ISTAT, Industry Census 2000.

Region	No Districts	Workers
Piedmont	12	297,034
Lombardy	27	1,745,042
Trentino-Alto Adige	4	46,814
Veneto	22	861,546
Friuli-Venezia Giulia	3	123,244
Emilia-Romagna	13	574,432
Tuscany	15	466,494
Umbria	5	61,823
MarcheMarche	27	435,063
Lazio	2	31,542
Abruzzo	6	96,859
Molise	2	4307
Campania	6	26,177
Apulia	8	144,096
Basilicata	1	9,927
Sicily	2	3,236
Sardinia	1	2,085
ITALY	**156**	**4,929,721**

Source: ISTAT 2001

Table 1. Presence of manufacturing districts in Italy

Industry	Industrial Districts	Local manufacturing units	Workers
Textile and clothing	45	63,954	537,435
Mechanics	38	56,816	587,320
Household goods	32	42,287	382,332
tanning and footwear	20	23,441	186,680
Food	7	3,781	33,304
Jewelry and musical instruments	6	13,010	116,950
Paperrmaking and printing	4	4,342	35,996
Rubber and plastic	4	4,779	48,585
TOTAL	**156**	**212,410**	**1,928,602**

Source: ISTAT 2001

Table 2. Types of industrial districts in Italy

and capable workforce, and of supportive institutions that improve the flow and the spillover of knowledge. Secondly, the cluster is useful to reach the functional objective to *provide a range of specialized and customized services* to a specific group of firms. Finally, clusters are characterized by some social and organizational elements, called *"institutional*

social cohesion tools", which link the different and interconnected actors, thus facilitating a closer cooperation and interaction between them.

At European level, two different approaches are used to identify clusters. The best known is based on *"case studies"*, the gathering of *qualitative information* through interviews with local experts or research on documents and publications. The second approach regards the various *quantitative techniques* that rely on the most sophisticated economic models and are based on statistical methods which encourage to identify clusters indirectly, by measuring the effects that are supposed to be detectable in the presence of a cluster.

There are hundreds of case studies that document the history, activities and impact of clusters on regional development, on employment and innovation. The European Cluster Observatory[6] has published 25 case studies of European clusters, related to the areas and the sectors indicated in the picture below.

Through the collection of "case studies" each cluster tells "its own story" and sometimes it is difficult to compare different results. Furthermore, due to the rapid changes occurring in clusters, the results may arise from old data. Therefore, by describing relationships, processes and interactions among actors this methodology becomes an excellent tool that can be used to complement statistical analysis. With regard to *quantitative techniques,* the approach used by the European Cluster Observatory is based on indirect measurement of the effects revealed by coordinated localization of those elements that are assumed to be detectable in the presence of a cluster, such as the concentration of workers or high productivity. There are other techniques for quantitative mapping of clusters but, unlike the operational methodology[7] of the European Cluster Observatory, they are not constantly updated according to changes which take place in the countries analyzed.

The first results came in June 2007 with the establishment of a framework of regional clusters in 31 countries, divided into 38 areas. For the first time, the quantitative analysis performed is based on a fully comparable and consistent methodology in all European countries.This method identifies clusters based on regional employment data collected by EUROSTAT and national and regional statistical sources. The approach used is deliberately based on the measurement of the effects that relationships and spillover have on the companies' choice of location, and not on the direct measurement of the dynamic interactions among the forces driving the cluster.

The quality and quantity of the knowledge that circulate and the *spillover* among firms located in a cluster depend on the size of the cluster, on its degree of specialization and on how well the areas are equipped and focused on the production in the main industries that make up the cluster. Therefore, the three factors *size, specialization* and *focus* can be chosen to assess whether the cluster has reached a "specialized critical mass" likely to *spillover* and develop positive relationships. Statistical mapping of Clusters by the European Cluster Observatory identifies over 2,000 regional clusters in Europe, among which clusters

[6] The European Cluster Observatory was founded in September 2006 by Europe INNOVA.

[7] Cluster Mapping methodology developed by the Institute for Strategy and Competitiveness, Harvard Business School.

classified as *"industrial districts"* are 1380[8]. The following table shows the geographical distribution of "industrial districts" clusters.

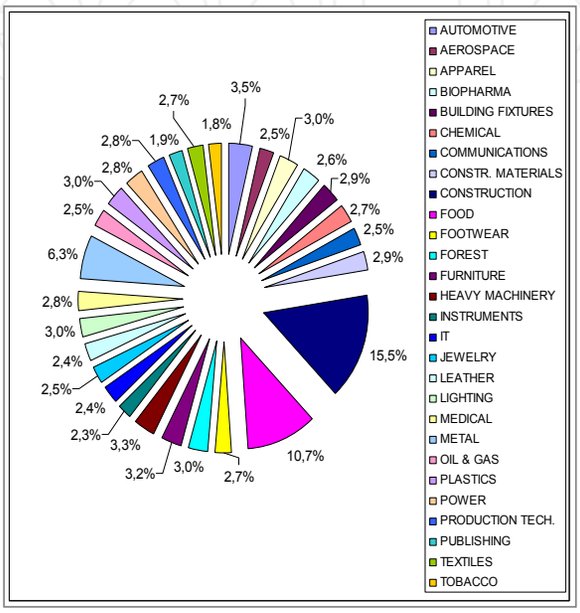
European States	No Industrial Districts	Percentage of total
Austria	34	2.5%
Belgium	19	1.4%
Bulgaria	33	2.4%
Cyprus	2	0.1%
Denmark	18	1.3%
Estonia	6	0.4%
Finland	16	1.2%
France	103	7.5%
Germany	269	19.5%
Greece	18	1.3%
Ireland	7	0.5%
Iceland	2	0.1%
Italy	158	11.4%
Latvia	3	0.2%
Lithuania	9	0.7%
Luxembourg	1	0.1%
Malta	4	0.3%
Norway	12	0.9%
Netherlands	29	2.1%
Poland	97	7%
Portugal	27	2%
United Kingdom	58	4.2%
Czech Republic	61	4.4%
Romania	75	5.4%
Slovakia	23	1.7%
Slovenia	8	0.6%
Spain	104	7.5%
Sweden	27	2%
Switzerland	34	2.5%
Turkey	83	6%
Hungary	40	2.9%

Source: European Cluster Observatory

Table 3. Geographic Distribution of "Industrial Districts" clusters

[8] Clusters that do not comply with the definition of Industrial Districts were not included in the total number of clusters considered by the European Cluster Observatory. Specifically, they are: Agricultural, Business services, Distribution, Education, Entertainement, Finance, Fishing, Hospitality, Sporting, Transportation.

Even taking into account the different spatial dimensions of the European countries analyzed, the table and the graph above show a greater presence of clusters in Germany, Italy, Spain and France. Within the above mentioned countries, there is a predominance of the Construction and Food sectors with 15.5% and 10.7% respectively on the total number of districts. The Construction sector is more prevalent in Germany (27 out of 269 districts), in Italy (21 out of 158), and Spain (17 out of 104). In France, however, the greatest number of districts is in the Food sector, with 19 out of 103 districts.



Source: European Cluster Observatory

Figure 1. Number of Districts by Industry

In recent years, many initiatives have been implemented in Europe in order to create favourable conditions for the establishment of new clusters and strengthen existing ones. To date, more than 130 specific national measures in support of clusters were identified in 31 European countries and registered by the INNO-Policy Trend Chart[9]. Nowadays, almost all European countries have specific measures for clusters or programmes developed at national and/or regional level, suggesting that they are a key element of the national and regional strategies in support of innovation

3.4. Cluster approach in the management of environmental issues

The size of clustering in a local context has critical relevance in the analysis of the environmental impact of industrial activities. When assessing the impacting factors related to a particular type of production, the characteristics of different local contexts in which that type of production produces its environmental effects have to be taken into account. Italy clearly shows how the environmental impact of some industrial sectors (textiles, tanning, ceramic) is localized around some areas where there is a high concentration of industries

[9] More detailed information in <http://www.proinno-europe.eu> and <http://cordis.europa.eu/erawatch>

from those sectors. In these cases local dimension becomes a key determinant of the significance of environmental issues for the entire industry sector and, at the same time, a key variable in coordinating an effective response by the companies.

There is no doubt that in terms of impacts on the environment, companies that operate in an industrial district have many elements in common.

First of all settlement, production and sales activities of these enterprises influence the same local ecosystem, characterized by specific and defined environmental aspects. Moreover, companies operating in one district often face similar environmental problems, because they dump the emissions from their production processes into the same receptacle: waste water that drains into the same river (eg the Bisenzio river that runs through the entire Prato textile area, or the Sarno in the Salerno tomato district) or solid waste that goes into the same landfill.

On the other hand, the high specialization of production and the usually very small size of enterprises (with all the implications in terms of limited availability of human, technical and financial resources) allows us to think of the district as an industrial area sufficiently homogeneous also in terms of production methods, degree of technology and organizational and managerial choices. The same technological and organizational matrix of the businesses in the district may show in common environmental problems that are related, for example, to the inefficiency and ineffectiveness of facilities to reduce pollution, to technology obsolescence, to inadequate structures for environmental management, cultural lag and so on.

Even relations with suppliers of equipment and components, according to the logic of "vertically integrated industry" that characterizes many districts, are often played at local level, thus also affecting the availability and appropriateness of the most innovative and advanced technological solutions for pollution prevention (think of the crucial role companies of the so-called mechano-ceramic play in the district of Sassuolo, as the almost exclusive repositories of technological know-how and, therefore, appointed to develop and propose new 'clean technology' to the ceramic businesses in the district).

A final aspect to highlight is the relationship with local stakeholders: for businesses in the district, interacting with the same community, the same institutions, the same local supervisory bodies means to deal with the same needs and requests concerning the quality of the environment. This is of fundamental importance if we consider that the significance of an environmental problem depends on the way in which it is perceived socially. The local dimension is a context where the relationship with company stakeholders is intensified, it becomes more straightforward (given the coexistence in the same area), more immediate (e.g. relationships with local institutions are more frequent than with national institutions), closer (just consider the number of residents employed by enterprises in the district). Besides, given the homogeneity of industrial activities, the physical proximity and frequent inability to attribute the environmental effects to any one production unit, enterprises in the district are considered by local partners almost as single entity.

The relational dynamics among companies and external stakeholders therefore become a crucial pressure factor to foster awareness on environmental issues within the district. By acting the same way and with the same incisiveness on a large number of similar businesses, it reinforces itself and strengthens its effects. For example, if the local population shows particular sensitivity to environmental issues, all enterprises in the district will undergo a high degree of examination from the public (which leads them to ensure continued compliance to regulations) and will be encouraged to use tools to enhance their environmental commitment to the local community.

Other important partners for companies in the district are local institutions. Sometimes companies interact with local authorities and supervisory bodies who are open to dialogue and willing to leave some room for negotiation, or with institutions that are particularly strict as regards law enforcement and extremely demanding on the compliance with obligations and deadlines. The different attitude of institutions can mitigate or amplify the context pressure, acting in the same direction for all firms in the district. Firms can be challenged with requests from local authorities that may focus on some environmental aspects (making them more problematic) or that may promote the application of certain environmental policy tools (e.g.: voluntary agreements at local level).

Local institutions may also prove to be particularly active in promoting common solutions (subsidiaries or consortium) to the most demanding and urgent environmental problems in the district, acting as a catalyst to encourage collaboration among businesses and promoting synergy in the commitment of human, technical and financial resources.

The local dimension represents an essential key in understanding environmental issues also because the same solution to environmental problems can be managed at district level. For example, the infrastructural equipment of a purification plant helps the industrial system in reducing the environmental impact. However, enterprises may find themselves having to directly invest in the installation of small treatment plants, which is known to result in a "scattered" distribution of facilities rather than in a systematic and consistent process.

Increasing awareness to environmental issues by the actors with whom the company interacts implies the need to meet certain "environmental questions".

This is especially significant for SMEs operating within an industrial district. In fact, efforts in the direction of environmental improvement by an individual company are here associated with new knowledge and with the onset of difficulties (the environment, as we have seen, is a challenge or new "turbulence") that once overcome constitute know-how that can be shared with other firms in the district. In this process of growth also appears/arises the need for support from (and relationships with) external actors, a need common to most SMEs, which fosters the development of new "answers" to the emerging needs/demands. In a territorial dimension the resulting "networking" takes peculiar forms, leading to the development of somewhat common solutions (i.e. based on sharing tangible or intangible resources) that are tied to the specific local environment in which businesses in the district interact.

Recent decades have shown the dynamic of those "common solutions" in industrial districts, connected to the different inputs and external forces that have enabled the development of strategies and tools to start up environmental management processes that could involve the whole district

4. Environmentally Equipped Industrial Areas (EEIA) Cluster

4.1. Cluster "Environmentally equipped production areas and eco-industrial parks: definition and boundaries"

"Industrial area" means an area with specific land uses, geographically limited, that is near or on the periphery of urban centers. The industrial area can affect one or more municipalities. "Environmentally equipped areas" were introduced in Italy by Legislative Decree no. 112/98 (the so-called "Bassanini Decree") that in Article 26 states: "The regions and the autonomous provinces of Trento and Bolzano govern, with their own laws, industrial areas and environmentally equipped areas, with infrastructures and systems necessary to guarantee the protection of health, safety and environment. The same laws govern the forms of single management of infrastructures and services in ecologically equipped areas by public or private actors... omission ... and procedures for land acquisition included in industrial areas,...omission .... The production plants located in ecologically equipped areas are exempt from the acquisition of permits concerning the use of services therein. The regions and autonomous provinces identify areas ... omission ...mainly choosing among already existing areas, zones or centres, even if partially or totally abandoned. The local authorities concerned participate in this identification procedure".

Hence, national legislation gives the individual regions the task to regulate the matter, giving some basic points of reference:

1. environmentally equipped areas have infrastructure and systems necessary to protect health, safety and environment;
2. environmentally equipped areas are characterized by forms of centralized management of infrastructure and services;
3. manufacturing plants located in environmentally equipped areas are exempt from the acquisition of permits concerning the use of services therein. [eliminato, era un copia e incolla che ripeteva la frase del punto 2).

A different approach must be used as regards the so-called "eco-industrial parks" (EIP), which are spread across Europe and the world and are in a way similar to Environmentally Equipped Areas, but are usually voluntary initiatives. Eco Industrial Parks as theorized by Lowe, Moran, and Holmes are communities of manufacturing and services firms linked by a common management, and they seek to improve their environmental, economic and social performances by collaborating when addressing environmental issues and using the resources (including energy, water and materials). This integrated approach aims to achieve collective benefits that exceed the sum of individual benefits each company would separately have from the optimization of its performances. The path to achieving this goal includes a

new design or redevelopment of infrastructures, and planning of the production area, cleaner production, protection from pollution, energy efficiency and cooperation among enterprises.

The early theorists of the concept of industrial ecology as we consider it today were scientists Robert Frosch and Nicholas Gallopolus, who in an article published in Scientific American in September 1989 defined a new strategy for the manufacturing industry: "the traditional model of industrial activity, in which production processes generate products for sale and waste for disposal, must be transformed into a more integrated model: an industrial ecosystem. This system optimizes energy and raw materials consumption up to using residues from one process...to feed other processes".

Other important researchers (Tibbs, Allenby, Graedel, Lowe, Holmes, Moran) contributed to the development of the concept of industrial ecology. They developed industrial ecology into a discipline based on multidisciplinary contributions aiming at the improvement of the industry-environment relationship. In 1992 Tibbs, another important pioneer, held that "*in natural systems there is no waste, meaning something that can not be absorbed constructively elsewhere in the system" coming to a key concept which is closing cycles: "...making maximum use of recycled materials in new products, optimizing the use of integrated materials and energy, minimizing waste and recovering waste as raw materials for other processes*".

Thus industrial ecology considers the flow of matter and energy with the aim of significantly reducing the use of resources and pollution. It suggests the application to industrial systems and their processing/production cycles of the rules and principles that determine the functioning of non-human biological systems, of ecosystems that are characterized by symbiotic relationships and by the absence of the concept of waste. Every scrap is reintroduced into the cycle to generate energy or as raw material to start another process that is essential to maintaining the overall balance.

Both types of production area (APEA and EIP), therefore, aim at the so-called "closing cycles" of material, water and energy; they aim at sharing key environmental services (water, energy, waste) and at optimizing the organization of activities that have an impact on the environment.

The cooperative approach can be seen mainly in two basic aspects:

- The adoption of collective systems and infrastructures within the industrial area (e.g. purification plant, centralized area for storing waste, industrial water supply systems, power generators for the area);
- The identification of a single production manager that deals with common services within the production area (e.g. collective management of waste, energy, security).

4.2. Cluster "Environmentally equipped production areas and eco-industrial parks" in Italy

As mentioned above, Italian legislation lets the regions regulate the issue of environmentally equipped areas on their territory.

The spread of APEA in Italy depends on the choices promoted by each region. To date, the regions that have issued laws and regulations are:

- Abruzzo (R.G.D. October 10, 2003, No. 1122, "Leg. Decree March 31, 1998, number 112 - P.R.D October 20, 1998, No. 447 as amended by Presidential Decree March 31, 2000, No 440 Definition of the discipline of "Environmentally equipped areas").
- Calabria (Regional Law December 24, 2001. Number 38 "New legal system for Consortia for Areas, Centres and Industrial Development Zones);
- Emilia Romagna (Regional Law No 20/00 "General framework on the protection and use of the territory", Legislative Assembly Resolution No. 118/07 "Adoption of the Guidelines Act and technical coordination on the implementation of ecologically equipped areas in Emilia-Romagna).
- Liguria (Regional Council Resolution of December 28, 2000 No 1486 "Criteria, parameters and methods on the industrial areas and environmentally equipped areas)
- Marche (Regional Law n. 16/05 "Regulation of urban redevelopment and guidelines for the environmentally equipped production areas", and DGR n. 157 of 07/02/2005 "Guidelines for the ecologically equipped production areas (APEA) of Marche Region").
- Puglia (Regional Law January 31, 2003, No. 2 "Guidelines on actions for economic development, production activities, industrial areas and environmentally equipped areas).
- Tuscany (Tuscany Regional Law No. 87 of 22/12/2003 "Ecologically equipped production areas. Changes to the regional law December 1, 1998, No 87").

In other Italian regions in which there are no laws specifically dedicated to APEA, there are other standards that facilitate the environmental management of industrial areas or the creation of EIP. It is the case with regional laws governing consortia of industrial development which are suitable structures for the collective management of a number of issues in the area, including environmental issues (eg, Friuli Venezia Giulia, Sicily).

In other cases, although APEA characteristics are not regulated by regional standards, they are often referred to in regional planning documents (eg. DOCUP 2000-2006 Regione Piemonte).

An analysis of the related regional legislation shows that regulations concerning the management of industrial areas come from different disciplines, especially laws related to planning and environmental and production activities.

In some regions the choice to go towards an APEA is compulsory, since it was decided in urban planning (e.g. Emilia Romagna), while in others the choice is voluntary (e.g.Tuscany). Although the national law was enacted over 10 years ago, its application in different regions is not settled yet, but still under development.

APEAs could potentially become a very popular model of production area in Italy, but to date there are only few cases of full implementation.

In the various Regions there is the enactment of laws and technical regulations, the implementation of experimental projects and (albeit only recently) financing, but the reality of APEAs in Italy has not yet established itself in terms of actual implementation.

It is therefore difficult to identify APEAs in Italy. To date, the most advanced experiences are in Tuscany, where it is possible to identify 12 production areas involved in a qualification path towards APEA, and in Emilia Romagna, with a process of public funding for APEA which saw the application of 42 industrial areas.

This gradual development is also linked to the fact that the different regional regulations provide for environmentally equipped areas a very broad field of application, stating that issues such as waste management, water resources, transport and logistics, security, etc. should be dealt with, thus covering all environmental issues in a systematic way.

However, some environmentally equipped areas are precursors, i.e. industrial areas that implemented solutions fully in line with the contents of Legislative Decree No 112, 1998.

For these areas the definition 'eco-industrial parks' is more correct, since they are production areas that do not fully comply with regulatory requirements of APEAs, but where environmental management initiatives such as collective management of certain environmental problems (not all) were activated, or collective facilities were built.

These experiences represent case studies with established characteristics in the review of Italian good practices, while actual cases of APEA will be mostly developing initiatives.

4.3. Environmentally equipped production areas and eco-industrial parks Cluster in Europe

Eco industrial parks are not identical to the Italian environmentally equipped areas, but they certainly show strong similarities.

First, the reference cluster, identified in the industrial area intended as a geographically defined and limited area, with production activities; then the adoption of engineering and management solutions designed to reduce environmental impacts, in fact making the environment variable a lever for competitiveness.

Indeed, the main difference between APEAs and EIPs is that while the former are governed by technical and planning rules, often involving public entities, the latter are usually created on the basis of future economic gain.

The involvement of the public administration is also less frequent, although it still constitutes a major subject in many cases.

Eco-industrial parks are spread globally, and it is possible to find examples of success in Europe, North America and Asia. Although it is difficult to define the categories, it is interesting to highlight some elements that differentiate the European EIP from the American or Asian EIP.

Although there are exceptions, in general in European countries the initiator of the development process of the production area is a public actor which promotes the EIP as a solution to territorial problems. The involvement may be associated with a form of local governance. On the contrary, in Asia EIPs are usually linked to the economic value related to the application of the principles of industrial ecology, especially as concerns the issue of waste.

Another difference is related to the size of industrial areas (much bigger in Asia), which makes it easier to trade secondary raw materials. In Europe, collective solutions are usually linked to the sharing of financial and human resources (services, collective facilities).

The EIPs in North America are more similar to the European ones, although the public presence in developing the production area is lower.

A further difference between the eco-industrial parks in Europe and those outside Europe is that in Europe there are many technology parks that are classified as eco-industrial parks, i.e. areas that are not strictly involved in production, but which play a role in research, communication and promotion for the development of environmental technologies and sustainable management solutions in the production industry. It is difficult to gain a thorough knowledge of the distribution of eco-industrial parks in Europe, America and Asia since there are no institutional structures of reference.

The summary of the presence of eco industrial parks in the world was based on data collected from studies, networks and devoted sites.

A study by the University of Patras (Greece) in 2003 on the state of the art of eco-industrial parks in the world identified over 100 cases, of which 42% in the U.S., 36% in Europe, 11% in Asia and 6% in Canada. In Europe, eco-industrial parks are mainly concentrated in the North-West, especially in England, France and Scandinavia.

The geographic department of Hull University mapped a distribution of about 30 eco-industrial parks in Europe. It points out that in some cases they are not actual industrial parks but science and technology parks or initiatives and programmes aimed at sustainable management of production areas.

In a Finnish study on eco industrial parks conducted in 2006, data on the number of eco-industrial parks in Europe is lower and equal to 20, while North American EIPs are 36.

An investigation conducted by the Chinese 'National Commission for Development and Reform' (presented on the website of *Cleaner Production in China*) analyzed the Eco Industrial Parks initiatives undertaken in Asia. There are about 40 initiatives for environmental industrial networking or Environmental Management. These initiatives were launched in eastern Asia: China, India, Japan, Philippines, Malaysia, Taiwan, Vietnam, Thailand, Sri Lanka.

4.4. Features of the cluster approach in the management of environmental issues

The environmental performances of an APEA, both in consumption of non-renewable resources and in emission of pollutants in the air, water and soil, are based on three

important aspects: urban planning, plant and infrastructure equipment, and management.

The search for performance excellence starts with the way in which the spaces within the industrial area are designed. The second aspect is based on using the best available techniques (eg. dual networks for the water cycle, own production of energy from cogeneration or from renewable sources) in line with national and EC legislation on Environmental Integrated Authorization (IPPC Integrated Pollution Prevention and Control) and on common spaces and facilities instead of individual ones (e.g. industrial sewage treatment plant for the entire area, common waste storage areas, centralized basins for the collection and treatment of stormwater).

The third aspect provides for the optimization of synergies already existing among the various businesses and the unified management of spaces and of centralized systems (e.g. provision of a grant for the recovery of waste among the firms located in the area, area mobility management, area energy management).

A collective management is the heart and engine of improving the environmental performance of the production area. Through the use of collective facilities and infrastructure it makes it possible to provide businesses with services that allow greater protection and environmental control and a reduction in costs.

The manager is generally an expression of the realities present on the territory, and it may be a public, private or mixed actor.

The single production manager is also responsible for the definition and implementation of an area environmental programme and for monitoring the environmental performance of the area. The Area Environmental Programme starts by analysing the existing issues and proposes solutions involving relevant local stakeholders (e.g. government, companies, trade associations, managers of public services).

Existing initiatives concern the activation of virtuous mechanisms among firms (sharing of human and technological resources, materials and energy flows in an industrial environmental perspective), the delivery of services to companies by the subject tha manages the area, the infrastructural and plant elements available to the production areas.

The following table shows the main solutions of good environmental management identified in the 32 analyzed cases (17 international cases[10] and 15 Italian cases[11])

[10] Eco-industrial park of Devens (USA); Burnside Industrial Park (Canada); Kokubo (Japan), Naroda Industrial Estate (India), LIK (Indonesia); Kalundborg (Denmark), Parc Industriel Plaine de l'Ain, Sphere EcoIndustrie D'Alsace, Syndival Lancadcres (France); Crewe Business Park, Sustainable Growth Park (U.K); Ecopark Hartberg (Austria); Vreten (Sweden); Value Park (Germany); S.Perpetua di Magoda, Parque Tecnologico de Reciclado Lopez Soriano.

[11] 1° Macrolotto Industriale di Prato, Z.I. Ponterosso - San Vito al Tagliamento (PN), Z.I.P. Padova, Z.I. Udine Sud, Z.I. Castello Lucento – Torino, Z.I. Valle del Biferno – Termoli, APO Ferrara, APO Ravenna, APEA Monte S. Vito (AN), APEA Pianvallico (FI), APEA Navicelli (PI), APEA Scandicci, APEA Ozzano (BO), APEA Ostellato (FE), APEA Colbordolo (PU).

RAW MATERIAL CONSUMPTION AND WASTE MATERIALS	
Good management of waste from construction activities	Recovery and safe disposal of waste generated during construction activities. The Italian experience demonstrates the success of the initiative when the monitoring activity carried out by the operator is accompanied by specific requirements in the Implementation Standards of Urban Planning.
Collective organization of waste disposal	It refers in particular to the special waste collection from businesses, which can be performed by the area operator or, more frequently, by third parties.
Promoting the principles of industrial ecology	Exchange activities among enterprises from the perspective of recovery and reuse of waste used as secondary raw materials. Usually there are specific agreements among a limited number of companies with synergic production processes.
SPREADING OF CLEAN TECHNOLOGIES	
Fostering of clean production technologies	Provision of research facilities; promotion of innovative solutions also through exhibition spaces; activation of pilot projects. Initiatives are generally aimed at creating of new jobs.
ADMINISTRATIVE SUPPORT FOR COMPANIES	
Interface between companies in the area and public administration	The area manager acts as mediator between businesses and the public administration with regard to administrative proceedings. The service can be simply informative (the manager contacts the local authority to obtain information and passes on said information to the interested companies) or it may concern the drafting of forms or the actual issuance of permits as delegated by the Municipality.
Environment info desk for businesses	Setting up an information service on environmental issues regarding regulatory obligations and as support for the processes of environmental certification.
Support to businesses for investment and funding	Activities carried out by the area manager for businesses as regards investments and research of grants and funding.
TRANSPORTATION	
Agreements with the provider of local public transportation	Study of traffic flows and routes from home to work, on the basis of which the single manager signs agreements with the provider of public transport to improve the service in terms of frequency and stops.
Car sharing and car pooling	Setting up a system of vehicles to stimulate the activation of a system of collective transport, as an alternative to the use of individual private vehicles. The initiative aims at reducing traffic in both commuting and missions.
TRAINING AND TECHNICAL SUPPORT	
Training on environmental issues	Courses for technical business personnel organized by the area manager, aimed at a proper application of environmental and

	safety regulations. Training and information activities for companies in the area offered directly or through third parties.
Eco – efficiency centers	Technical assistance and training to companies to improve their energy and water efficiency and in the production and disposal of waste.
SETTING UP OF BUSINESSES	
Environmental remarks in the selection of companies that wish to settle in the area	Generally carried out by drafting a questionnaire that the interested companies are required to fill in. The area manager is responsible for the selection as actor in charge of selling parcels of land or on behalf of the local authority.
Checking the companies status of compliance in terms of environmental requirements	Check up the relevant documentation prior to the settlement and visits to the site at the time of installation. This service is successfully carried out where companies have adopted an area Environmental Management System.
Envisaging environmental clauses in the contracts of sale for parcels	Provision of specific environmental clauses in contracts of sale for land parcels (e.g. when planning the areas for material handling or storage of waste) or request to adhere to the environmental policy.
Urban-environmental advantages	Removal of infrastructure costs, reduction of safety, health, and environmental taxes.
Landscape protection	Preserving the environment and integrating the business with the surrounding landscape through a centralized management of the development of the production area.
INNOVATIVE MANAGEMENT SOLUTION	
Implementation of environmental management system	Implementing an Environmental Management System complies with regulatory standards (ISO 14001 or EMAS) by the subject that manages the area. The EMS can provide a business involvement in varying degrees, for example in the adoption of common procedures or construction of a participatory environmental program. These elements also depend on the area of infrastructural facilities available
Creation of a territorial information system of the industrial	Development of a GIS on-line with all spatial information (geographical, cadastral and possibly environmental). The GIS is accessible by the companies settled and may represent a geo-referenced base that allows performance monitoring of the area. The management of the SIT is borne by the operator or company in charge of the area.
Agenda 21 meeting to define the action for cluster	Organise meetings within the local Agenda 21 to encourage the productive area to address environmental sustainability issues (energy supply, waste management, cleaning, transport and construction).

	Through working groups involving representatives of companies can address problems related to environmental issues and identify solutions that best suited for that territory.
Definition of an environmental action plan based on performance standards	Participation of local communities and businesses in programs of environmental action through the application of standards of environmental, social and economic performance and certification. The standards are defined by a committee made up of representatives of local production activities (trade associations) and citizens.

Table 4. Solutions for good environmental management

5. Cluster supply chain

5.1. Cluster "supply chain": definition and boundaries

The concept of this kind of cluster is not yet an 'autonomous' element in the economic literature, as is rather the case for other types of clusters (for example the large and consolidated strand of economic literature on *industrial districts*, or the most recent and innovative one on *environmentally equipped production areas*).

Although the meaning has not been conceptually developed yet, references to the 'supply chain' cluster are widespread and detectable in several contexts, both legal and academical.

Starting from Porter's remarks (1990), the *cluster theory* originally focused on identifying the key features of the 'cluster entity', with the aim of analyzing the ways in which its operation functioning mechanisms and its internal dynamics are able to determine a competitive advantage for businesses/industries belonging to the cluster itself. According to Porter, clusters are geographic concentrations of interconnected companies, specialized providers, service providers, and associated institutions in a particular field[12]. Firms located in the same area have the opportunity to operate with ease, in coordination along the value chain. The cluster is based not only on goods and *material* resources, but also on *intangible* resources such as development and exchange of knowledge, expertise, and relationships. These elements make a territorial area unique, an area in which human factor and knowledge make the difference when compared to any other area.

In other words, the supply chain is conceived as a geographically defined element within the cluster. This approach is confirmed by that part of literature aimed at investigating the connections between cluster theory, supply chain and supply chain management theory. This is a trend not developed theoretically and empirically yet, but which contributes to clarify some important aspects of the relationship between cluster and supply chain. Some authors observe that one of the key elements of Porter's cluster theory - the benefit deriving from knowledge exchange and cooperation between firms - is shared by the theorists of the

[12] "*A cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities*" (Porter, 1998).

supply management theory13 (De Witt et al., 2006; Mentzer et al., 2001). In fact, supply chain management aims at producing benefits for companies that are part of the chain through process integration and the set up of long term relationships (cooperation, trust) among companies. When companies belonging to the same supply chain operate in the same geographical context, they benefit from coordination and from the boost to competitiveness and innovation that comes from their geographical proximity (Mentzer et al., 2001).

To sum up, according to Porter the factors that characterize the cluster can be identified in geographical proximity, production specialization and in the interaction among the different actors in the cluster.

In this sense and for the purposes of our analysis it is relevant to note that proximity both upstream and downstream the supply chain is what facilitates interaction and promotes a continuous exchange of ideas and innovations.

Some studies aimed at providing empirical evidence of the existence of positive synergies, in terms of the impact on competitive performances that arises from belonging to a cluster. According to De Witt et al. (2001), the geographical proximity of firms belonging to a supply chain allows long-term competitive advantages that are more stable than those achieved by outsourcing to distant companies. Other studies highlight that the relational factors that characterize the relationship between buyers and suppliers belonging to the same cluster are able to enhance their performance in the long run (Noordewier *et al*. 1990; Corsten and Kumar, 2005). More specifically, the key elements that determine long-term competitive advantages are the *interdependence*, the mutual *trust* and *shared goals and commitments* that pervade the relationship among actors in the chain within a cluster, and the reduction of conflicts among the actors themselves (Ganeson, 1994, Doney and Cannon, 1997, Kumar et al., 1995).

A second important connecting element between cluster and supply chain refers to a particular connotation of the cluster, defined by the presence of a large multinational company surrounded by a 'halo' of suppliers ("A large demanding purchaser, such as a major multinational firm […] surrounded by a 'halo' of suppliers", Johnston, 2003). In this respect, territorial location still plays a central role in the competitive dynamics of the cluster: the proximity of suppliers of a large enterprise allows for the development of agglomeration economies thanks to the direct or indirect links that are established between the economic activities upstream and downstream.

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[13] In spite of the popularity of the *supply chain management* both in theory and in practice, there is no unanimous agreement on its meaning, also because its development in the managerial and academic fields is relatively recent. In his important work of 2001 ('*Defining Supply Chain Management'*), Mentzer defines the supply chain management, or management of the supply chain, *'a systemic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supplu chain as a whole'* (Mentzer, 2001). With 'supply chain' he means '*a set of three or more companies directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from the source to the ultimate customer*' (Mentzer, 2001).

More recently, the literature recognizes the need to introduce a new meaning of the word cluster alongside its more 'traditional' concept. Nowadays, the technological improvement of communication systems and of distribution networks at global level makes it possible to talk of 'virtual' clusters, where the element of geographical proximity is missing while emphasis is placed on features such as exchange and sharing of information and knowledge among the actors in the cluster (Johnston, 2003).

According to Rullani[14], this new type of cluster is characterized by an "evolved" form of proximity, not only physical but also virtual, among people and businesses that use technological mediation to develop 'close relationships' (easy, frequent, reliable, complex) even when they are physically distant from each other, thus replicating in a virtual space the benefits of proximity that in the past were a typical (and almost exclusive) characteristic of the territory.

The academic theory of virtual clusters is joined by their institutional recognition. In its working paper annexed to the EC Communication "Towards world-class clusters in the European Union: Implementing the broad-based innovation strategy" [COM(2008)652][15], the European Commission, while recognizing that most definitions of cluster focus on two factors - the concentration of one or more sectors in a given geographical area and the importance of networking and cooperation among enterprises and institutions - indicates that the spatial dimension of a cluster is variable and not necessarily limited to certain geographic boundaries, depending, among other things, on the ability and willingness of its actors to perform changes that are functional for the development and preservation of relationships that feed the cluster itself.

The definition of clusters developed by the OECD makes the "release" of the concept from the element of geographical proximity even more explicit, emphasizing once again the production and exchange of knowledge within the value chain as a key element of identity of the cluster "Clusters are characterised as networks of production of strongly interdependent firms, knowledge-producing agents and customers linked to each other in a value-adding production chain" (OECD, 1999).

A final element of analysis comes from recent literature aimed at defining the links between the concepts of cluster and supply chain in the context of today's 'knowledge-based economy''. If it is true that the cluster theory in general takes a macroeconomic perspective in which the theories on supply chain refer to a purely microeconomic level, it is possible to recognize some key elements the two theories share and that can lead to the identification of significant similarities between the two concepts (Sureephong et al., 2008). In particular, the success of a cluster is often due to the presence of a Cluster Development Agent (CDA), an organizational entity that represents the different socio-economic actors in a cluster, acts as coordinator and facilitator of cooperative dynamics among the actors, promoting knowledge sharing, innovation, the ability to communicate and the mutual recognition and trust[16].

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[14] Enzo Rullani, *Cluster: tendenze e scenari nell'economia globalizzata*, "Pattern of clusters evolutions" conference proceedings, Venezia.

[15] European Commission (2008b).

[16] Notice how this role and functions correspond to what in the context of E.U. policies are the tasks of the governing body of a cluster that is established when a cluster is 'institutionalized' (Cfr.: CE, 2002).

The literature recognizes a strong similarity between this role and the one that in the context of the supply chain management theory is played by the Supply Chain Facilitator (SCF), the person that guides the relationships among actors in a supply chain, and encourages the development of relationships and cooperation among them. If this role was originally played by the large multinational company, in the context of the current '"knowledge-based economy"' its function can be successfully carried out by other bodies - such as universities, associations, local institutions, *ad hoc* coordinating organizations - that belong to the same cluster as the socio-economic actors in the supply chain (Sureephong *et al.* 2008).

5.2. Supply chain cluster in Italy

As abovementioned, for the purposes of this analysis we should highlight how within this theoretical model it is possible to trace a first description of cluster as a type of "supply chain", relating to a local chain dimension, coinciding or included in the 'classic' industrial district, physically located in a given territorial area. The cluster supply chain is especially notable for the presence of a primary industry supported by several companies specializing in various phases of the industry. Thanks to territorial proximity and the presence of a socially cohesive community, these companies have the ability to easily operate by coordinating along the value chain (Sacco, Ferilli, 2006).

With respect to this first description, the literature emphasizes how clusters linked to local industries represent an area of strong identification and specialization in the economy of many Italian regions, although generally the cluster does not reach the regional dimension (Bardi, Bertini, 2005). In many contexts, some leading companies' ability to grow and export can foster local induced activities and is an example increasingly imitated by dynamic new small businesses, a catalyst of growth processes and territorial specialization. Examples of chains related to this meaning may be found in many traditional Italian industrial districts. Consider, for example, the area between Carpi and Reggio Emilia for knitwear and clothing, the area of Forlì and Cesena for the food industry, the Bassa Bresciana for shoe manufacturers, the furniture chain located between Matera and Puglia, etc.

More recently, the literature shows how in many cases this type of articulation of the cluster supply chain reached maturity during the 90s, and how the highest degree of complexity of the industry and the increased competition on international markets led to an expansion of the classical concept of district, which meant an area in which a single homogeneous production chain was focused. To respond to these changes, the new articulation of a cluster is as metadistrict, that is a territorial chain not concentrated locally, but that creates a widespread, sectorially specialized network - on a regional, multi-regional or national scale - with strong interaction/interdependence/competition among the business realities belonging to it. In many cases this connotation can be traced back to the development of products that identify the so-called 'Made in Italy' in some specific areas (typically the North East of the country and Tuscany), mainly focusing on sectors such as fashion, home, typical food products (e.g, buffalo mozzarella in Campania, bresaola of the Valtellina), light engineering (e.g. the biomedical field in Emilia-Romagna) (Rullani, 2002).

In this respect, the cluster supply chain is characterized by the different role of territorial contiguity of businesses with regard to cooperative and competitive dynamics that characterize it. Studies and remarks note how the metadistrict was established to overcome the old links among companies - where proximity is a prerequisite for the existence of relationships that can trigger processes of technological exchange and learning – by creating new links related to the development of new technologies and services necessary to keep those companies competitive. Globalization and new information technologies do not "disengage" companies from the territory, but help to provide the cluster with another operational dimension, in addition to and not as a replacement of the local dimension (Zucchetti, 2003).

The change of competitive scenarios also influence the *nature of relationships among companies within the supply chains and production chains*. While within the traditional districts of the '70s and '80s the relationships among companies along the supply chain are basically egalitarian, mostly informal and usually direct, beginning from the '90s these characteristics deeply change. The stability of the suppliers' relationship with a limited number of clients, typically located within the district, is no longer a 'dogma', i.e. the degree of 'mobility' of the system is increasing.

Furthermore, to support the internationalization and export activity aimed at enhancing the 'Made in Italy', territorial production chains sometimes adopt a form of 'twinning' among the original industrial districts. Aggregation, in these cases, also aims at improving the awareness of belonging to a quality industry, promoting high visibility of the territories, increasing transparency and credibility with all stakeholders - investors, tour operators, consumers, etc. - and especially at increasing cooperation among industrial districts within a sector at national level[17] (Fontana, 2007). Consider, for example, the chain of leather products for shoes and clothing in Tuscany, or the textile chain in Lombardy.

Finally, the literature recognizes that even in our country the previously defined *virtual clusters* are taking shape. According to Rullani[18], a virtual cluster may arise from very different evolutionary paths:

1. From *previously existent clusters* that learn to master new technologies, combining the advantages of the existing local network with the advantages deriving from long distance relationships and multi-territorial sharing;
2. From *medium enterprises*, once "plunged" in a regional system, that use new information technologies to extend their supply and distribution networks in the global circuit (without losing their roots in the area of origin);
- From *multinational companies*, that discover the importance of differences and specificities of each territory they have access to, eventually anchoring themselves permanently to certain territorial specializations. These specializations are enhanced

[17] An example is the 'agro-ichthyc-food industry' twinning between the districts of *San Daniele del Friuli* (famous for the prosciutto *Dop*), *Nocera Inferiore-Gragnano* (famous for its tomatoes and pasta), *Mazara del Vallo Co.S.Va.P.* (fisheries) and *Vulture* (specialized in wine, fruit and vegetables, olive oil, cheeses and dairy products) (Fontana, 2007).
[18] *Ibidem.*

and expanded through access to that global network of virtual proximity and coexistence made possible by the multinational company itself.

If, in general, our country sees setbacks in the rise of virtual clusters (mainly due to the difficulty for the traditional districts/clusters of SMEs to evolve rapidly[19]), the third path here outlined leads to the identification of a third type of supply chain cluster in Italy, defined in terms of '**trade mark**' **(or** '**brand**'**) industry.** The connotation, though not prevalent in the Italian production reality (characterized by a structure of small and medium enterprises), can be recognized in all those cases in which large companies and/or multinational companies or large chains (whether the property be domestic or foreign) operate on a national scale through a widespread and 'loyal' network of suppliers and subcontractors. The following section presents in detail this specific type of supply chain cluster, widely present in the European and international context.

5.3. Supply chain cluster in Europe

While in Italy the patterns adopted by the supply chain cluster are significantly influenced by the specificity of the economic and social fabric, in the rest of Europe chain clusters are generally configured as business combinations, often multi-sectoral, linked by supply relationships (of goods and services) at different levels with large leading companies and/or multinational corporations.

Due to globalization, in recent decades the European context has wirnessed the emergence of the concept of cluster supply chain in terms of virtual aggregation. As anticipated, this type developes around large companies that become a drive of the territorial development of some industrial areas at regional level, through processes of "virtualization" of the flow of information and of internationalization of the supply and distribution networks. These companies are able to stimulate and support the growth of competitiveness poles of global significance, within which operate production chains belonging to one or more related manufacturing sectors.

Many corporations belonging to different sectors, such as IKEA, Ericsson, ABB, H&M, Volvo, belong to this type of cluster (Sölvell, 2006).

Therefore, in this type of cluster the globalization of the supply chain and of innovation goes hand in hand with the strategic importance of the so-called *'local environments'*. While local markets seem to have exhausted their function of driving force for most goods and services, the local concentration of activities related to various production sectors (old and new) continues to act as a driver of (multinational) business innovation. In other words, the multinational companies' ability to compete is linked to their ability to act as *"insiders"* (through their branches or subsidiaries) within the most dynamic regional clusters, and to

[19] Among the main factors that hinder the 'virtual' development of Italian districts and clusters, the literature identifies chronic saturation of work environment (full employment), of infrastructures (congestion), of free space (crowding), and of environmental tolerances (with balanced under constant stress) (Rullani, ib.).

globally coordinate activities in order to connect in large-scale networks global markets and the innovative thrust deriving from local clusters[20] (Sölvell, 2002).

In summary, the literature recognizes in this type of cluster the persistence of some distinctive features of the supply chain cluster, except for the element of proximity, now redefined on a virtual basis. The specialization of production and the interaction among actors in the production chain continue to classify the cluster, developing through a virtualization of the flows of knowledge that stimulates the constant change and "upgrading" of products and services, thus creating the bases for advanced supply chains that are diversified geographically as well.

5.4. Features of the cluster approach in the management of environmental issues

This paragraph analyzes the characteristics of the "supply chain" cluster with reference to the elements that characterize its management from an environmental point of view. To this end we gathered a review of existing theoretical and empirical studies, oriented along the three trends of literature identified as priority areas of investigation about the connections between *cluster approach*, e*nvironmental management* and *supply chain management*:

- The trend of the so-called **Green Supply Chain Management,** or the development of supply chain management practices in environmental terms and their connections with the application of Environmental Management Systems (EMS);
- Studies and experience related to the adoption and implementation of **strongly product-oriented EMS**, so-called **POEMS** (*'Product-Oriented Environmental Management Systems'*), mainly based on the need to identify, assess and manage the so-called "indirect environmental aspects" (introduced by EMAS II Regulation) related to the product;
- The literature on the application of the concept and methodologies of **Life Cycle Assessment (LCA) in line with the chain/supply chain.**

These three trends have in common (albeit with different meanings at times) the acknowledgement of the need to adopt an inter-organizational approach to environmental management based on coordination and co-operation among different actors in the sector and not necessarily linked the territory. This need is the culmination of an evolution in the application of environmental management tools, characterized by the progressive recognition and assimilation by the businesses of a management approach inspired by the so-called life cycle thinking[21], marked by a greater sense of awareness and responsibility towards the environmental impacts that their activities have outside the confines of the production site (Carnimeo et al., 2002).

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[20] In literature such clusters are sometimes called "*Hollywoods*" with reference to the californian cluster, world leader in the *entertainment* industry.

[21] In summary, *Life Cycle Thinking* can be defined as a 'cultural' approach that aims at focusing all management aspects of a product through a single 'magnifying glass': its life cycle. Under this approach, the environmental impacts (actual or potential) generated during the life cycle should be considered in an integrated manner when designing, developing and managing a product. For further reading see: Carnimeo, Frey, Iraldo (2002).

As previously stated, the first trend refers to the so-called Green Supply Chain Management, or that part of the literature born by integrating and "contaminating" environmental management and supply chain management studies, and targeted at investigating supply chain approaches and management logic from an environmental point of view (Srivastava, 2007)[22]. This is a trend literature regards as underdeveloped although potentially fertile for investigation, and so far studied in depth only in relation to certain phases or activities of the supply chain *viewed individually* (eg. green design, green procurement, reverse logistics, etc.) (Srivastava, 2007; Sharfman *et al*., 2009). Conversely, the same literature agrees in giving particular importance to studies and contributions that on the one hand account for the reasons for adopting environmental supply chain management practices, and on the other hand account for the benefits and difficulties related to the implementation of the same practices.

At the empirical level, studies have shown the existence of a wide range of internal and external factors that may push companies to expand the environmental management to upstream and downstream supply chain activities: from the need to respond to increasing *pressures from external stakeholders* (e.g. consumers or institutions), to the need to *ensure compliance to more stringent environmental regulatory requirements*, to reasons of a *strategic nature*, or related to the opportunity to gain a competitive advantage (Sharfman *et al*. 2009; Darnall *et al.* 2008; Nawrocka, 2008). Corbett and Decroix (2001) affirm that nowadays the need to extend environmental management practices to the supply chain to improve performances is so recurrent in studies it has become a 'mantra' ("We have heard [...] various versions of the 'mantra': 'the next step forward in environmental improvement lies in supply-chain coordination', Corbett and Decroix, 2001).

Important for the purposes of this analysis are those studies that investigate the reasons that push companies to extend the environmental management to the supply chain under a cooperative approach. In this context, the empirical contributions emphasize how - beyond the reasons more closely tied to a proactive and '"value-driven"' environmental management - the key element that pushes companies towards a logic of cooperation with suppliers is mainly due to the uncertainty of information that governs the nature and extent of environmental impacts associated with the production process upstream and downstream activities, and the complexity and difficulty of decision-making processes frequently created by this uncertainty (Vermeulen and Ras, 2006 ; Sharfman et al., 2009).

In the context of a relatively scarce literature it is significant to note that some recent studies focus on the relationship linking the adoption and implementation of an Environmental Management System and the development of supply chain management practices, with the main objective to investigate (i) if and what kind of correlation exists in the adoption of these management practices, that is (ii) if and to what extent the adoption of one practice influences the adoption of the other (Darnall et al. 2008; Nawrocka 2008).

The process of gradual 'opening' of EMS and their redefinition in inter-organizational terms is recognized by the literature as a significant innovation in environmental management

[22] Srivastava's work (2007) offers a very detailed review of GSCM literature.

practices, characterized by the gradual assimilation by enterprises of the management logic inspired by the so.called life cycle thinking. This trend is identified by some authors with the gradual extension of the objectives and scope of management systems to environmental issues related to the lifecycle of the product (or service). The result of this "integration" is called POEMS - Product Oriented Environmental Management Systems (Klinkers et al., 1999).

The links between environmental impacts related to production and product make the environmental management tools within the company ineffective by shifting the emphasis on the relationships the company itself has with the actors that influence those impacts. By this logic, the goal of the management system is not only to ensure the implementation of the company's environmental policy by governing the processes and internal resources, but also to manage relations with the outside world, to foster and promote dissemination of that policy to other actors that share it. In other words, the scope of implementation of the management system becomes that of the actions and interactions through which many actors manage the impacts related to the different stages of the product's lifecycle (Sharfman et al., 1997).

The literature on POEMS highlights the benefits and limitations of these tools. In fact, although taking into account the entire lifecycle can provide more opportunities to reduce the environmental impact associated with the products - either through actions on specific issues and joint efforts involving different stakeholders along the chain - (Sharfman et al., 2009), thus contributing to the achievement of tangible improvements in performance (van Berkel et al. 1999; Charter and Belmane, 1999; Brezet and Rocha, 2001), the process of 'opening up' the environmental management systems is not immediate or 'painless' for businesses.

At European level, some experiences of POEMS developed since the '90s. In the Netherlands the signing of voluntary agreements between various industries and local authorities has allowed the development and funding of some pilot projects for product-oriented EMS. A study of sixty Dutch companies shows that the most sensitive element in the development of such tools is the difficulty for organizations to obtain the necessary information from their suppliers, because of the other companies' unfamiliarity with POEMS and the little influence of single organizations, especially small ones, on the whole product chain. Other experiences have demonstrated the 'compatibility' of the approaches and the requirements of international and European standards on environmental management systems (ISO 14001 and EMAS) and POEMS.

In France, a project to develop product environmental management in the automotive sector involved 250 companies, mostly SMEs, with the aim of honing tools and methodologies for the development of POEMS in organizations belonging to the sector. In this case the main project stimulus was of a regulatory nature, in connection with the requirements of the European Directive End of Life Vehicle, which demands specific knowledge of the supply chain[23] (Andriola et al., 2003a).

[23] Directive 2000/53/CE.

In Italy as well several POEMS experiences were carried out in medium-large businesses, or under programme agreements with public institutions (Ardente et al., 2006; Andriola et al., 2003a). Overall, the Italian experiences and the experimental applications in Europe (mainly in the Netherlands, France and Denmark) have not led to a 'coding' of POEMS by any international or Community standard. However, it must be noted how these experiences have contributed significantly to the development of methodological and management tools aimed not only at accounting for the impacts associated with the lifecycle of the product, but also at involving the suppliers in the assessment and quantification dynamics of these impacts. Among these tools, the methodologies of Life Cycle Assessment (LCA) are predominant[24].

A vast literature deals with the technical and methodological aspects as well as with numerous case studies and methods of dissemination of the LCA in Italy and in other advanced countries. For the purposes of this analysis, it is particularly important to observe the studies that investigate the role and mode of application of the LCA in the context of the management of supply chain relationships and management. In this respect, the literature recognizes that the potential of a LCA is revealed mainly in the form of a methodology capable of triggering an inter-organizational and networking approach within the chain. In fact, the steps that make up the tool[25] imply the need to activate along the entire supply chain the information and communicational channels necessary to collect and process data and information that allow to quantify the interactions between the 'product system' analized and the environment (Pesonen, 2001, Lefebvre 2000, Krikke et al. 2004; Sarkis, 2001; Sroufe et al., 2000).

Finally, it is important to note that some studies go further in analyzing the relationship between LCA and supply chain. They apply the methodology of Life Cycle Assessment as an opportunity to "restructure" the supply chain, with the aim of improving the environmental performance associated with a specific "product system". It is essential to take into account a number of factors for the LCA to be able to effectively contribute to

[24] The most common definition of this method comes from the Society of Environmental Toxicology and Chemistry (SETAC): *"a LCA is a process to evaluate the environmental burdens associated with a product […] by identifying and quantifying energy and materials used and wastes released to the environment to assess the impact of those energy and materials used and releases to the environment; and to identify and evaluate opportunities to affect environmental improvements. The assessment includes the entire life cycle of the product […] encompassing, extracting and processing raw materials; manufacturing, transportation and distribution; use, re-use, recycling, and final disposal"* (SETAC, 1993). If the inter-organizational approach of the POEMS consists in considering the product-system as *"a network of operations linked together by flows of materials and energy […] that ties activities and processes in different organizational contexts"* (Heiskanen, 2000), the use of a LCA proves itself extremely useful, since it can be aimed at finding the optimal solutions for the entire product-system, regardless of what would be preferable from an environmental point of view for each single process (or single organization) (Carnimeo *et al.*, 2000).

[25] The structure of the LCA derives from the scheme set up by SETAC in the early '90s with the aim of proposing a common approach for all the analyses carried out until then. This format is still the basic structure from which the subsequent changes and amendments derived. Internationally, the scheme proposed by SETAC was complemented by the ISO Regulations 14040 series, which rule the drafting of LCA studies. According to the ISO general regulation, the assessment of the life cycle must include the following steps: 1) definition of the objective and scope of the study, 2) inventory analysis, 3) impact assessment; 4) interpretation of results.

improve the environmental performances associated with the implementation of a product or service which combine multiple actors along the value chain (Hagelaar G. and van der Vorst J., 2001):

- The results of the LCA methodology are closely tied to the definition of the objectives and scope of this tool that are set at the startup of the evaluation process;
- The application of LCA in the perspective of the supply chain involves strong cooperation among all actors involved, not only in terms of trust and openness, but also of *transparency in the shared data and information* and of *consistency in their policies*.

In conclusion, it is possible to account for some empirical evidence related to the implementation of tools linked to *Life Cycle Thinking* in the logic of supply chain management. When LCA is integrated into the environmental management system in a logic of supply chain dynamics management, it is to be assumed that companies that use and promote this approach are able to affect the environmental impacts or influence the behaviour of actors that are external to the "boundaries" of the companies' organization. This is a pre-condition for the integration of product logic to be effective. If this pre-condition occurs, the use of LCA within the supply chain relationships provides important contact points, synergies and complementarity with an "extended" environmental management system. The above mentioned approach of "indirect environmental aspects" introduced by the EMAS II Regulation is well suited to be the "leverage" through which to introduce these tools.

The experiences in the analyzed scenario refer to the implementation of a LCA aimed at including *product-oriented* logic in an environmental management system. A first empirical evidence refers to the transition from a single company to a supply chain perspective, in the implementation of the Initial Environmental Analysis (as provided by ISO 14001 and EMAS) that crosses the company's boundaries and allows to identify and properly assess the indirect environmental aspects thanks to the adoption of the LCA. Although in practice the EMAS Regulation does not require the company to conduct a thorough LCA, it is clear that knowledge of these impacts is necessary, especially when it is functional to the identification of the most significant indirect environmental aspects. Understanding the impacts of product disposal, or of the product's packaging, may be decisive for a company that uses large distribution channels and targets/is addressed to the final market.

The same applies when a company uses a transport network for the delivery of its products to intermediate customers "spread" on the territory. This activity can be carried out as part of a chain. In the case of the local supply chain that drove the PIONEER project26, for example, a simplified LCA of paper products was implemented (streamlined or screening LCA, to use English terminology), useful to companies in the supply chain to identify

[26] The Life PIONEER Project (2003-2006) had the objective to define and experimentally implement a methodology based on the EMAS Regulation to the paper industry district of Lucca. The methodology has promoted a cooperative and integrated approach to the environmental management at local level, aimed at involving all stakeholders in actions to improve the environmental performance of the territory. For further reading, see: Frey and Iraldo, 2008 and the website www.life-pioneer.info

particularly relevant indirect aspects and to determine the connections among the various business activities of companies operating at different stages of the supply chain, in order to focus on critical points on which it was then possible to work with joint programmes and improvements.

LCA can be applied effectively in the supply chain environmental management also in the pursuit of ways to improve eco-efficiency. The so-called Life Cycle Costing (LCC), for example, provides guidance on how to integrate "conventional" accounting with an approach that allows to identify longer-term strategic opportunities and efficiency margins. An interesting example of application of LCC is that of the logistics of the large company Xerox (Bennet, James, 1999). Careful analysis of logistics costs by the company (related to product distribution and the recovery of remains to be reused) showed efficiency margins in its supply chain. However, in order to seize these opportunities some interventions were needed to design, manage and reorganize logistics flows which would mean a different allocation of costs and benefits among the different stakeholders (Xerox suppliers and customers).

Examples of these solutions were the internalization of the costs of packaging (including disposal) in accordance with the suppliers, and the standardization of packages so that they were adaptable to every product and, above all, reusable by customers to pack the product being replaced (and returned) at end of life. With an initial investment of 4-5 million dollars, Xerox estimated annual savings of $1.2, to which some “intangible” benefits (e.g. in the management and organizatin of logistics: handling of homogeneous packaging, reduction of operations’ time, etc.) added up. Although the overall comparison gave a positive outcome, some phases of the chain showed an increase in costs. Had the company not analyzed costs and potential benefits in the different stages of the lifecycle using the LCC method and reasoning in terms of actions promoted and coordinated by Xerox in an integrated logic with the other industry players, they would have never independently decided to engage in the improvement programme.

There are other examples that show how attention to the product under a “supply chain” environmental management system driven by the logic of the life cycle can constitute a solid basis on which to build a strategy oriented to an “environmental” customer satisfaction27. An interesting case is that of Baxter International. After stating in its policy that "we will work with our clients to help them tackle their environmental problems”, the company managed to translate this principle at the operational level by applying an approach heavily oriented towards the green supply chain management. Resolutely going beyond the boundaries of its organization, management at Baxter decided to take charge of the issues related to the disposal of waste that results from the use of intermediate products in the "downstream" activities. By this logic, a waste auditing service was activated with the aim to

[27] Although the concept of environmental *customer satisfaction* is not totally alien to the logic of a management system, it is usually related to social actors, since the main “customer” in environmental terms is the one that suffers the externalities of production. When this customer coincides with the traditional customer, however, the dynamics with which relationships can be managed differ from those that govern relationships with social *stakeholders*.

verify the needs in the waste management of their intermediate customers. The activity developed by this service has produced a set of suggestions/recommendations, then implemented through a thorough and extensive redesign of products and services in order to minimize their impact downstream of the production process (Fuller, 1999).

Another interesting case is that of the initiatives undertaken by a group of U.S. chemical companies in a "horizontal supply chain" (Elwood and Case, 2000) for the management of orders from customers in a logic of eco-efficiency. In this case, the needs of production efficiency go together with the attempt by the manufacturers to reduce the environmental impacts of their products in all stages of the lifecycle.

The examples here reported show some approaches that were made possible only through the cooperative relationship among the companies in the supply chain and, although not directly related to the application of LCA, they clarify that a product-oriented logic can effectively engage on the environmental management system of a company that operates as a producer or as a customer in any type of supply chain. This logic provides crucial support for the management of customer relationships, and bridges the gaps of the system when it comes to identifying the customers' needs, defining interaction modes, handling complaints and returns (for environmental reasons), reviewing the contract (which can include requirements concerning the product's impact) and measuring customers' satisfaction, which is essential in order to assess the environmental competitiveness and "green" marketing strategies implemented by the company itself.

In terms of marketing and environmental communication, there is another interesting example of application of product logic within a supply chain. It is the opportunity, now available and potentially very effective, to certify the environmental impact of a product of a "local" chain or a group of producers on the basis of an international scheme based on the ISO standard. The EPD international system (Environmental Product Declaration), currently managed by a body comprising representatives of some EU countries (including Italy) was born with the objective to certify the environmental performances of a product or service of a single firm.

Because of the evolution of the system and its gradual spreading (currently it counts more than 100 companies) there is the the need to promote products and services that come from an entire production system (i.e. a "cluster" or chain of companies) precisely because of environmental marketing objectives of a typical product or a product tied to a "brand". Thanks to the recent amendment of the EPD certification system groups of producers (from a district, a chain, a geographical area) were offered the opportunity to develop an *Environmental Product Declaration* that can enhance the excellent environmental performances of their "average" product.

6. Conclusion

SMEs are to be considered a crucial target if policy makers really want to pursue sustainable development. The environmental problem does not fully emerge if one considers individual firms (although in some cases there can be serious impacts on local environments and

communities exerted by a single SME), but it pertains to their combined and cumulative impact across sectors. Therefore. these companies are responsible for a large share of business environmental impacts.

These observations have stimulated the development of the so-called "cluster approach" to manage the environmental issues of a large number of SMEs located in limited territorial areas. As above mentioned, this concept is not limited to the classical configuration of the industrial district (geographically confined industrial areas) but it also encompasses environmentally equipped production areas ("APEA"), or industrial parks up to the interactions along the supply chain.

For example, the Industrial District is a local system with the presence of a prevalent production activity carried out by a group of small independent firms highly specialized in different stages of the same production process. On the contrary, Production Areas represent an organizational model characterized by the territorial element but, unlike the District, they are concentrated in areas that are easier to define and circumscribe geographically, and do not necessarily show the presence of one or more specialised production sectors.

The networking approach allows enterprises to co-operate by identifying and assessing similar environmental aspects and by finding technological and operational solutions that can be applied to similar production processes and products, as well as by defining organisational structures suitable for the same kind of production cycles

In the APEA case, co-operation is facilitated by the 'physical contiguousness' and there are synergies both in improving the environmental impact on the same local eco-system, and in interacting and communicating with the same stakeholders (local population, authorities, etc.).

In some cases, a network was created among SMEs within a 'cluster' in order to foster information exchange and experience dissemination and to define and apply common solutions to similar environmental, technical and/or organisational problems, or to share environmental management resources (Iraldo & Frey, 2007). A specific kind of co-operation within a cluster of organisations takes place in the supply-chain: when a large customer is willing to support small suppliers in the EMS implementation process, then all the smaller organisations involved in the supply chain can greatly benefit from networking. This approach proved to be effective in some Member States such as Germany ("Konvoi" approach), Spain (co-operation in the tourism supply chain), Nordic Countries (Denmark and Sweden) but in particular in Italy, where by means of the so-called APO "Ambiti Produttivi Omogenei", it has shown its effectiveness in promoting the environmental compliance of SMEs.

Therefore, we collected some empirical cases to demonstrate how the innovative approach to environmental management called "cluster approach" can be an effective tool available to SMEs in order to improve their environmental performance and find innovative management solutions.

The goal for future research and experimental initiatives should be the development of the cluster approach and its structural inclusion in policy-making.

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