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Industrial Clusters and Environmental Management

Massimo Battaglia, Tiberio Daddi and Francesco Testa

1. Introduction

The "territorial approach" to Environmental Management began in the European context at the end of the Nineties [1, 2, 3]. These experimentations showed the possibility of a new application of the EMAS (Reg. EC/761/2001, modified today in the EC/1221/2009) requirements to territorial contexts in which many similar SMEs are "aggregated", and not only to a single organization or productive site. This interpretation lead to applications in industrial areas (a group of industrial companies located in a limited and constraintable area), but was not applicable as such to a wider territorial cluster [3, 4].

This wider applicability of EMAS gave the possibility of considering the Regulation a new available policy tool able to integrate the environmental managerial needs of enterprises (and in particular SMEs, suffering of a lack of human, technical and economic resources for the application of an Environmental Management System) and the interest of a Local Government to improve the environmental performances of a governed area [1, 5, 6, 7, 8, 9]. The adoption of EMSs represents a relevant opportunity for SMEs facing with challenges of globalization processes and the increased (and increasing) social attention and sensitiveness towards environmental protection [10, 11, 12]; on the other side, a new approach to territorial management is needed to overcome the limits showed by the traditional policy tools available for Local Governments, such as the Agenda 21 Local processes [13].

In this perspective, a "territorial" approach based on EMAS can be considered as a new opportunity to integrate industrial, territorial and environmental policies; in particular, this approach gains a great importance if we consider specific territorial and productive systems, known as *industrial clusters[1] and districts*. These contexts are characterized by the presence of

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[1] Clusters have been officially defined by the Final Report of European Commission Export Group on enterprise clusters and network as follows: *"groups of independent companies and associated institutions that are collaborating and*

a large number of SMEs operating in the same productive sector and characterized by specific technical and social relationships among private and public actors. The cluster "organizational structure" and entrepreneurial culture is characterized by the presence of systematic business and non-business relations among the local actors, sharing technical solutions for integrating the processes and technologies in a common value vision [14, 15, 16, 17, 18, 19]. Also in an "environmental management" perspective, within these territorial agglomerations the high concentration of similar pollutant production processes of industrial activities causes similar and increasing environmental problems: firms in an industrial cluster, because of operating in the same sector, affect in a cumulative way the same local ecosystem, get environmental pressures on the same targets, and interact with the same local communities and authorities. In order to limit and efficiently manage their impacts, enterprises (mostly SMEs) operating in industrial clusters tend to cooperate strictly amongst themselves and with the other local stakeholders (local authorities, local trade associations, and other local intermediary institutions) [1, 3, 20, 21, 22].

On the basis of these premises, a new model of diffusion of voluntary management tools has been developed (named cluster approach), involving also (but not only) the environmental dimension [23, 24]. Specifically, in this contribution the proposed methodology fosters a co-operative and integrated approach for environmental management at the cluster level, based on the relationships existing between territorial environmental performances and proximity between firms and other local actors and stakeholders. This approach encompasses the implementation of the different steps foreseen by the EMAS Regulation at the cluster level [3, 4]; in particular the foreseen phases are the following:

a. set up of a *Promotion Committee*, coordinating environmental management initiatives of the different local actors and driving all planning actions at the cluster level; this must be representative of all the relevant public and sectorial interests of the cluster

b. carrying out a *Cluster Environmental Review*, identifying and assessing the main environmental criticalities of the cluster, by a territorial, sectorial and perceptive points of view

c. definition by Committee, of a *Cluster Environmental Policy*, identifying the commitment towards the continual improvement of the environmental performances within the cluster; elaboration of a *Cluster Environmental Programme*, based on the results of the Cluster Environmental Review, containing the concrete and measurable commitments for carrying out strategic and high-priority intervention for the cluster

d. promotion of collective initiatives addressed to local actors (SMEs, Local Authorities, suppliers, etc.) aimed at satisfying the commitments of the shared Programme.

The first step concerns the *creation of a Promotion Committee*, able to co-ordinate and integrate environmental issues within the cluster. This Committee must favor the synergies and

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competing; geographically concentrated in one or several regions, even though the cluster may have global extensions, specialized in a particular field, linked by common technologies and skills, either science-based or traditional; clusters can be either institutionalized (they have a proper cluster manager) or non-institutionalized. The cluster has a positive influence on: innovation and competitiveness, skill formation and information and growth and long-term business dynamics".

coordination among the different local actors. The Promotion Committee identifies the priorities, the main actions for the improvement and the possible ways of their implementation; it should express the main public and private interests existing in the cluster. The members of the Committee should be the representatives of all the relevant public bodies involved in the environmental regulation and control (such as the Local Government carrying out territorial planning and local Agencies for the Environmental Protection) and the representatives of SMEs operating in the local productive sector (such as trade associations or local consortia of enterprises), legitimated to act on their behalf as a whole. The Committee should fix specific rules concerning, at least, the appointment of its members, the decision making process and the organisational rules guaranteeing the active role of the Committee. These rules should be formalized in a voluntary agreement signed by the members of the Committee.

The second step consists in carrying out a *Cluster Environmental Review* by the Promotion Committee. It should represent a useful tool for SMEs operating in the cluster, to support them in the identification of the environmental aspects that are important for them. represent a useful tool for SMEs operating in the cluster, to support them in the identification of the environmental aspects that are important for them. An effective and satisfying Cluster Environmental Review should provide a thorough and in-depth description of the cluster territorial area, both from a geo-morphological point of view and from a socio – economic one, identify the main environmental problems of the area, analyse the local production processes, evaluate all the environmental aspects directly and indirectly linked with each phase of these processes, and, finally, provide an overall picture of the projects and initiatives carried out up to that time. The evaluation process aims at identifying the main critical environmental aspects characterizing the cluster area and measuring the contribution of the characterizing productive sector in terms of pressure exerted on the environment. From this point of view it's important to focus on the role of the Promotion Committee in fixing the criteria for evaluating the local environmental aspects and establishing the weight of each one in the final algorithm. Because of this, the evaluation process is the result of a multicriteria analysis [25, 26], in which the opinions of the participants of the Promotion Committee can influence significantly the final result and the following planning phase.

The following step in the "cluster approach" to environmental management concerns the drafting of a *Cluster Environmental Policy* that includes the commitment of all the main local actors towards the continuous improvement of the environmental performances within the cluster. This Policy is developed by the Promotion Committee and has to be strictly consistent with the territorial and sectorial contexts and based on the results emerged by the previous evaluation process. The Cluster Environmental Policy is the milestone for all the environmental actions to be carried out in the cluster, and the point of reference for the policies to be drafted by every company operating in the cluster interested to contribute to these actions. On the basis of the Environmental Policy, a *Cluster Environmental Programme* is subsequently elaborated by the Promotion Committee. The Programme details the commitments for carrying out strategic actions for environmental improvement in the

cluster. Such a Programme establishes these actions at the operational level and contains the detailed planning for their implementation. The Programme should be continuously monitored, revised and updated.

The final step consists in the implementation of initiatives for a *Cluster Environmental Management*; in order to achieve the Programme targets and objectives, the Promotion Committee can promote and implement a number of managerial, technical and organizational initiatives addressed to local actors. These cluster initiatives should consist both in direct implementation of tools addressed to local SMEs aiming at facilitating their single adhesion to EMAS requirements, and in developing and promoting activities aiming at monitor the compliance to targets and actions detailed in the Cluster Environmental Programme. This process should be implemented such as an Environmental Management System adopted by a single organization, with an orientation to a cyclic PCDA process based on checking the planned results and on monitoring, year after year, the real improvement of the local environmental performances.

2. Description of the case study

The described methodological approach was experimented in a pilot project co-financed by the European Commission (Environment GD), length 28 months and ended on February 2006, involving the Lucca paper Cluster. This project, named PIONEER project – "Paper Industry Operating in Network: an Experiment for EMAS Revision" (www.life-pioneer.info), was financed within the LIFE Action Programme. The methodology of the PIONEER project encompassed the implementation of the different steps foreseen by the EMAS Regulation at the cluster level, so to create a common basis for facing the local environmental problems and supporting all the individual organisations operating in the cluster that intended to use collective resources to achieve an individual EMAS Registration [3, 4]. The involved territorial area was the paper industrial cluster of Lucca, in the Tuscany region. This area is extended on a geographical surface of 750 km2, including the territories governed by 12 Municipalities. More than 100 companies, located in this area, operate in the local sectorial supply-chain (most of which SMEs), with a high level of aggregation, a considerable density per km2 and with an occupational capability of more than 5.000 employees. In this area, concentrating more than 80% of the Italian production of tissue paper, the industrial activities are deeply rooted in the social and institutional local context, and the production sites are mixed and integrated with many other civil, commercial, logistic, administrative and services activities.

The first step was the set up of a Promotion Committee for EMAS, aiming at designing and implementing an Environmental Management System for the paper cluster. The members of the Lucca Cluster Committee are:

- *Lucca Province – Environmental Department*, expression of the public interests and representative of citizens; the Lucca Province was the applicant of the project, too.
- *Association of the Industrials in the Lucca Province*, expression of the private interests and representative of local paper producers

- *Coordination organism of the paper Lucca Cluster*, an NGO representative of local paper industry and expression of the Lucca cluster development policies.

Powers, responsibilities and functioning rules of the Committee have been fixed in an official statute signed by all its members.

After constituting the Promotion Committee and detailing the powers, its first action was the Cluster Environmental Review; it focused on three levels of analysis:

- *first*: identification and assessment of the environmental problems and territorial criticalities of the area (by use of a specific set of environmental territorial Performance Indicators)
- *second*: focused on the industrial activities characterizing the cluster and the environmental impacts connected with their productive processes (by use of a specific set of environmental sectorial Performance Indicators); in particular by means of specific questionnaires addressed to the paper firms located in the cluster, all their environmental performances were measured
- *third*: survey about the environmental perception of local communities (carried out by means of questionnaires and directed towards a representative sample of the adult population of the investigated area); the survey aimed at giving an analytic framework and an evaluation of the environmental problems perceived by the local communities, of the way these problems are perceived, of the expectations the local communities show towards the economic, social and institutional actors operating in the territory.

After the previous data and information collection, a methodology of evaluation was prepared. The criteria of evaluation were the following ones:

- level of legislative compliance in respect to national and EU standards and limits
- inter-temporal trend of selected environmental indicators
- territorial and sectorial benchmarking
- results of the survey about the environmental perception of local communities

These criteria were applied to the different levels of analysis, and by the integration of the results a list of significant cluster environmental aspects was drafted.

In the following paragraph a focus concerning the indicators used in the "Cluster Environmental Review" and the evaluation methodology will be proposed.

On the basis of the Analysis results, a Cluster Environmental Policy was defined by the Promotion Committee; this Policy has been shared by the Agenda 21 Local Forum and formally approved by all members of the Committee on the 24th of September 2004 .

On the basis of the principles fixed in the Policy, a Lucca Cluster Environmental Programme was defined by the Promotion Committee; this Programme included 17 objectives and 50 detailed targets and was formally approved on March 2005.

The Lucca Cluster Environmental Programme specifies the following items:

- *Objectives*: medium–term targets referred to the cluster territory, aiming at improving the Cluster most significant environmental aspects
- *Targets*: short–term targets, consistent with the objectives, that are quantified and measurable whenever possible, and clarifies the implementation responsibilities for the actors operating in the cluster
- *Actions and sub – actions*: the Programme design in detail the activities to be carried out in order to achieve the foreseen objectives and targets
- *Resources*: definition of the human, economic and technical resources that are necessary to carry out each action
- *Timetable*: specification of the deadlines for each objective and target
- *Actors involved*: definition of the local actors (institutional or private ones, single companies or their consortia, etc.) that should be involved in carrying out the described actions for each target

The Lucca Cluster Environmental Programme was formalized by one voluntary agreement among all the most representative actors of the cluster who will be in charge of the fulfilment of the targets and objectives.

The following step of the project regarded the implementation of initiatives for the Lucca Environmental Cluster Management System. The main actions developed during the project can be summarised as follows:

- definition, documentation and communication of the organisational structure and of responsibilities, in order to improve the environmental management of the Lucca industrial cluster and make it more effective
- identification of the possibilities to improve the collective and co-operative management of the industrial operations, commercial, logistic activities and services (environmental pressures) linked with the significant environmental aspects for the territorial cluster
- definition and adoption of managerial and organisational procedures that can be shared and diffused to the different local actors (such as: emergency plan for the whole cluster, system of qualification of the paper industry suppliers on the basis of environmentally sound criteria, definition and updating of a register of all the relevant environmental laws for the local production, etc.)
- training and information initiatives within the Cluster EMS addressed to private and public actors;
- definition of procedures for favouring stable communication flows and exchange of information among the local actors
- planning and carrying out of auditing initiatives at the cluster level addressed to the whole *Cluster Environmental Management System* and to sample organizations, with the aim of evaluating their efficiency and, above all, effectiveness (compliance to legislation, to environmental standard of management and to planned objectives and targets)

During all the previously described process, a very relevant role was represented by the definition of a basket of Cluster Key Performance Indicators; these indicators were, at first,

defined in the first phase of the process (during the *Cluster Environmental Review*) by the Promotion Committee for evaluating the local environmental performances, and then they were inserted in the local environmental performance monitoring procedure. In the next paragraphs a particular attention will be focused on the process adopted in the PIONEER project by the Promotion Committee for selecting the indicators in the Cluster Environmental Review and for the identification of the most critical local environmental aspects (multi criteria methodology for the evaluation process); moreover a framework of environmental performances at local level measured by the selected indicators will be detailed.

3. Focus on cluster environmental indicators

The first phase of the process of adhesion to EMAS for a single organization is the occasion for evaluating the level of its impacts on environment and identifying the priorities of action in terms of improvement of environmental performances. In accordance with the EMAS Regulation requirements, in the Environmental Review each single organization has to analyze its territorial context and the environmental issues characterizing the area; moreover the single organization, for each phase of its productive process, has to identify the connected environmental aspects and to evaluate their significance on the basis of specific defined evaluation criteria. These criteria have to be objective, repeatable and they have to consider the views of interested parties.

These requirements, in the cluster approach to EMAS, can be satisfied by the application of a specific objective methodology, shared by the members of the Promotion Committee, able to interpret the environmental significant aspects from territorial and sectorial points of view (evaluated also on the basis of the points of view of the stakeholders) [27, 28].

The first step of the PIONEER approach was a detailed environmental analysis of the local territorial context and subsequent selection of State indicators representative of the whole cluster area; the considered territorial aspects were: quality of air, water pollution, water availability, levels of wastes production, level of energy consumption, biodiversity, traffic and mobility, soil pollution, electromagnetism, noise pollution. For each aspect a specific set of performance indicators was selected; this selection was carried out by the Promotion Committee on the basis of the existing methodologies of environmental reporting and analysis (OCSE, United Nations, European Commission, Global Reporting Initiatives) [29].

Table 1 shows the territorial indicators used in the PIONEER project (with indication of the environmental issue and its unit of measurement).

These indicators were used by the Promotion Committee for drafting the Cluster Environmental Review; later on, in the phase of implementation of the cluster managerial activities, they were inserted in the Cluster Monitoring System (with a triennial term for monitoring them).

At the same time, the second level analysis started; a data collection process was implemented by the Promotion Committee with the aim of selecting a basket of sectorial performance indicators.

Issue	Selected indicators	Unit of measurement
Quality of air	- Annual average concentrations : CO, NO₂, PM10, O₃ (last three years)	CO: mg/mc ; NO₂: µg/mc PM10: µg/mc ; O₃: µg/mc
	- N° of events exceeding the levels of standard quality (for each year): CO, NO₂, PM10, O₃	Number per year
	- Biomonitoring process results: *Index of Air Purity*	% of territory with IAP < 25,5
	- Emission on air (CO, PTS, NOx)	T/kmq
Noise	- n°of municipalities with approved acoustic classification of the territory	% of classified territory
	- levels of noise monitored in the last three years	diurnal and nocturnal levels of dB(A) monitored
Electroma-gnetism	- Levels of electic field monitored in the last three years	V/m
	- Levels of electromagnetic induction monitored in the last three years	µT
	- Number of new radio stations installed in each municipality	N° for each year
Energy	- Pro – capite consumption of electric energy	kWh/inhabitant
	- Pro – capite consumption of LPG	l/ inhabitant
	- Pro – capite consumption of green petrol	l/ inhabitant
	- Pro – capite consumption of methane	mc/ inhabitant
	- Pro – capite consumption of diesel gas	l/ inhabitant
	- Pro – capite consumption of combustible oil	kg/ inhabitant
Water availability	- Levels of water stratum	m/year
	- Pro – capite water pickings and consumptions	mc/ inhabitant
Quality of subterranean water	- N° of events exceeding the levels of standard quality (for each year): chlorides, ammonium ion, nitrates	N°/year
	- N° of events exceeding the levels of standard quality (for each year): trichloroethylene.	N°/year
	- Annual average concentrations : chlorides, ammonium ion, nitrates, trichloroethylene	µg/l e mg/l

Issue	Selected indicators	Unit of measurement
	- Environmental State of Subterranean Water	ESSW Index
Use of soil	- Ratio between used agricultural surface and total agricultural one	%
	- Built surface	%
	- Wooded surface in respect to the total one	%
Quality of surface water	- Chemical monitoring of the main cluster rivers	LIM Italian Index of quality
	- Biological monitoring of the main cluster rivers	IBE Italian Index of quality
Wastes	- Pro – capite urban wastes	Kg/ inhabitant
	- Differentiated level of wastes	%
	- Per employed special wastes	Kg/employed
	- Level of hazardous produced wastes	%
	- Level of recovered paper	%
Quality of soil and subsurface	- N° of industrial sites forced to reclamation (in respect to the total existing ones)	%
	- Surface of industrial sites forced to reclamation (in respect to the total one)	%
Biodiversity	- Protected areas	mq
	- Agroforestal biodiversity	Shannon index
Traffic and transportation	- Density of streets in the cluster	Km / Kmq
	- Motorization rate	N° cars*100/ inhabitants.
	- Territorial density of vehicles	N° vehicles/km of streets
	- Level of registered industrial vehicles	%

Source: Cluster Environmental Review, PIONEER project – *www.life-pioneer.info*

Table 1. Territorial indicators

The sector of reference was the paper one; a questionnaire concerning the environmental aspects and performances was sent to all paper firms operating in the Lucca cluster (with information concerning their emission to air, quality and quantity of their water discharges, typologies and quantities of produced wastes, water and raw materials consumptions, and so on). On the basis of the obtained answers (about 70% of sent questionnaires were compiled, representing more than 80% of the whole cluster paper production), the Promotion Committee, for each environmental aspect characterizing the paper productive

process, defined a basket of sectorial environmental performance indicators (many of these couched in terms of *coefficient of emission*). These indicators (as the territorial ones) were inserted in the monitoring plan defined by the Promotion Committee. In the following table environmental sectorial aspects and the selected indicators.

Environmental aspect	Selected indicators
Emission on air	• PM10 [kg/ton of produced paper] • CO [kg/ton of produced paper] • NO$_x$ [kg/ton of produced paper]
Noise	• Levels of max dB[A] monitored on the firm perimeter
Energy	• Annual consumptions of methane [mc/ton of produced paper] • Annual consumptions of electric energy [kWh/ton of produced paper]
Water consumption	• Specific water consumption [mc/ton of produced paper]
Effluents on water	• Specific water emission [mc/ton of produced paper] • BOD [kg/ton of produced paper] • COD [kg/ton of produced paper] • SST [kg/ton of produced paper] • Emission of N [kg/ton of produced paper] • Emission of P [kg/ton of produced paper] • Chloride [kg/ton of produced paper]
Hazardous materials	• mc of asbestos/number of employed • mc of asbestos/number of firms
Wastes	• Specific production of wastes [kg of wastes/ton of produced paper]
Transportation	• Number of IN-OUT vehicles/ton of produced paper
Raw materials consumption	• Chemical substances specific consumption [kg of chemical substances /ton of produced paper] • Virgin fiber specific consumption [ton/ton of produced paper] • Package specific consumption [kg /ton of produced paper]

Source: Cluster Environmental Review, PIONEER project – *www.life-pioneer.info*

Table 2. Selected sectorial indicators

The third phase, transversal to the previous ones, was characterized by a survey about environmental perception of local communities, with direct interviews to 700 cluster inhabitants. The survey focused on ways of perception of both environmental territorial issues and the entity of pressures produced on environment from paper enterprises. As academic literature shows [30, 31], for many environmental aspects a big difference exists between real risk and perceived one: in a territorial perspective, the community perception of environmental issues represents an interesting way for learning the "point of view of the

interested parties". Two questions addressed to citizens were used as criteria in the significance evaluation process of cluster environmental aspects and issues:

- Which are, in your opinion, the two most serious issues characterizing this territorial area?
- Which are, in your opinion, the two most significant environmental issues inducted by the large presence of enterprises operating in the paper industry?

Criterion of evaluation	Description of the criterion
Territorial section of the analysis	
Intertemporal trend of performances	Last three years trend of selected performance indicators
Comparison with overterritorial contexts	The comparison was carried out in respect to Regional and National performance
Comparison with quality standards and legislative limits	The comparison was carried in respect to standard legislation fixed by EU Directives and national laws
Results of survey about environmental perception	The question was: Which are, in your opinion, the two most serious issues characterizing this territorial area?
Indictments of citizens	The indictments of citizens to Public Authorities in the last three years represented another indirect indication of environmental perception of local communities.
Sectorial section of the analysis	
Intertemporal trend of performances	Last three years trend of selected performance indicators
Comparison with objective sectorial benchmark	The standards were: - Bref IPPC for paper industry - Ecolabel requirements for paper industry - Performance indicators concerning the paper industry (Environmental Assocarta Annual Report, SCA Group Environmental Report, data published by other paper clusters in Italy and Europe]
Presence of environmental laws concerning that specific environmental aspect	The legislative references were national and European ones
Results of survey about environmental perception	The question was: Which are, in your opinion, the two most significant environmental issues inducted by the large presence of enterprises operating in the paper industry?

Source: Cluster Environmental Review, PIONEER project – *www.life-pioneer.info*

Table 3. Criteria of evaluation

The first question was used as evaluation criterion in the territorial section of analysis; the second one was used as measure of perception of local communities of pressures produced by paper industry on environment. After selecting the performance indicators and

summarizing the results of the survey about environmental perception of local communities, the Promotion Committee fixed a list of evaluation criteria for the identified environmental issues and aspects. In the Table 3 the list of evaluation criteria adopted in the PIONEER project.

The Promotion Committee, after approving the previous criteria, defined the weights to assign to each criterion in the evaluation algorithms of environmental significance. The application of the alghoritms to the baskets of territorial and sectorial indicators gave as result the list of significant environmental aspects and issues of the cluster. The shared algorithms were the result of opinions and interests expressed by the members of the Promotion Committee (in its turn representative of public, private and sectorial local interests).

The last step of the assessment phase was the integration of results of significance concerning the territorial section of the cluster analysis with the results of the sectorial section, with the aim of obtaining a measure of the pressure produced by the paper industry on environment in the cluster. The scheme of integration is represented in Table 4.

Environmental aspect	Issue
Emission on air	Quality of air
Effluents on water	Quality of surface water
Energy consumptions	Energy
Water consumptions	Availability of water resources
Wastes	Wastes
Transportations	Traffic and transportation
Noise	Noise
Odours	Odours
Visual impact	Use of soil
Hazardous materials	Quality of soil and subsurface

Source: Cluster Environmental Review, PIONEER project – *www.life-pioneer.info*

Table 4. Correspondence table

On the basis of the emerged results by integration of environmental issues and aspects (also in this case the weight assigned to each dimension was the result of a shared process among members of the Promotion Committee), the Cluster Environmental Programme was drafted.

4. The monitoring system and trend of performances

After the end of the project (February 2006), at cluster level the activities continued and the local Promotion Committee pursued to carry out its ordinary activities. In the environmental monitoring procedure the Promotion Committee established to monitor the cluster environmental performances at least biennially. This monitoring system involves both issue indicators (representing local environmental conditions), and indicators related to

sectorial environmental aspects (representing the entity of environmental pressures from local paper enterprises). On the basis of the collected evidences, the Promotion Committee established initiatives to be acted at cluster level and the incidental new targets of improvement to be integrated within the Programme. Nevertheless, what relevant in this paper is not the framework of developed initiatives after the end of the project, but the trend of environmental performances characterizing the cluster from 2006 to today. This framework of performances has to be interpreted with respect both to local environmental conditions and to impacts of paper enterprises.

In the tables 5 and 6 we have selected in a synthetic way the trend of the monitored indicators from 2006 to 2011. The monitored indicators can be found in the "Updating charts of Lucca paper industrial cluster" available at www.life-pioneer.it. Last monitoring updating was November 2011; not all indicators are collected annually, and the trends refer to different periods.

Trends evaluation has been carried out by 5 different categories of data:

++   ➜ relevant improvement of the performance
+   ➜ slight improvement of the performance
=   ➜ steady condition
-     ➜ slight decrease of the performance
--   ➜ relevant decrease of the performance

Issue	Selected indicators	Period	Trend of performance	Comments
Quality of air	Annual average concentrations	2006 - 2010	+	General improvement of performance
	N° of events exceeding the levels of standard quality	2006 - 2010	+	
	Biomonitoring process results	Not monitored	/	
	Emission on air	2005 - 2007	=	
Noise	N° of municipalities with approved acoustic classification	2006 - 2011	++	Relevant improvement
	Levels of noise monitored	2007 - 2010	+	
Electroma-gnetism	Levels of electric field monitored	2006 -2010	=	Initial situation already in compliance with regulation
	Levels of electromagnetic induction monitored	2006 -2010	=	
	Number of new radio stations	2006 - 2010	-	
Energy	Pro – capite consumption of electric energy	2003 - 2008	-	Steady situation (not critical)
	Pro – capite consumption of fuels	2003 - 2008	=	

Issue	Selected indicators	Period	Trend of performance	Comments
Water availability	Levels of water stratum	2006 - 2008	=	Steady situation (critical)
	Pro – capite water pickings	Not monitored		
Quality of subterranean water	N° of events exceeding the levels of standard quality	2006 - 2010	++	General improvement of performance
	Annual average concentrations	2006 - 2010	+	
	Environmental State of Subterranean Water	2007-2010	=	
Use of soil	Ratio between used agricultural surface and total one	Not monitored	/	Decrease of performance (but not critical)
	Built surface	Not monitored	/	
	Wooded surface in respect to the total one	2004 - 2007	-	
Quality of surface water	Chemical monitoring of the main cluster rivers	2006- 2008	=	General improvement of performance
	Biological monitoring of the main cluster rivers	2006 - 2011	+	
Wastes	Pro – capite urban wastes	2007 - 2010	+	General improvement of performance
	Differentiated level of wastes	2007 - 2010	++	
	Per employed special wastes	2007-2009	++	
	Level of hazardous produced wastes	2007-2009	=	
	Level of recovered special wastes	Not monitored	/	
Quality of soil and subsurface	N° of sites forced to reclamation	2006 - 2011	- -	Relevant decrease of performance
	Surface of industrial sites forced to reclamation	2006-2011	- -	
Biodiversity	Protected areas	2006-2011	=	Steady situation
	Agroforestal biodiversity	Not monitored	/	
Traffic and transportation	Density of streets in the cluster	Not monitored	/	Decrease of performance (critical aspect)
	Motorization rate	2006 – 2010	-	
	Territorial density of vehicles	Not monitored	/	
	Level of registered industrial vehicles	2006 – 2010	-	

Source: Updating charts of Lucca paper industrial cluster

Table 5. Trend of territorial performance indicators

Environmental aspect	Selected indicators	Period	Type of product		Comments
			Tissue	Packaging	
Emission on air	NOₓ [kg/ton of produced paper]	2006 - 2010	=	-	Steady situation, influenced by a decrease of production in the period
	CO [kg/ton of produced paper]		=	+	
	PM10 [kg/ton of produced paper]		-	/	
Noise	Levels of max dB[A] monitored on the firm perimeter	Not monitored	/	/	
Energy	Annual consumptions of methane [mc/ton of produced paper]	2006-2010	-	+	General steady situation
	Annual consumptions of electric energy [kWh/ton of produced paper]		+	-	
Water consumption	Specific water consumption [mc/ton of produced paper]	2006-2010	- -	=	Worse performance, influenced by a decrease of production
Effluents on water	BOD [kg/ton of produced paper]	2006-2010	-	+	General steady situation
	COD [kg/ton of produced paper]		=	=	
	SST [kg/ton of produced paper]		=	+	
	Emission of N [kg/ton of produced paper]		=	-	
	Emission of P [kg/ton of produced paper]		=	=	
	Chloride [kg/ton of produced paper]		=	-	

Environmental aspect	Selected indicators	Period	Type of product		Comments
			Tissue	Packaging	
Hazardous materials	- mc of asbestos/number of employed - mc of asbestos/number of firms	Not monitored	/	/	
Wastes	Specific production of wastes [kg of wastes/ton of produced paper]	2006-2010	+	=	General steady situation
Transportation	Number of IN-OUT vehicles/ton of produced paper	Not monitored	/	/	
Raw materials consumption	Chemical substances specific consumption [kg of chemical substances /ton of produced paper]	2006 – 2010	-	-	Light decrease of performance
	Virgin fiber specific consumption [ton/ton of produced paper]		+	/	
	Package specific consumption [kg /ton of produced paper]		/	=	

Source: Updating charts of Lucca paper industrial cluster

Table 6. Trend of sectorial performance indicatorS

Data show an orientation to improvement of environmental conditions at cluster level, with respect to local cluster conditions (the only one decreasing datum refers to quality of soils and subsurface). On the contrary, with respect to data related to paper industry performances, we have a general steady of performances in the period 2006-2010, by the way in a period characterized by recession and decrease of productions.

5. Conclusions

From the PIONEER experience we can draw two different levels of conclusions; the first one (technical) regards the specific results obtained by the PIONEER project, while the second one regards the fallouts of the proposed methodological approach on territorial clusters and its reproducibility in other territorial and sectorial contexts.

From the first point of view, the PIONEER project produced results in terms of a high participation in EMAS by a relevant number of organisations; in fact, within the end of the project, 18 organizations obtained the individual EMAS Registration and, since 2007, the Promotion Committee obtained the award promoted by the Italian Competent Body for industrial clusters with a well implemented process for simplification of EMAS registration of local SMEs. Moreover, as described in the previous paragraph, local environmental conditions improved and pressures of enterprises (although in a recession phase) didn't increase.

From the second point of view, the comparison with other EU territorial contexts showed an high potential of transferability of the methodological approach; in fact, the PIONEER experience showed that there is a high number of synergies that can be obtained at the managerial and technological level to promote the inclusion and diffusion of innovative elements based on the partnership between the different firms operating within the same area. It is a question of exploiting the "co-opetition" attitude (co-operation between firms which also compete) and the collaboration between the enterprises and the other economic and institutional actors. These issues are the same for every industrial cluster, making the project methodology reproducible in each of these homogenous areas, characterizing the productive systems of many EU countries, in Italy, Spain, Portugal, Denmark, France, Finland and the UK. Moreover the project showed the operational feasibility of the methodological approach previously described, fostering an innovative approach to decision-making, based on multistakeholder involvement. According to this approach, EMAS has become a real territorial policy instrument, able to integrate industrial development targets and environmental quality ones, with a key–role played by the Promotion Committee.

Author details

Massimo Battaglia
Scuola Superiore Sant'Anna, Institute of Management, Pisa, Italy

Tiberio Daddi* and Francesco Testa
Sant'Anna School of Advanced Studies, Pisa, Italy

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* Corresponding Author

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