CHALLENGES AND LIMITATIONS IN THE PLANNING AND MANAGEMENT OF SUSTAINABLE INDUSTRIAL AREAS

Ruiz M.C.
Fernández I.

Universidad de Cantabria

Abstract
The planning of an industrial park is a complicated process and a number of stakeholders are concerned. Basic and added value services must be guaranteed to be competitive, especially when sustainable industrial areas are dealt with. Currently in Spain, the management of industrial areas hardly exists due to the lack of a manager able to conserve the existing infrastructures and offer modern services. This work aim at analysing the types of stakeholders involved and management forms set to develop and industrial area. Taking this framework, new roles, opportunities and risks have been established for building up sustainable industrial areas.

Keywords: management, industrial areas, sustainability

1 INTRODUCTION

1.1 Agents involved
The development and performance of any type of industrial area requires the participation and collaboration of different organisms that are internal and external to the community where it is situated. The industrial area community is comprised of the social, environmental and economic system where it is located. This community is the source of the labour required for the area to work; it may also be a source of resources, and is the one most affected by the environmental impact of the new industrial park at a local level. Regarding the organisms external to the community, these are companies that establish relationships with the industrial park members to promote exchanges of resources, services and information that are beneficial to both parties.

The internal organisms of the community where the area is installed and their main goals are:

Administration. The goals may include reduction of the unemployment rate, increase of income from taxes or improvement of local environmental conditions. The Administration may work from the central, autonomous and local levels.

Population. The aims include achieving good working, education and income conditions and improvement of environmental quality. The workers offer their labour and skills to attain these aims.

Other companies. Their aim is to establish relations with the industrial area, the result of which will allow them to obtain mutual benefit in the exchange of goods and services.

Industrial area. The aim varies depending on the perspective of the companies that make up the industrial area, of the developer or the manager. When the developer’s function is limited to the development and marketing of the plots, his main aim is economic benefit. However, in the case of companies and managers, their aim may be, in addition to socio-economic benefits, to attain an equilibrium with the surrounding
area that guarantees a better quality of life for the population and feasibility and future growth of the industrial area. In order to achieve these aims the infrastructures, buildings and services of the park must be designed efficiently by the companies that are installed, developers and managers. The developers and managers of the industrial area may be public or private.

2 FORMS OF MANAGEMENT

Areas given over to industrial parks usually offer services of public lighting, waste collection, water, electricity and telephone outlets on the different plots available. Once the park is built and the different plots have been sold or partially or fully rented, companies begin their activities. The park operations entail that in time maintenance of the infrastructures is required in order to guarantee the correct performance of the different businesses located there. However, it is quite common that by then the developer company has already become disassociated from the park. This situation leads to management being non-existent and the companies installed in these parks are not very competitive as opposed to others that do have all of the basic infrastructures and even additional services.

Diversity and quality of the services has become an essential requirement for modern parks. Additional services, which until recently had been implemented in a fashion parallel to their growth, have become today an important part of the package offered by industrial locations. The services offered in a modern industrial area could be classified in a first category of general communal services, a second category of optional services (advanced telecommunications, personalized maintenance, labour and legal advisory, leisure, bank services, logistics…) and a third emerging type of service for parks that are governed by industrial ecology principles. These services comprise environmental information systems, communal infrastructures and sustainable park management.

The provision and maintenance of these complementary services become an important requirement for the park to be attractive as an area for a company to locate to. The organism in charge of management is an essential figure for promoting relations between the enterprises and improving their competitiveness. Therefore different management forms are presented and summarised in Figure 1.

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Figure 1 Management options for industrial areas.
In the United States and in Europe the most common management forms are private and public-private. However, private management in all of its forms has gained substantially in importance in recent years. In the particular case of Spain, the implementation of management organisms in industrial areas is quite poor. In the cases where there is a managing organism, it is usually public or public-private. Although the creation of partnerships comprising the companies located in the industrial area is a growing initiative, its implementation is still rare, and is limited solely to parks of a certain size. Tables 1, 2 and 3 show this evolution.
<table>
<thead>
<tr>
<th>AGENT</th>
<th>LOCATION AND TENDENCY</th>
<th>EXAMPLES</th>
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<tbody>
<tr>
<td></td>
<td>Europe</td>
<td>Juntc10N Industrial Park Management Company Limited (England)</td>
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<td></td>
<td></td>
<td><a href="http://www.ukdata.com/">http://www.ukdata.com/</a></td>
</tr>
<tr>
<td></td>
<td>Spain</td>
<td>Nuon IP, (Germany and The Netherlands) <a href="http://www.nuon-ipm.de/?changelang=4">http://www.nuon-ipm.de/?changelang=4</a></td>
</tr>
<tr>
<td>Developer company</td>
<td>USA</td>
<td>IO Group (Engalnd) <a href="http://www.iog.co.uk/iog-industrial-property/">http://www.iog.co.uk/iog-industrial-property/</a></td>
</tr>
<tr>
<td></td>
<td>Spain</td>
<td>Infraserv (Germany) <a href="http://www.infraserv.com/en/ish_home.htm">http://www.infraserv.com/en/ish_home.htm</a></td>
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<td>iO Lar Grosvenor (Spain) <a href="http://www.iolargrosvenor.com/IOLG/index.html">http://www.iolargrosvenor.com/IOLG/index.html</a></td>
</tr>
<tr>
<td></td>
<td>Europe</td>
<td>ADECA (Asociación de Empresarios de Campollano, Albacete) <a href="http://www.adeca.com/">http://www.adeca.com/</a></td>
</tr>
<tr>
<td></td>
<td>Spain</td>
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Table 1 Private management.

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**LEGEND**

Performance grade
- **Green**: High
- **Yellow**: Medium
- **Red**: Low
- **White**: No-existent

Tendency
- **Blue**: Increase
- **Pink**: Decrease

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### AGENTS

#### LOCATION AND TENDENCY

<table>
<thead>
<tr>
<th>Performance grade</th>
<th>Tendency</th>
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</table>

#### EXAMPLES

**Incorporation of a Management company (public organism + businesses)**

- **USA**
  - ENDECO, Entidad de Conservación del Polígono Industrial Oeste, Murcia (Spain) ([http://www.endeco.org/](http://www.endeco.org/))
  - Livernois Industrial Park Association (USA) ([http://www.setenterprises.com/ceo.shtml](http://www.setenterprises.com/ceo.shtml))

- **Spain**
  - Entidad Urbanística de Conservación de “Elche, Parque industrial” (Spain) ([http://www.elcheparqueindustrial.com](http://www.elcheparqueindustrial.com))
  - Central Place Industrial Park (USA) ([http://www.dmoed.org/whats_hap/industrial.html](http://www.dmoed.org/whats_hap/industrial.html))

**Indirect participation of public organism (subsidies)**

- **USA**
  - Community of Murcia (Spain) ([http://www.ifrm-murcia.es/contenido/servicios/desempresarial/desarrollo.html](http://www.ifrm-murcia.es/contenido/servicios/desempresarial/desarrollo.html))

- **Europe**
  - Polígono Industrial de Cross, Camargo Municipality (Spain) ([http://www.aytacamargo.org/](http://www.aytacamargo.org/))

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**Tabla 2 Public-private management.**

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**Tabla 3 Public Management.**

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3 DEVELOPMENT AND MANAGEMENT OF SUSTAINABLE INDUSTRIAL AREAS

3.1 Functions of agents involved

Collaboration and coordination of the organisms is the predominant feature in the planning of EIPs. Table 4 summarises the functions and responsibilities entailed in addressing a strategy of this type for the organisms involved. Prior experiences have proven the essential role of Universities and Technological Centres as active agents in the design and simulation of proposals and in bringing together the interests of all the parties involved. For example, the Management Faculty of the University of Dalhousie (Halifax) studied the Burnside Industrial Park (Dartmouth) to develop the principles, guidelines and strategies for its rehabilitation into an eco-industrial park (Côte & Hall 1995, Peck and Associates & Dalhousie University 1997). Other examples are the cases of the Environmental and Political Studies Department of the University of Utrecht (Lowe 2001), Industrial Ecology Centre of the University of Yale (Harper & Graedel 2004) or the Eco-planning and Development Institute of the University of Technology of Dalian (Zhu & Côte 2004).

Table 4 Functions of the organisms involved in the development of an EIP.

<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community where the industrial area is installed</td>
<td>Definition of the performance objectives of the industrial area. Establishment of environmental standards for the industrial area’s operation (limits on noise, smoke, dust, smells, vibration, lighting…). Search for industries suited to be located within the industrial area. Development of strategies for financing the industrial area. Increase of efficiency in land use, administrative procedures and development of environmental laws that increase flexibility for carrying out by-product exchanges. Financing of technological development and transfer programmes, in addition to providing the technical training required for their correct use.</td>
</tr>
<tr>
<td>Administration</td>
<td></td>
</tr>
<tr>
<td>Industrial area Developer</td>
<td>Choice of location that will maximise the economic and environmental benefits of the industrial area. Design of infrastructures within the industrial area that cater to the needs of the companies for specialised services. Design of industrial services that offer the necessary flexibility to allow the park to grow and evolve. Design of buildings that maximise energy and materials efficiency. Use of construction practices that are environmentally-friendly.</td>
</tr>
<tr>
<td>Manager</td>
<td>Guarantee the park’s future feasibility. Management of the design and process development. Maintain relationships between companies. Manage the park’s property and maintenance of the shared infrastructures and services.</td>
</tr>
<tr>
<td>Companies</td>
<td>Cost-profit analysis of the location within a sustainable industrial area. Selection of the companies to establish relationships with. Search for the most suitable technologies. Marketing activities towards clients and the general public on belonging to a sustainable industrial area.</td>
</tr>
<tr>
<td>Population</td>
<td>Offer their labour, skills and cooperation.</td>
</tr>
<tr>
<td>Other companies</td>
<td>Establish cooperation relationships with the different organisms of the community (administration, industrial area, population and other businesses).</td>
</tr>
</tbody>
</table>

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3.2 Benefits and limitations of EIPs

Planning and development of an eco-park requires an in-depth study of the system and area of influence in each case. In general, however, a series of benefits and limitations can be identified (Lowe & Evans 1995, Tudor et al. 2007).

Benefits

The advantages can be classified as benefits for the industry, environment and society.

Benefits to Industry. An eco-industrial park offers the opportunity to decrease production costs through increased materials and energy efficiency, waste recycling and elimination of practices that incur regulatory penalties. Increased efficiency may also enable park members to produce more competitive products. In addition, the costs in which companies incur individually (costs for infrastructure, research and development and the cost of design and maintenance of sophisticated information systems) can also be shared between all of the companies in the park. The added value of the projects increases for developers and for the companies managing the park.

Benefits to the environment. This planning model of industrial park represents the establishment of sustainable development principles. Its own dynamics promotes innovation in systems for pollution prevention, energy efficiency, resource recovery and other environmental management technologies. Furthermore, and what may be the most important point, is that each park will serve as a working model for future eco-parks and other environmentally friendly forms of operation.

Benefits to society. Eco-industrial parks offer governments a laboratory for creation of policy and regulations that are more effective for the environment, while less burdensome to businesses. If joint operations between companies are achieved, this would make parks a powerful tool for economic development. At the same time, communities can benefit from the new jobs created in industrial plants that are much more environmentally friendly.

Limitations

The hurdles and limitations that have to be overcome refer to issues of coordination and communication between the organisms involved, technological factors, system fragility, financing capacity and definition framework.

Coordination and communication. The complex structure and the agents involved in the EIPs lead to difficulties in communication and coordination. These difficulties are mainly due to the fact that companies are separate entities, with different management and personnel structures, therefore their company values are different, as well as the way in which their employees relate and communicate. Among companies competition also prevails over cooperation, because they perceive the latter as a high increase in costs. On the other hand, industrial areas are conceived as isolated areas, not accessible to the public, which hinders cooperation between companies and the social environment that surrounds them.

Technological limitations. The establishment of materials and energy exchange networks may be greatly hindered by technological factors. The creation of symbiotic networks requires production processes of a modular design, which would allow improvements in the different stages of obtaining the product without having to modify the whole process. On the other hand, the production processes implemented by the companies were not designed with
the capacity to absorb the waste and energies from other processes, which hugely complicates the creation of exchanges.

Potential fragility of the system. The potential fragility of EIPs also hinders their development. A small industrial network is vulnerable to any company leaving or seeking other places for its materials/products, which could affect the functioning of the entire chain. One possible strategy to deal with this fragility could be diversification regarding suppliers and resources, so that the system could adapt quicker to the changes. In fact, a diverse system with a strong inter-sector cooperation is more sustainable. However, it might be quite complicated to achieve a large diversity because conflicts in values, preferences, interests and needs may arise, as well as an increase in transaction costs.

Market uncertainty. The closing of cycles (materials and energy) may be affected by fluctuations in the entry price or by its substitute or by changes in the markets, entries to the industrial process or in production/purifying technologies. The political climate and the lack of guarantees that demand for a specific product will remain constant over time may also be decisive factors.

Financing capacity. The differences between developed and developing countries, regarding availability of resources and economic-environmental policies have an impact on the development of EIPs. For example, developing countries, due to their financial limitations, have tended to partner with agencies such as the UNDP (United Nations Development Programme) and UNEP (United Nations Environmental Programme) to develop their EIPs. Access to financing is obviously an important aspect in the starting up and continuity of EIPs. Legislation also tends to vary from country to country, and this is the case of the countries signing the Kyoto Protocol on climate change. Consequently, environmental strategies and incentives aimed at changing resource management also vary from country to country. Having the necessary legal instruments as well as political support are important aspects in the creation of the optimal climate for development of EIPs. We can thus conclude that the EIP models should be adapted to each country.

Responsibility and awareness. Lastly, the lack of precise definitions that mark what industrial development is and the functions proper to the different organisms involved are restrictive aspects, as well as the lack of knowledge on the potential of industrial ecology and of technologies, practices and management systems that should be implemented in the planning, development, management and operation stages of EIPs.

If these barriers and limitations are to be overcome, joint efforts between the industry and its environs must be made, so that all of the organisms participating in the development and operation of an EIP are fully integrated. At present there is limited knowledge on these concepts, as well as a certain dislike of the idea of establishing exchanges between companies and commercial or residential areas, therefore it is necessary to work on showing companies and the general public the many advantages of this new concept of industrial park. Lastly, it is important to highlight that although it is possible to learn from the development of other industrial ecosystems, each one has its own particularities regarding social, economic, cultural and ecological aspects that are not easily extrapolated.

4 CONCLUSIONS

Changes towards a new development model of sustainable industrial areas are not easy and they require a firm commitment based on knowledge and joint work of all the agents.
involved. Planning and design of eco-industrial parks and transformation of the existing ones entail the development of new management models based on organization and cooperation. Administrations, developer organisms and managers of industrial parks currently face the challenge of joining forces to seek new formulas that make this possible. This is a basic and essential element to promote companies' competitiveness through the exchange of material resources, energy and information between the businesses comprised in the industrial area system.

REFERENCES


Contact:
Mª Carmen Ruiz Puente.
Grupo de Ingeniería y Gestión de Proyectos (INGEPRO)
Dpto. de Transportes y Tecnología de Proyectos y Procesos – Escuela Técnica Superior de Ingenieros Industriales y Telecomunicación – Universidad de Cantabria
Av. de Los Castros s/n 39005 Santander
Phone: +34 942 201789
Fax: + 34 924 201703
E-mail: ruizpm@unican.es