Methodology to form an Industrial Eco-system in the Municipality of Torrelavega (Northern Spain)

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Abstract

This contribution presents a methodology to form an Industrial Ecosystem in the industrialized municipality of Torrelavega (Northern Spain). The aim is to form a network of Industrial Symbiosis based on the exchange of waste/by-products among companies within the municipality. The industrial framework is formed of big companies and small to medium sized enterprises split into two sub-systems. Combining techniques of Industrial Ecology and Information and Communication Technology is at the core of the technical methodology. Information sheets and collection of information, digitalizing the compiled data, preliminary analysis of synergies and opportunities to improve the environment among the companies and geo-processing and spatial analysis are some of the main actions of the methodology. ICTs technologies offer many opportunities but also barriers in the progress of this work.

1. Introduction

The concept of Industrial Eco-systems aims to get a better match of industrial performance with ecological constraints, by means of the redesign of industrial systems as resemblance of the natural ones. This idea is suggested by the theory of Industrial Ecology (IE) (Lowe/Evans 1995). As Graedel and Allenby (2003) enounced, “this is the means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural, and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems view which one seeks to optimize the total materials cycle from virgin material extraction, (…), to ultimate disposal”. The Industrial Symbiosis (IS) is an area embedded in the field of Industrial Ecology, which develops the previous principles through the creation of cooperative networks. Its strategy is based on the exchange of wastes streams among companies, so the residual flows (material, water or energy) from one company become as feedstock for another. Thus, the decrease of waste generation and resource consumption is achieved as well, the improvement of the global efficiency (Lowe/Evans 1995, Chertow 2004).

This proposal aims to develop these concepts and strategies in an industrial municipality of the North of Spain, in order to improve the global operation of the area and reduce the environmental impacts, through business cooperation.

To carry out these strategies, the use of ICTs is needed. These allow a quick and effective collection and analysis of data. Due to the current limited development of specifics ICTs in Industrial Symbiosis (for instance, Presteo, IUWA, MatchMaker!) and the barriers such as the difficult accessibility to them, the language and the special codification for materials flows of each country, we have to adequate and address data bases and spreadsheets to the requirements of our study.

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For tackling this methodology we found some difficulties. The most important ones to carry out the objectives of the project are: contacts with companies in reporting and ordering information, the relationship between the various participants so that no internal distrust and management of ICTs.

2. Objectives and scope

The aim of this contribution is to present a methodology to form an Industrial Ecosystem based on the Industrial Symbiosis strategies. After the analysis of the industrial activities of a specific municipality, the main objective is to study the creation of exchange networks among companies, which allow the decrease of environmental impacts and business economic improvement. One of the objectives is assembling these two kinds of companies through this exchange network. This study is focused on the Municipality of Torrelavega (Northern Spain), which is an industrialized-intensive area. This industrial framework is split into two sub-systems. The first one is formed of capital intensive manufacturing companies and is concentrated in a complex industrial area (4 companies). The second group is made up by 160 small and medium sized enterprises (SMEs, companies with a workforce of between 1 and 250), which are spread across the municipality or located together at a business park. One of the objectives is assembling these two kinds of companies through the exchange network. The environmental synergies and business opportunities that arise among the two groups of companies are analyzed. Combining techniques of Industrial Ecology and Information and Communication Technology is at the core of the technical methodology.

3. Methodology

The proposed methodology is presented in three stages. The two first are common steps for the definition of the general framework. These stages are developed simultaneously. Then, last stage is approached from two perspectives, each one focused to each industrial sub-systems (big intensive factories, and SMEs).

3.1 Establishing synergies

From the scientific literature review about existing experiences of Industrial Symbiosis (Chertow 2004, CECP 2007), a list of possible synergies is elaborated, in order to analyze the potential opportunities in the studied area. The proposed list of synergies is classified according to three main groups defined by the team work:

- Synergies of mutuality: These practices consist on the shared use of common services, facilities or infrastructures for the participant companies.
- Synergies of substitution: These practices involve that the residual flows of one company becomes as substitute of raw materials for another company.
- Synergies of genesis: These strategies are related with the creation of a new activity to satisfy the need for any flow or company.

In order to specify the analysis, the different synergies are studied on to the flow of materials (raw materials, water, wastes, fuels and products), energy (electricity and heat) and auxiliary services (steam, compressed air, vacuum, cooling and inert gases). Furthermore, it was required the creation of indicators for each synergy. These indicators are a series of quantitative and qualitative parameters to detect preliminary synergies. These indicators were presented in the companies as specific questions.
3.2 Delimitation of the project

The other most important initial task of this project has been the creation of a database to gather all companies in the study area. Various sources of information have been consulted such as statistical institutes, public information companies such as Integrated Environmental Authorizations, which are mandatory for companies (Directive 2008/1/EC) for the prevention and integrated control of pollution. Other sources of information companies have been annual statements of producers of hazardous wastes, as well as the registration of non-hazardous waste inputs to landfills of Cantabria.

Database tools like Microsoft Office Excel and Access have been used to integrate all information gathered by the different sources. As a result, a list of companies was elaborated, in which the minimum information required for each company is the name of the company, the business sector (referenced to the National Code of Economic Activities (NCEA)), address, range of number of employees, as well as contact information, person contact, telephone and email address. From this complete list, the project was initially limited to the companies of the municipality of Torrelavega. Besides the elimination of companies which have no industrial activity related with this project.

After defining the first geographical boundaries of the project, the companies were georeferenced using Google Earth software. This program allows to observe the map with participant companies, and to deduce, where the largest concentration of companies are. The result showed that the largest concentration of companies was located in the industrial estates, although ailed sites with an important accumulation of companies were also found outside these estates. As a result, the project was defined to 4 large companies and 160 SME companies located in 7 industrial estates and 4 areas of high concentration of companies.

3.3 Making contact with companies/Information Inventory

For the different size among companies that we found, we have to develop two different strategies to tackle the problem of gathering the information about them. In the first case (large companies), we developed a questionnaire that asks a lot of detailed information because we assumed that they have their information organized. But in the second case (SMEs companies), a questionnaire which has two phases for collecting the information, was developed.

3.3.1 Large companies

In the delimitation of the project, it was found that 4 large companies are going to participate. The large companies belong to textile fabrics and as well as nonwoven fabrics, chemical, tyres and plastics. This type of company, due to its commercial activity and volume of business, acts as a catalyst for the Industrial Symbiosis network.

Before the taking of information, it was made a stage of design and planning information in order to ask the greatest volume of information accurately. In this stage a standard-business organization was developed as the work scheme. The scheme shows the general areas which compose a manufacturing company, for instance the production area, storage areas, auxiliary service among others, so that any information we receive can be adapted to this framework.

After this first stage, we went over to design a questionnaire in which we divide the information into different flows that interact within the company. The questionnaire was developed in an Excel spreadsheet in which we detailed the necessary information for each flow that companies should provide with the purpose of do so in an orderly manner and a once. After the design phase, the way to get the information on these companies was performed using a 2-week stay in each company. In the stays was tried to know internally the production system and different departments of production and services were visited, to collect the data to respond to the indicators mentioned above.
In order to have the information in a clean, clear and useful as possible for the next stage of the project, we discussed a strategy for presenting information, which in addition to understand it, it was intuitive enough that all participants could understand without any extra effort. For each company, the information compiled by means of the plot plant and the process flowsheets.

3.3.2 Small and medium enterprises SMEs

Unlike with large companies, there are about 160 SMEs and it was proceeded differently because it was not possible to stay in all of them. In the table 1 the distribution of the SMEs companies is showed by sector of industrial activity.

<table>
<thead>
<tr>
<th>National Code of Economic Activities</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of food products, beverages and tobacco</td>
<td>3</td>
</tr>
<tr>
<td>Manufacture of pulp, paper and paper products; publishing and printing</td>
<td>4</td>
</tr>
<tr>
<td>Manufacture of rubber and plastic products</td>
<td>1</td>
</tr>
<tr>
<td>Manufacture of wood and wood products</td>
<td>2</td>
</tr>
<tr>
<td>Manufacture of basic metals and fabricated metal products</td>
<td>17</td>
</tr>
<tr>
<td>Manufacture of other non-metallic mineral products</td>
<td>4</td>
</tr>
<tr>
<td>Manufacture of machinery and equipment not elsewhere classified</td>
<td>4</td>
</tr>
<tr>
<td>Manufacture of transport equipment</td>
<td>1</td>
</tr>
<tr>
<td>Manufacture of chemicals, chemical products and man-made fibres</td>
<td>2</td>
</tr>
<tr>
<td>Manufacturing not elsewhere classified</td>
<td>4</td>
</tr>
<tr>
<td>Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods</td>
<td>41</td>
</tr>
<tr>
<td>Construction</td>
<td>12</td>
</tr>
<tr>
<td>Transport, storage and communication</td>
<td>3</td>
</tr>
<tr>
<td>Real estate, renting and business activities</td>
<td>1</td>
</tr>
<tr>
<td>Other community, social and personal service activities</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1: Distribution of SME companies by type of industrial activity

A questionnaire to be submitted via web was elaborated. The questionnaire was divided into two parts. The first part consists of primary indicators, which are qualitative indicators, in which numerical information is not requested, only information relating to the possession of material, water and energy flows or services. The second part is the secondary indicators, which are the numerical data related to the primary indicators. This division into primary and secondary indicators attempt to prevent companies do not want to participate in the project for having to facilitate numerical data about what they have on their businesses. After receiving the primary indicators, a first selection of possible synergies could be detected. That is, qualitative indicators can already make a first approach to possible synergies could be established among the companies studied. Next, a second survey is sent, consisting of the quantitative information requested, where numerical data are ordered only on possible synergies identified with the primary indicators. For the survey of small and medium enterprises, a specific computer tool for designing questionnaires, Lime Survey, was used. To ensure a minimal participation of companies, sending surveys were conducted for the one hand by e-mail and the other hand, the surveys were conducted through an meeting with the company responsible.
3.4. Preliminary detection of synergies and spatial analysis

From the information collected, it was analyzed to identify opportunities for synergies among companies. Through the indicators for the detection of synergies that had been collected from the review of all experiences, potential synergies are proposed. This process compares the unit flows of different companies to identify synergies and to get a list of the potential ones. A own programming in Microsoft Office Excel was designed, from all data collected during visits to large companies and the questionnaires completed by the SMEs, to achieve a automated search for potential synergies.

Then the next stage is the prioritization of the most competitive synergies. One parameter that we can’t omit for the analysis is the georeferencing of the companies due to the distance among them because it allows or restrict the technical feasibility of the synergic opportunities.

4. Conclusions

The establishment of Industrial Symbiosis opportunities in the area of Torrelavega is promoted by the high industrial activity. The use of ICTs has facilitated the methodology implementation of the Industrial Symbiosis philosophy in our study area. Instead applying specific ICTs related to Industrial Symbiosis due to the disadvantages that we found in this study, we have elaborated a specific design for managing the collected data. On the one hand, ICTs help the work of collection, processing and analysis of information to adapt to our framework. Due to the large volume of information handled (unit flows of 160 different companies), the analysis of synergies would not be addressed without the use of these tools.

From this experience the necessity of ICTs and IS theories integration is deduced. Further work proposes the improvement of the applied tools in this work as well as their integral design and a more intuitive interface in order to detect the different synergic opportunities from a systemic way.

Bibliography


