Subsidies for the re-design of the industrial location in the Rio de Janeiro Metropolitan Region through cooperatives initiatives

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Abstract

The purpose of this paper is to indicate some initiatives ushering in changes in the configuration of the Rio de Janeiro Metropolitan Region Industrial Zoning System.

During the last twenty years, the Rio de Janeiro Metropolitan Region (RJMR) has suffered many modifications: a high urban concentration process, an increasing number of land conflicts, the construction of important highways and infrastructure devices and the growing deterioration of environmental quality. In this period, the industrial location was based on an industrial zoning developed in 1976. Today, the industrial settlement of the RJMR reflects its disorderly development, shown by tightly clustered industries outside industrial zones, as well as the use of areas defined as industrial zones for other purposes, mainly residential. This scenario clearly indicates that innovative management mechanisms must be sought, based on cooperative initiatives that are grounded on industrial ecology. Through the concepts relating industrial ecology and interfaces with environmental issues, this paper provides inputs for discussions of re-designing the location of industries in the RJMR. In order to demonstrate the application of the concepts outlined above, an Industrial District in the Rio de Janeiro Metropolitan Region was selected as a case study.
1 Introduction

In general, Metropolitan Regions in the developing countries feature a high level of industrial concentration, in parallel to increasingly dense populations, producing extremely high environmental pollution rates. The Rio de Janeiro Metropolitan Region (RJMR) is a well-known example of this situation. Today the RJMR extends over an area of 5,738 km², which includes nineteen districts with a total population of around eleven million.

In 1976, a study was carried out by the Metropolitan Region Development Foundation (FUNDREM - Fundação para o Desenvolvimento da Região Metropolitana) that defined the Industrial Zoning system for the Rio de Janeiro Metropolitan Region, regulated in 1981 through a State Law (FUNDREM [1]). Three types of industrial zones were identified: Strictly Industrial Usage Zones (ZEI), Predominantly Industrial Usage Zones (ZUPI) and Diversified Usage Zones (ZUD). The first two categories cover a total of 24,000 hectares (25% ZEI and 75% ZUPI).

According to the Industrial Registry of the State Environmental Engineering Foundation (FEEMA - Fundação Estadual de Engenharia do Meio Ambiente), which is the Rio de Janeiro State environment agency, the Rio de Janeiro Metropolitan Region currently has 850 industries located in 11 ZEIs and 45 ZUPIs defined through the zoning system.

The heaviest concentration of industries is found in the Rio de Janeiro Municipal District and the Eastern part of the RJMR around the Guanabara Bay, in regions that also post the highest levels of environmental saturation. The West region around the Sepetiba bay is less concentrated and less saturated in environmental terms. However, this region will probably undergo significant modifications due to the expansion of the Port of Sepetiba, which is planned as the largest port in Latin America.

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Problems related to industrial location in the Rio de Janeiro Metropolitan Region can be assigned mainly to:

- Adoption of an industrialization model based on traditional processing industries that generally have high pollutive potential;
- Fragmented administration that shut down the FUNDREM, with various planning tools defined for the RJMR being forgotten;
- Intensification of a disorderly population densification process, which is a phenomenon typical of Metropolitan Regions in the developing countries;
- Inability of the environmental management implemented in this Region to reverse or mitigate the levels of degradation.

As a result of this situation, the RJMR is today facing serious environmental problems that are not only affecting the quality of life in the region, but are also hobbling its development. Reversing this situation is certainly difficult and
probably long-term. However, it is well worthwhile analyzing the possibility of implementing some mechanisms that could help reshape the current configuration of industrial locations over short term, and that would help improve environmental quality.

2 Trends in environmental management

In historical terms, the track-record of Environmental Management and policy has been scarred by fierce clashes between public and private interests, jurisdictional conflicts within the State itself, and disputes between companies, the State and civil society. However, an acknowledgement of these problems by government authorities and the introduction of negotiating mechanisms has been neglected over the years, undermining the efficacy of environmental policies and weakening their results.

The concept of sustainable development was introduced in 1987 by the United Nations Report that was very appropriately entitled “Our Common Future” which was designed to foster a type “reconciliation” among the parties involved in these conflicts. Despite much talk about this term, we still today lack Environmental Management and policy tools and mechanisms that can effectively foster this “reconciliation”. This means that setting up partnerships and building up cooperative Environmental Management are still far from becoming a reality (see Meppem [2], Kapoor [3]).

This situation is very clear in Brazil, which launched its environmental policy in 1981 and is today quite outdated. This same situation is also noted in the more specific case of Rio de Janeiro State.

Only recently has it been possible to note some Federal and State initiatives that could be viewed as attempts – even if incipient – at negotiating and/or setting up partnerships.

In terms of negotiations, a recent initiative that has produced some good results in Rio de Janeiro State is the signature of Deeds of Environmental Commitment (TCA) by the environmental authorities and private enterprises. This tool was introduced by Provisional Measure 1949-24/00 under Brazil's Environmental Crimes Act (Federal 9,605/98), in order to allow companies to adapt to environmental requirements (Scheeffer [4]). Although rooted in a classic command and control instrument, these Deeds of Environmental Commitment have encouraged talks between the parties. Another less recent mechanism that paved the way for talks between companies and the public sector dates back to the 1980s and has been deployed at both the Federal and State levels. This is the Environmental Impact Assessment and the correlated Public Hearing mechanism. This is not the place to discuss the efficacy of these mechanisms (on this matter, see Magrini [5]) but it is nevertheless important to stress that although these initiatives are already in place, there is still no effective Environmental Management culture in practice that explicitly acknowledges the conflict and underpins negotiations that are more firmly structured. The use of techniques and/or procedures for dealing with these issues needs further encouragement (Bredariol and Magrini [6]).
In terms of setting up partnerships, Rio de Janeiro State is endowed with two mechanisms - PROCON-Ar and PROCON-Água – that consists of air and water control programs implemented by companies and monitored by the environmental authorities. Another tool is the Industrial Wastes Manifest System and the Waste Materials Exchange, which also constitute way of "sharing" activities with private enterprise that are normally handled only by the environmental authorities. Although most of these mechanisms were introduced during the late 1980s in order to cut costs and lighten the control burden on the State environmental authorities, within today's new context, their potential requires fresh dynamics in order to turn them into effective partnerships.

The recent introduction of Brazil's Water Resources Management Act (Federal Law No. 9,433/97) which is still at the regulation stage, may also constitute an advance in negotiating and setting up partnerships. By appointing the river basin as the core management unit, this new system can intervene in its management through various levels of government (Federal, State and Municipal) in addition to involving the many different users of the river basin through seats on the River Basin Committees. This Act also introduces new management tools that will certainly require negotiations and partnerships.

Figure 1 illustrates the dynamics of Environmental Management over the past thirty years. The traditional tools used by Government Environmental Management are listed on the left, as well as those implemented more recently through private Environmental Management activities. On the right, this Figure shows the forecast trends for the development of Environmental Management from the standpoint of acknowledging conflicts and negotiations through the use of structured techniques, setting up partnerships among different agents through introducing cooperative management tools and practices. Looking back over the development in Environmental Management over the past thirty years and analyzing the current context of State withdrawal from all economic activities, in parallel to the expansion of market forces, building up partnerships clearly seems to offer the most feasible way of achieving progress.

Outstanding among the cooperative environmental initiatives that seem feasible in the Rio de Janeiro Metropolitan Region are the Eco-Industrial Parks. This type of industrial system seems particularly appropriate to situations such as those portrayed by a Metropolitan Industrial Zoning diagnosis that indicates several industrial zones or clusters that are severely down graded from the environmental standpoint. Merely strengthening environmental controls by the State environmental authorities will not be sufficient to usher in an about-turn in the situation of degradation found in the Rio de Janeiro Metropolitan Region.

3 The principles of industrial ecology and industrial networks

Studying the links between industrial and economic systems with natural systems, Industrial Ecology attempts to fine-tune industrial activities in terms of economics, performance and environmental impact (Tavares [7]). Based on an
Figure 1: Environmental management dynamics.
analogy between biological systems and industrial systems, Industrial Ecology was defined by Graedel [8] as "the study of means through which humankind can deliberately and rationally seek and maintain a desired support capacity, assuming the ongoing development of economic, cultural and technological conditions; this concept requires that an industrial system be viewed not in isolation but rather together with its surroundings; this demands a systemic view that strives to optimize the global materials cycle from the raw materials through to the finished goods, including components, products, obsolete products and even final disposal".

The principles of Industrial Ecology and more specifically reducing pollution through swapping wastes materials among different activities have been used through certain initiatives: the Zero Emissions Research Initiative (ZERI), Ecologically Balanced Industrial Complexes, and Eco-Industrial Parks.

Eco-Industrial Parks are defined as units housing production activities and services that strive to achieve good economic and environmental performance through cooperative resource management. The tenants of these Parks work together in order to achieve collective benefits that are greater than the individual benefits that would be achieved if each company sought to optimize only its activities. These types of industrial groupings have been studies recently, with several experiments under way.

In order to provide input for drawing up an industrial location policy for the Rio de Janeiro Metropolitan Region, some international experiences in the implementation of these Parks are described below.

Named through an analogy with the symbiotic relationship between two organisms in Nature, industrial symbiosis at Kalundborg in Denmark consists of a cooperative network of enterprises that swap and sell their by-products among themselves.

Located some 75 miles from Copenhagen near the coast, this industrial ecosystem has been developing since the 1970s with no specific planning. It is a cooperative network linking five companies and the Kalundborg Council, with the following components:

- Asnaes Thermo-Power Station, fueled by coal and oil, with a capacity of 1,350 MW and 500 employees;
- Statoil Refinety with a crude processing capacity of 5.2 tons/year, the largest refinery in Denmark with 290 employees;
- Novo Nordik, a pharmaceutical and biotechnology enterprise producing insulin and industrial enzymes, with 1,400 employees;
- Bioteknisk Jordrens, one of the four plants in Denmark of a soil bioremediation company that cleans up land polluted by hydrocarbons (including polycyclic aromatics), chemical products and heavy metals, treating some 300,000 tons of oil-soaked soil a year; the Kalundborg plant has 35 employees;
- Gyproc, a plasterboard plant owned by the largest plasterboard company in Scandinavia with 180 employees;
The Kalundborg Town Council, which has been attracting heavy investments due to its development policy and the dynamics of its port, with a population of 20,000 inhabitants.

The main products retailed among the participants are: steam and heat, water, refinery gas, slaked calcium sulfate, biomass, fertilizer, fly-ash and water treatment.

The success achieved by Kalundborg is attributed by its participants (see http://www.symbiosis.dk [9]), basically to the following location criteria:

- The companies operate in an integrated manner, meaning a correct composition of enterprises in the area allows the wastes and by-products of some of them to be used as raw materials by others; this means that the diversity of the local industrial structure is a core pre-condition for implementing industrial symbiosis;
- The companies are located close together, with short distances speeding up swaps, particularly electricity, which would otherwise require high transmission infrastructure costs;
- The companies are very open, meaning within a relatively small context that is tightly located in space, they can build up good relationships and expertise among the various agents based on openness, communication and trust.

These types of industrial clusters have been studied, and several experiments are currently under way. In the USA, the Presidential Council for Sustainable Development (PCSD) set up a task force to implement Eco-Industrial Parks (EIPs) and set aside four locations in 1994 as demonstration Eco-Industrial Parks: Baltimore, Maryland; Cape Charles, Virginia; Brownsville, Texas; Chattanooga, Tennessee (Rosenthal, 1996). There are at least ten other initiatives currently under way, all in the USA. In Europe, particularly in Germany, Denmark, the UK, the Netherlands, France, Spain and Italy, as well as in Asia, South America and Africa, various Eco-Industrial Development Programs (EIP) are also being implemented.

4 Industrial Zoning in the Rio de Janeiro Metropolitan Region: Indications of a fresh look at industrial location

Based on earlier analyses, some initiatives may be mentioned that are clearly fostering changes in the industrial locations in the Rio de Janeiro Metropolitan Region. To do so, the Industrial Zoning System introduced in 1981 is taken as basis.

A recent study diagnosed the Metropolitan and Industrial Zoning System (Consortium COPPE/UFRJ-IBAM [10]), indicating the following results: nine zones show prospects for industrial expansion although not yet fully saturated from the environmental, town planning or location standpoint; seventeen offer no prospects for expansion with the use of four of them has been shifted to residential purposes and thirteen are effectively saturated from all points of view; thirty still offer possibilities for expansion, but are dependent on environmental, town planning and/or location-related aspects.
The nine zones (eight ZUPIs and one ZEI) that offer prospects for expansion could well house new industrial activities, provided that the necessary attention is paid to the weak points indicated in the diagnosis. According to trends noted in other Metropolitan Regions, it is suggested that high priority be assigned to introducing forms of production in these areas that focus on high-technology and consumer goods.

For the set of seventeen zones (sixteen ZUPIs and one ZEI) that offer no prospects for growth, it is suggested that immediate constraints be placed on industrial expansion, because even if the environmental conditions were to be upgraded and the environmental performance of these industries were to be improved, they are located in densely-settled urban areas that seem to offer no possibility of change over the short and medium terms. In this case, broader-ranging upgrade solutions should be sought for these regions, including deconcentration and/or industrial reconfiguration.

The set of zones requiring the most attention over the short term consists of the thirty zones (twenty one ZUPIs and nine ZEIs) that offer prospects for expansion, stressing environmental, town planning and/or location-related aspects. It is suggested that a specific control program be established for these areas by State Environmental Engineering Foundation (FEEMA), tailored to these industries but also covering the zone as a whole in order to check possible synergies and complementarities among the different types of industries current found there.

Consequently, it is suggested that the pertinence be checked of undertaking experiments similar to the Eco-Industrial Parks in these regions. This would allow the ZEIs to be analyzed initially, whose administration is the responsibility of Rio de Janeiro State through the Industrial Development Company (CODIN - Companhia de Desenvolvimento Industrial) with an agreement signed by these two State institutions and drawing up a Deed of Commitment with the companies belonging to them. It is suggested that a strictly industrial usage zones (ZEI) be selected initially as a pilot study, and that enterprises should be allowed to participate in this initiative on a voluntary basis, perhaps establishing some type of incentive for them to join, such as tax cuts or merely adherence seals that they could use as marketing tools. Of the nine strictly industrial usage zones (ZEIs) with prospects for expansion, the most suitable for an initiative of this type are those located in the Sepetiba Bay Basin, particularly in Campo Grande, Santa Cruz and Campo Alegre, as they cluster a wide variety of industries with better potential prospects for complementarity.

In view of the points outlined above, a pilot study was carried out for the Campo Grande ZEI. Table 1 presents the preliminary results of the study.

From the matrix presented in Table 1, it seems clear that most of the solid wastes generated in the Campo Grande ZEI have potential for use by the types of industry found within the district itself. In fact, ten of the fifteen solid wastes generated in the Campo Grande ZEI offer potential uses by nearby industries. Acids, lube-oils, plastic wastes in general and solvents are those with the greatest use possibilities.
Table 1: Overview of the waste producers in the Campo Grande Industrial District and potential users within the same industrial district.

<table>
<thead>
<tr>
<th>Potential Wastes</th>
<th>Current Types of Industries</th>
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<tbody>
<tr>
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<td>1</td>
</tr>
<tr>
<td>Acids</td>
<td>P/R</td>
</tr>
<tr>
<td>Bases</td>
<td>P</td>
</tr>
<tr>
<td>Catalysts</td>
<td>P</td>
</tr>
<tr>
<td>Caustic sludge</td>
<td>P</td>
</tr>
<tr>
<td>Filter cake</td>
<td>P</td>
</tr>
<tr>
<td>Glass</td>
<td>P</td>
</tr>
<tr>
<td>Lube oils</td>
<td>R</td>
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<tr>
<td>Metal slag</td>
<td>R</td>
</tr>
<tr>
<td>Paint sludge</td>
<td>R</td>
</tr>
<tr>
<td>Particulate</td>
<td></td>
</tr>
<tr>
<td>PET and plastics in general</td>
<td>P</td>
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<tr>
<td>Solvents</td>
<td>P</td>
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<tr>
<td>Stones</td>
<td></td>
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<tr>
<td>Tires</td>
<td></td>
</tr>
<tr>
<td>Treatment station sludge</td>
<td>P</td>
</tr>
</tbody>
</table>

Key: P – Producer of waste materials; R – Possible recipient (user); P/R – Producer and possible recipient (user)

In addition to the potential solid wastes swap network identified within this district, other exchanges could be undertaken with industries located in nearby regions, as well as industries that may be established here. In fact, the solid wastes generated as catalysts, caustic sludge, particulates, filter cake and treatment station sludge that currently lack users within the district could service these industries.

This preliminary analysis confirms the feasibility of setting up a solid wastes swap network today, at least potentially, in order to establish an EIP. However, in order to check its effective feasibility, it will be necessary to carry out a survey of the operating costs and investments required. Another aspect to be assessed is the possibility of using these solid wastes either untreated, or after pre-treatment. It is also important to stress that the industrial processes should be endowed with sufficient flexibility to absorb these new types of feedstock.
5 Conclusion

This paper is designed to highlight initiatives leading to alterations in industrial locations in the RJMR that would help improve the quality of the environment in this region. In order to support this proposal, the recent development of Environmental Management and Industrial Ecology concepts and practices were analyzed. Based on the study of these trends, new industrial settlement policies were proposed for the zoning system in effect in the RJMR.

In view of the points outlined above, a pilot study was carried out for the Campo Grande ZEI. This analysis indicated the feasibility of setting up a solid wastes swap network in the district, which is key element in establishing an Eco-Industrial Park. However, the effective feasibility of an initiative of this type requires the development of two keys aspects: the technical and economic sizing of the solid wastes swap network, and the park itself, in parallel to defining the institutional arrangements and cooperative management tools required.

References