EIP Model of a Self-Powered manufacturing Unit to Enhance Sustainability

Vineeta Adhikari[1], Rahul Pandey[2], Ankit Kumar Shukla[3]

[1]Associate Professor, Department of Mechanical Engineering, Amrapali Institute of Technology, Haldwani, Uttarakhand, India.
[2]Affiliate Member (AM), IMeche, London, United Kingdom, Research Scholar, Department of Mechanical Engineering, Amrapali Institute of Technology, Haldwani, Uttarakhand, India.
[3]Research Scholar, Department of Mechanical Engineering, Amrapali Institute of Technology, Haldwani, Uttarakhand, India.

Abstract - *With the rapid evolution in industrial sector, natural resources have abruptly been harnessed and has caused a decline in the environmental quality. In this paper a hypothetical approach has been made for a model which encompasses the technological advances as well as does not degrade the environment, also certain ongoing methods adopted by certain industries have been reviewed. Eco Industrial Parks (EIP) has shown significant advances and offers great scope in the future development. The principle of EIP has been collaborative operations of interdependent industries to maximize net productivity and reduce overhead costs and material handling costs. A systematic analysis of this of some of the most successful ongoing EIP have been done. Symbiosis technique offers local small-scale businesses to go hand in hand with the industry being set up in the area. The major analysis has been done considering trends followed in the United States of America.*

Key Words: **EIP, Symbiosis**

1. INTRODUCTION

An EIP is a community formed between the manufacturing and the management sector seeking enhanced environmental and economical results with the resources available. The term EIP is often misused by people, misleading the others to think of EIP as something else. In certain countries EIP is used as: - a collection of companies making green products, a collection of environmental technological companies, an industrial park designed around a single environment theme like hydro power plant, etc. Such description of EIP are wrong and mislead the people about the actual meaning and functionality of it. Prior commencing on this paper, it was observed that only a few projects and case studies account for EIP with most of them in context of the United States of America.

It looks promising and viable in various circumstances but a very little information is available on industries using EIP models to sustain themselves. Also, the support by government bodies regarding it as almost negligible in terms of resources and finances. In India due to excessive competitive business background and lack of trust among people, the entrepreneurs generally tend to avoid partnership or go into collaboration until they are under certain obligations or losses. The EIP management unit adds value to the production and service functions of EIP members by performing the roles that in some way support improvements in the EIP's efficiency.

2. Impact on Firms and Community

The EIP's community is the local social, environmental, and economic system in which the EIP resides. The local community, which includes community government, households, and community businesses that are not members of the EIP, is the area in which the EIP has the greatest economic, environmental, and sociological impact.

Membership in an EIP can potentially bring economic benefits to companies by improving their efficiency, reducing their infrastructure requirements, providing access to better information about their customers and suppliers, and reducing their costs for regulatory compliance.

However, the EIP may also require that each member form relationships with other EIP members that might bring greater risk than traditional customer/supplier relationships. Furthermore, because the EIP is an emerging form of organization, members face regulatory and technological uncertainties that pose additional risk.

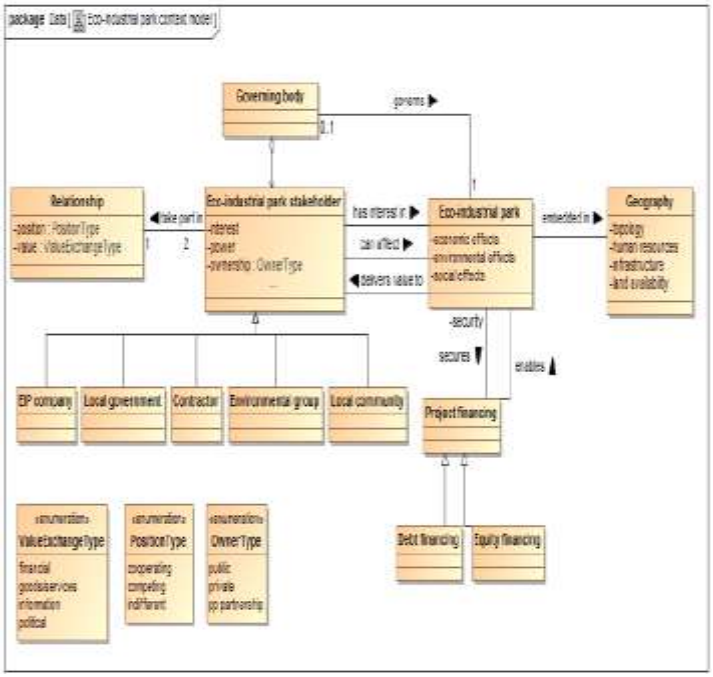

Fig- A general overview about the functioning of the EIP

Presently there is no benchmarked framework to give an overview about the benefits done by it to the local communities, but there are certain examples of some isolated EIP which have not been able to get much revenue whereas some have served the purpose. Success of an EIP might depend on the industries involved, the location of the EIP, the economic profile of the region, the openness of local developers to a new development strategy, the local political and regulatory environment, and the willingness of the business community to work together. EIPs might affect the companies that participate in them, the managers of EIPs, the members of the communities that host them, and the wider community. EIP members are the building blocks of the EIP's economic and environmental systems. Each EIP member exchanges inputs (labor, capital and materials) with other EIP members, members of the community, and suppliers and customers from outside the community. EIP members seek to maximize their profitability.

3. Quantifiable Impacts

The EIP members can enjoy economic benefits which are measured in terms of profitability and investment schemes as mentioned below: -

- Return on Investment (ROI)
- Payback Period
- Change in Productivity
- Change in Annual Profit
- Change in Production Cost per unit (If a manufacturing unit is set up)

The community also enjoys economic benefits supporting the EIP, rather it is measured under different schemes as indicated below: -

- Total number of production workers
- Average Wage
- Tax Revenues
- Value added by manufacture
- Public expenditure for sanitation as a percentage of value added or tax revenues

The EIP cannot be considered successful unless it fully complies with all applicable environmental regulations. Beyond compliance, the environmental impact of the EIP can be determined by examining the resources exploited and emissions caused by groups of companies in a with-EIP versus without-EIP scenario. A weighting scheme could be used, if necessary, to place all discharges on a risk-based metric and to convert quantities of resource use to a single metric of resource efficiency. Other weighting schemes can be developed that account for a community's special environmental concerns.

4. Prototyping an EIP

To develop the prototype EIP and its scenarios, we referred to the information we obtained from many companies operating in the area, as well as companies that operates in another location, but which we believe would fit well with the economic and environmental conditions of the proposed EIP.

- **Stage 1- Choosing a site**

Some of the relationships among these companies and their potential economic and environmental impacts depend on details specific to a site. Here in this case, we choose the SIDCUL region of Uttarakhand, India for our EIP model. The SIDCUL provides good connectivity to central parts of the country by both road and railroads. The area supports cheap labor costs as compared to other industrial zones in the country, although it does not have port or air connectivity but it is 255km to the nearest international airport the IGI Airport.

- **Step 2- Choosing the Members of the Prototype EIP**

With the adversity of the area, the power, manpower, support and transportation are the key factors require. For power Tehri Dam provides clean Hydro-electricity to the region, manpower the local communities offer cheap and viable labor. Support we refer to as the waste management and waste disposal methods, here waste can be disposed off by creating certain dumping grounds in the hills and covering it by sand, making it a landfill, since the waste mostly generated is degradable, we can plant tress on these dumping stations to maintain the economical balance. As of for transportation as discussed earlier we have 24x7 road and railroad connectivity.

- **Step 3- Pollution Prevention, Industrial Symbiosis, and Collocation; Joint EIP Services**

In this stage, we assume that the remote partners are collocated with the remainder of the EIP members. We do not analyze their decision to move into the park from their current location; we only show the additional benefits that could be derived from collocation. These joint services include a solvent recycler, an oil recycling operation, and a water pre-treatment plant. These changes produce the following
opportunities:

- The water pretreatment plant provides clean water to the power plant.
- The solvent and waste oil recyclers are used by several EIP members.

5. Estimated Results of Prototyping EIP

There are various methods for carrying out the estimation, some of the simulation-based methods are discussed as follows: -

a. Analysis Approach

The analysis procedures and spreadsheet model used to simulate changes in economic and environmental performance can provide three basic types of information for each EIP scenario:
➢ net changes in their materials flows
➢ changes in their net annual revenues
➢ their incremental annualized fixed costs

From this information, we can calculate changes in annual profit, ROI, and payback periods. These measures refer exclusively to the profitability of the EIP relationships we describe, rather than to the overall profitability of an EIP member, which would require complete knowledge of each company's baseline operations and finances. Net changes in materials flows represent the expected environmental impact of each EIP scenario.

b. Simulation of Economic and Environmental Benefits

This approach involves simulating the models based on the economic aspects prevailing in the industry and the environmental impact it causes. This stage requires a model prototype to be devised before hand and then, using above cited conditions calculate the result and analyze the benefits offered by the proposed model.

6. Discussion

Our study was based on a number of assumptions and much conjecture. However, it served to demonstrate some important points about the elements required for a successful EIP:

i. The first and most essential input to the EIP is information about members' operations.
ii. The success of the EIP requires that members are open to depending on each other.
iii. To achieve the greatest economic benefits, the EIP will require substantial investment in infrastructure.
iv. The economic and environmental benefits to the EIP and the community are greater if the potential symbiosis opportunities are recognized during the planning stages of a park or plant. Retrofitting existing plants, while possible, decreases the economic benefits.

Our analysis was limited in several ways. First, we did not consider the influence of the changes in operations on several important factors that may affect the EIP's economic and environmental impact:

➢ the risk to companies of investing in symbiotic relationships with suppliers and customers
➢ the risk to companies that they may be liable for the environmental impacts of other EIP members' operations
➢ the implications of the operations changes depicted by the scenarios for the regulatory costs faced by each EIP member

The second way in which our analysis was limited was that we did not examine whether the EIP member would rather locate at the EIP than at alternative locations. That is, we assumed that everything else about the baseline scenarios and the with-EIP scenarios was the same except for the byproduct exchanges. This would certainly not be true if a company was trying to decide whether becoming a member of an EIP would be more profitable than some alternatives.

The third way in which our analysis was limited was the exclusion of aspects of the EIP aside from the symbiotic relationships between companies, shared infrastructure, and shared EIP services. EIPs may differ from traditional industrial parks in other ways that affect the magnitude of the environmental and economic benefits. At the end, we did not consider the costs of managing the EIP.

REFERENCES

[1]. DeSorbo, Louis A. 1994. "Benefits of Global Environmental, Health and Safety Databases." Adhesives and Sealants Industry Oct/Nov:42-43.

[2]. Akerlof, G. A. 1970. "The Market for 'Lemons': Qualitative Uncertainty and the Market Mechanism." Quarterly Journal of Economics 84:488-500.

[3]. Gertler, Nicholas, and John Ehrenfeld. 1994. Industrial Symbiosis in Kalundborg: Development and Implications. Working paper, Program on Technology, Business, and Environment. Cambridge, MA: Massachusetts Institute of Technology.

[4]. Graedel, T.E., and B.R. Allenby. 1995. Industrial Ecology. Englewood Cliffs, NJ: Prentice Hall.

[5]. Just, Richard E., Darrell L. Hueth, and Andrew Schmitz. Applied Welfare Economics and Public Policy. Englewood Cliffs: Prentice-Hall.

[6]. Vogel, R.A., and K.G. Murray. "Waste Minimization Opportunities for Petroleum Based Solvents." Paper in the Incinerable Hazardous Waste Minimization Workshops. pp. 48-57.

[7]. U.S. Environmental Protection Agency. 1994. Guide to Cleaner Technologies: Alternatives to Chlorinated Solvents for Cleaning and Degreasing. February. Washington, DC: Office of Research and Development.