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Industrial symbiosis in the Taranto industrial district: current level, constraints and potential new synergies

Bruno Notarnicola*, Giuseppe Tassielli, Pietro Alexander Renzulli

Ionian Department of Law, Economics and Environment, University of Bari Aldo Moro, via Lago Maggiore angolo via Ancona, 74121 Taranto, Italy

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ABSTRACT

The environmental crisis affecting the Taranto provincial industrial district in Italy, centred around the Ilva steelworks, has made its existence within the surrounding contexts unsustainable. The application of industrial symbiosis principles in this district can certainly represent a purposeful means for a move towards a more sustainable industrial system. This work presents the results of a research project, funded by the Caripuglia Foundation, for a study of industrial symbiosis in the Taranto industrial district. The study of the district, which is characterized by the presence of heavy industries such as steelworks, oil refinery, cement industry and power stations with an energy consumption of 182.4 PJ/year, identified the industrial sectors and firms that could be involved in symbiotic activities and the spontaneous existing synergic interactions taking place among the largest firms of the district. The study has also quantified and illustrated the useful recycling, within various industrial sectors, of inefficiently used and disposed waste energy (44.6 PJ/year of heat) and material waste and by-products (3.28 Mt/year). Among the latter are steelworks slag, mill scale, spent refractories and coal fly ash. However, the study has revealed that, despite the presence of multiple anchor tenants on the territory, the industrial symbiosis is still implemented at a basic level. There are different constraints on the full development of the industrial symbiosis in the industrial district of Taranto. Among these, the focus of the entrepreneurs on their core business was the main one, while additional uses of the current waste are seen as a diversion of human resources and capital.

1. Introduction

The strategy for the industrial development of southern Italy, implemented by the national government at the beginning of the 1960s, brought a series of districts containing large industrial complexes into existence. Many of these districts have now been closed down and only a few are still active. Among the latter is the Taranto industrial district in the Puglia region. This productive district includes the Ilva integrated steelworks (the largest in Europe of its kind), a crude oil refinery, three power plants, the third largest naval port in Italy (including a military dockyard), a cement factory and a large beer factory. These industries are responsible for the production of 3.25 Mt of solid waste and by-products and the energy consumption of over 182 PJ/year.

This district, since 1990, has been declared an area with a high risk of environmental crisis because the heavy alterations of the ecological balances of the ground, water and air surrounding the district represent a serious risk for the environment and the health of the local population.

There is thus a strong need for environmental innovation in the Taranto industrial district in order to make it more sustainable. This environmental innovation can be driven not only by the development of new technology, by the market needs or by environmental regulations, but it can also be obtained via approaches implementing the Industrial Ecology paradigm (Frosch and Gallopoulos, 1989). Such paradigm tackles sustainability problems with a systems perspective using natural, social and technical science tools. One such tool is Industrial Symbiosis (IS) that involves conventionally separate industries in a collective approach to competitive advantage encompassing physical exchange of energy, materials, water and by-products (Chertow, 2000).

The potential of symbiotic matter and energy exchanges or reuses deriving from the steel industry has often been emphasised in literature (Koros, 2003). By-products such as slag, scale or dust, which are typically considered as waste and sent to landfills, offer

* Corresponding author.
E-mail address: bruno.notarnicola@uniba.it (B. Notarnicola).

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significant potential for cost savings or profits if properly reintroduced in the industrial metabolic system. The nature of the integrated steelmaking process guarantees a continuous flow of waste material and energy that makes steelmaking plants fulcrums around which symbiotic districts can develop as for example in the UK Humber region (Mirata, 2004), the Jinan district in China or the Japanese eco-town of Kawasaki (Newmann and Matan, 2013). There is thus a need to examine the context of the Taranto district, in particular that of the Ilva steelworks, in order to try to highlight the potential benefits for the area deriving from the IS approach.

The work presented in this paper stems from a project entitled "Application of the principles and tools of Industrial Ecology to the manufacturing district of Taranto", developed with the intent of carrying out a study of the potential sustainability improvements of the Taranto industrial district obtainable via the implementation of IS. Preliminary results and partial findings have been illustrated in Notarnicola et al. (2014). The present work, based on comprehensive final results of the project, has the objective of analysing in detail the Taranto industrial district in order to exhaustively identify and discuss current and new potential IS interactions among the firms of the district and the current barriers to IS expansion.

2. Method

The working method implemented for this research is intended as a means of gathering and elaborating background data needed for the development of future practical implementation of IS specific projects and feasibility studies within the area. These are fundamental for overcoming the current crisis and making the district more competitive and environmentally sustainable. The approach used for the development of the project and the analysis and discussion of the respective information (described in the next sections) is illustrated in Fig. 1.

The first step of the project involved the collection and analysis of large quantities of data concerning the economic and environmental performance of the various productive sectors. Among such sectors the main firms of the district were identified (see Section 3) by using cut-off criteria concerning, the number of employees, total revenue and waste production. Next, a detailed material and energy waste analysis of such firms was conducted (see Sections 4 and 5). The analysis of all this information allowed the current state of symbiosis of the district to be pictured (see Section 6). New possible symbiotic interactions, based on the waste recycling scenarios, illustrated in Section 7, were identified via literature research which included patent examination. The overall results of the project are discussed in the final sections of this paper.

The approach is a sort of top-down method in which, starting from the available official statistics and public reports, a screening of the main firms in terms of waste and energy recycling potential is carried out; once the selection of firms was made, a detailed analysis of the existing symbiotic interactions and the possible alternatives was carried out.

3. The productive district

The province (Fig. 2), whose capital is the city of Taranto, covers an area of 2430 km^2 located in the southern Italian Puglia region facing the Ionian sea. The current population of the province is just over 570,000 inhabitants with 166,000 people currently employed, mostly in the services and industrial sectors. The manufacturing sector, representing 7% of the 42,000 active firms operating in the province, amounts to approximately 3000 companies. Fig. 2 illustrates the location of the largest industrial companies of the district around Taranto, that due to their large productive capacity, are of vital importance to the economy both at regional and national level.

Table 1 describes some of the main characteristics of some of the most active industrial segments and firms of the district, which could potentially be involved in symbiotic interactions.

Besides the large industrial complexes, throughout the province there are many small and medium enterprises grouped together in specific districts (Table 2) according to their type of activities.

4. Material waste analysis

Starting from the firms identified and described in the previous section, a material waste analysis was performed as a means of identifying the main quantities of waste produced, disposed and recovered. The analysis of such information highlights a provincial yearly production of 3.17 Mt of material waste and a total recovery or disposal of 3.99 Mt per year (Fig. 3). This indicates that over 800 kt of material waste that originates from outside the province is managed within it.

At first sight the above illustrated waste flows might give the idea of a provincial system with a sustainable industrial waste recovery. However the classification of the recovered waste, deriving from European directives regarding waste management (European

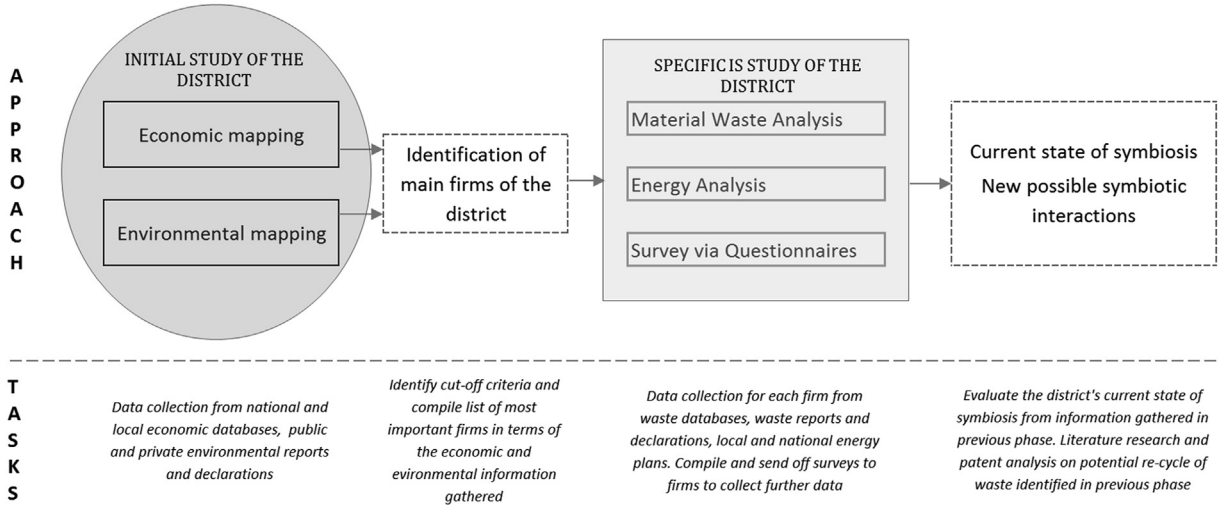

Fig. 1. The method and tasks performed for the development of the project.