

ACTIONS FOR A SUSTAINABLE **WORLD** FROM THEORY TO PRACTICE



BOOK OF PAPERS



**THE 24th INTERNATIONAL
SUSTAINABLE DEVELOPMENT RESEARCH
SOCIETY CONFERENCE**

MESSINA · ITALY JUNE 13/15 2018

The 24th International Sustainable Development Research Society Conference (ISDRS 2018)

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13-15 June 2018, Messina (Italy)

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Edited by: The Organizing Committee of the ISDRS 2018 Conference

ISBN 978-88-943228-6-6

Department of Economics

Piazza Pugliatti, 1 – Messina (Italy)

Circular economy and industrial symbiosis: The role of the municipality of Prato within the EU Urban Agenda partnership

Leonardo Borsacchi¹, Valerio Barberis², Patrizia Pinelli^{1,3}

¹ ARCO (Action Research for CO-development) - PIN Srl, University of Florence, leonardo.borsacchi@pin.unifi.it

² Municipality of Prato, v.barberis@comune.prato.it

³ University of Florence - Department of Statistics, Computer Science, Applications (DiSIA), patrizia.pinelli@unifi.it

Abstract

The City of Prato, in Italy, is famous worldwide for its textile district. Despite the economic difficulties and the major market transformations, the district is still active and vital. The policies of productive re-organization, based on the circular economy principles, are recognized at EU level as a model for urban economies improvement. Prato has been always a model of innovation in textile sector having historically based its industrial fortune on the reuse of second-hand clothing from all over the world. The recycling techniques and valorisation of these fractions - that would otherwise be land-filled or burned - started at mid of XIX century – led to consider Prato one of the most advanced and innovative industrial city in Italy. With this mindset, part of the DNA of the city, Prato anticipated by decades a behaviour that today is promoted by the “green economy” principles and the green management of productive chains in the logic of Circular Economy. The aim of this paper is to describe a real experience of industrial symbiosis, performed both by the Municipality of Prato together with local enterprises, organisation and the scientific community. At present, the Municipality of Prato is the Italian representative in the EU’s “Urban Agenda: Circular Economy Partnership” initiative. The Urban Agenda project would enhance EU policies, strengthen the EU’s understanding of urban issues, and would share best practice strategies. Thus, the Partnership aims to stimulate the re-use, repair, refurbishment, and recycling of existing materials and products, in order to promote growth and to create new job opportunities. Within the Partnership, the Municipality of Prato leads the debates regarding wastewater reuse and conducts the team discussing on sustainable buildings. About wastewater, Prato was one of the first industrial district, at European level, arranging a close water cycle. A system, which led to significant results in terms of green infrastructures and green economy and that has been studied, promoted and replied elsewhere (since the early 1980s the Prato district has been a case study in the investigation of innovative environmental recycling dynamics). Therefore, Circular Economy in Prato also means the reuse and the transformation of existing building, in particular the dismissed ones situated in industrial areas, with the logic to improve the environmental performance of buildings and infrastructures in their entire life cycle.

Keywords: Industrial symbiosis, Circular economy, Urban agenda, Wastewater reuse.

1. Introduction

Industrial symbiosis consists of place-based exchanges among different entities. By working together, businesses strive for a collective benefit greater than the sum of individual benefits that could be achieved by acting alone (Chertow M. R., 2000). In fact, in a developed economy with several industrial activities, many different by-products are generated, and the range of potential uses for them can be equally various, according circular economy principles. At city level, this kind of collaboration can advance social relationships among the involved local actors, including surrounding neighbourhoods. Activities involve a form of brokering to bring companies together in new positive collaborations, finding innovative solutions to use resources, and thus to increase revenues while reducing waste.

In 2015, the European Commission has adopted a "Circular Economy Package" (CEP), which includes revised legislative proposals on waste to stimulate the transition from the old concept of linear economy to the more recent one of "circular economy" (CE). CEP consists of an action plan that establishes a concrete action programme, with measures covering from production and consumption to waste management and the potential market and reuse of secondary raw materials (European Commission, 2015). These actions aim at both promoting to close the loop in products' life cycle and bringing benefits for both the environment and the economy. CE enables, in fact, the development of a brand new paradigm, where the new model of CE overcomes the concept of an economy that close the loop with waste (Ellen Macartur Foundation, 2015). Today, both the reasons for the sustainability and the environmental impact suggest a radical switch to the new circular paradigm, with positive conditions leading to a full exploitation of the big potential of this new approach (Ghisellini P., et al., 2016). One of the most important challenges that the CE has to face is the necessity, in the near future, of designing indicators capable to assess the level of efficiency in terms of reduction, reutilization, and recycling of waste generated in the linear economy model (Molina-Moreno V., et al., 2017). During the Dutch presidency of the European Union in 2016 the Pact of Amsterdam (PA) was adopted by EU Ministers responsible for Territorial Cohesion and/or Urban Matters. PA strives to involve Urban Authorities in achieving better regulation, better funding and better knowledge, considering cities as drivers of innovation. The Urban Agenda for the EU (UAEU) helps to ensure that these facts are acknowledged and reflected by EU legislation, funding and knowledge sharing. UAEU is composed of 12 priority themes essential to the development of urban areas and each theme has a dedicated partnership. These partnerships bring together cities, Member States and European institutions. Together, they aim to implement the UAEU by finding workable ideas focused on the topics of EU legislation, funding and knowledge sharing. One of these partnerships is the EU Partnership on Circular Economy (PCE). Cities play an essential role in the development of a circular economy; they act as enablers of potential measures by which they can influence both the consumers and the businesses (Kirchherr, J., et al., 2017). Moreover, overall governance, enabling businesses, public procurement, consumption and resource management are the themes that would all have a bearing upon the development of circular economy concepts within cities.

The City of Prato is one of the largest Italian industrial districts and one of the most important textile and clothing production centres in the world. According the local Chamber of Commerce, the manufacturing district counts 35,000 direct employees and 7,200 companies, which produce 17% of Italian textile exports. The overall revenues consist of 65% textile and 35% tailoring, with an estimated total sales volume of 400M EUR per year. Since the post-war period, textile waste management has represented one among the main drivers for textile district development: recovery and recycling of natural fibres from rags and used clothes were the basis for the Prato's yarn and textile industry. Prato has been always a model of innovation in this sector having historically based its industrial fortune on the reuse of waste from the textile process and on the reuse of second-hand clothing from all over the world. The evolution of materials technologies, together with the progressively changing market demands have led to a profound transformation both in industrial processes and in the use of materials. Furthermore, new players have entered the textile industry context: since the '90s a tailoring parallel district, handled mainly by the Chinese community, has settled in Prato's industrial areas

At present, the Municipality of Prato (MoP) is the Italian representative in the PCE initiative. While UAEU will enhance EU policies, strengthen the EU's understanding of urban issues, and share best practice strategies, PCE aims to stimulate the reuse, repair, refurbishment, and recycling of existing materials and products, all of which will help promote growth and job opportunities. The partnership consists of six urban authorities, namely the City of Oslo, The Hague, Prato, Porto, Kaunas and Flanders region. The Member States are Finland, Poland, Slovenia and Greece. The European Commission (in particular DG Regio, Dg Env, DG Clima, DG RTD, DG Grow), the Council of European Municipalities and Regions, Eurocities, Urbact, the European Investment Bank and the Association of Cities and Regions for sustainable Resource management are also partners. The MoP is a leader in the debates that have emerged regarding waste water reuse and on sustainable buildings and the authors of this paper are taking part of all debates and meeting within the partnership.

ARCO is a university action-research centre founded in 2008 at PIN S.c.r.l. (Polo Universitario "Città di Prato")— University of Florence that integrates the expertise and skills of economists, statisticians, political scientists, sociologists, commodity

scientists, and technical professionals. ARCO is organized into five strategic research units: local development, social economy, M&E and impact evaluation, inclusive development, sustainable food commodities. On CE, ARCO consults with the MoP and offers its scientific and technical support especially on the topic of the circularity of production processes. ARCO participates to the meetings and the workshops within the Partnership, contributing to contribute at the discussion and proposing ideas along the way.

2. Methods

In order to describe the main actors involved in the application of CE strategies and policies and the main projects that take in place by the MoP within the new Urban Master Plan of the City, this study has adopted a methodology based on the active involvement of the stakeholders. In particular, the following activities were conducted: a) Desk-based analysis of reports and publications on CE; b) Conduction of semi-structured interviews with local representative stakeholders; c) Participation at all debates and meeting within the PCE. This methods has allowed diversifying the sources of information, digging deeper in all relevant topics in order to obtain a comprehensive and consistent picture of the main issues.

3. Results and Discussion

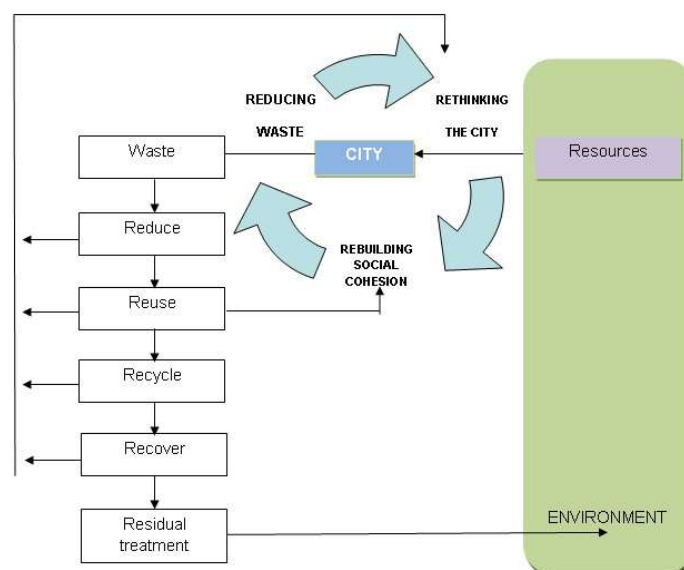
MoP is currently managing innovatively, with a circular approach, its territory, "rethinking" itself without forget its past and to face new challenges for a more sustainable future. The application of the CE approach within the territory of Prato involves all the main production activities and actors including municipalities, companies, cooperatives, associations and citizens, in order to create new economic and social opportunities without consuming new resources ("Rethinking the City"). The Prato's model for CE (see figure 1) aims to promote a holistic and systematic governance, bringing together public authorities, universities and R&D centres, enterprises and their associations, NGOs and citizens. This governance model envisages the following forms of interaction:

- Public authorities promote research and innovation for the CE;
- Citizens and NGOs engage with research institutes to explore the potential of new innovations, with a strong attention to the social implications of the circular economy;
- Enterprises work with citizens to co-design new business models for circularity services;
- Businesses and public authorities collaborate to define and deploy circularity services in the public interest, including green public procurement and innovation.

In terms of waste management ("Reducing waste"), Prato can bring sound experiences to explore in depth the 5 "R" (Reduce, Reuse, Recycle, Recover, Residual treatment) of the waste strategy. This approach is fully part of the strategy of Prato, investigating the use of waste in different production chains, bringing together the private and public organizations that operate in the reuse sectors with the aim to produce innovation, aggregation and networks. Significant effort will be devoted to the reduction, reuse, and recycling of the waste materials. In particular, synthetic fibre residues create a substantial concern regarding a sustainable recycling strategy. The circular approach is fully part of consolidate policies in Prato, investigating the use of waste in different production chains and new operational innovative actions, bringing together the private and public organizations that operate in the reuse sectors with the aim to produce innovation, aggregation and networks. As a result, Prato can be conceived as a great experimental re-cycle district; a model of development and management of the city under the principles of the CE as a paradigm to have citizens taking care of their territory and institutions closer to citizens' needs. Nowadays, within the textile district, synthetic textile waste are not suitable to be used within the traditional recycling process. In fact, discarded scraps of synthetic textile that end to become a waste is a key problem for the city and the textile district. Furthermore, starting from January 2017 textile waste are considered "special waste" and therefore can no longer be disposed in the undifferentiated bins. The main factors that limit the possibility of waste recovery are the great variety of textile fibres,

which make problematic classification and recycling and illegal disposal of textile scraps. Very often, these scraps are abandoned in the street or in hidden places or burned in abusive land fields. Beyond the environmental aspect raised by incorrect and illegal disposal of the textile waste, this challenge entails as well economic and social facets as it generates economic cleavages undermining the principles of competition between enterprises and also social cleavages between citizens, which jeopardize integration process and efforts made so far for building a cohesive society.

Figure 1. Prato's circular model



Source: Author.

New policies has to take into consideration both citizens and entrepreneurs, in order to reduce the gap within potential bad waste management and to help in a general rebuild of the social cohesion. Thus, one of the main goal of the adoption of a new CE approach is to strengthen the social cohesion at urban level ("Rebuilding Social Cohesion") through the construction of an inclusive and supportive community, based on the principle of sharing and creative reuse as a mean to stimulate innovative driving forces for business activities: starting from the recovery of waste and materials that others consider refuses/rejections, also considering social purposes and charity, within the paradigm of the Sharing Economy. One of the main local stakeholder managing technical innovation on the collection and the reuse of textile synthetic fibres is Programma Ambiente (PA), a publicly owned company leader in ecology and environmental management. A thorough technical, legal and administrative knowledge of the subject, cutting-edge equipment, a wide array of services, a deep customer focus, and a strong innovative ability, are the grounds on which the company has been founded, which is synonym with safety, reliability, research and innovation aimed at reducing the use of waste management facilities and maximising the recycle and reuse of waste. With its organisation linked to market dynamics and the endless developments of the industry, PA provides its expertise to public organisations that look for answers and solutions to any environmental issue. In the management of the waste cycle, the corporate strategy pursues the reuse of energy and materials through players who can provide innovative solutions through research. Depending on the season, these residues are from synthetic and natural fibre. In particular, synthetic fibre residues create a substantial concern regarding a sustainable recycling strategy. Today this material is disposed through landfill only as the calorific value is too high for waste incineration. Landfill disposal is also problematic as the capacities are declining and

costs are rising. In contrast, natural fibre would provide more options for material recycling if collected separately, as proposed by PA. In this context, the described waste disposal requires constant creation of new landfill spaces, which is in contradiction to the environmental goals, including ecosystem protection. Moreover, the synthetic textile waste has become a new issue to be addressed both from the collection and from the end of life management point of view. There are different reasons for low recycling rate of waste textiles, which are related with the different composition of textile goods being composed of various materials such as cotton, wool, rayon, polyester, nylon, etc., making it difficult to separate the waste textiles. Within this project, following the CE approach, new proposals and ideas will look for new technologies that offer a pathway towards the sustainable recycling of synthetic fibre residue from the local garment industry.

Within the PEC, MoP leads the discussion on wastewater reuse. In fact, Prato was the first industrial district arranging a close water cycle so to be able to reuse wastewater more than one time within the textile productive process. In 1981 was created, following the introduction of Italian Law 319/76, the Gestione Impianti Depurazione Acque S.p.A. (GIDA), a mixed private and public limited company. Thanks to the construction of the Baciacavallo plant, the first nucleus of the current centralised system of civil and industrial wastewater treatment, the MoP and the Prato Industrial Union, agreed on the creation of a synergic strategy in order to guarantee the satisfaction of one of the main need of the Prato textile industry and the safety of the population of Prato. The plant's first unit dates back to 1980. In 1986 the treatment line was doubled. In 1992 the ozonation plant was built for the removal of surfactants and colour. In 1999, the tertiary treatment of flocculation was doubled and, at the same time, the section for dewatering the resulting sludge was improved and modernised. Weekdays the plant can treat up to 130,000 m³/d, breaking down up to 100,000 kg of COD per day and 4,500 kg of surfactants per day. It essentially consists of stages for equalization, primary sedimentation, biological oxidation, sedimentation, flocculation and a final refinement with ozone to remove colour and surface residues. The sludge line consists of gravity thickening, mechanical dewatering by centrifugation and sludge incineration. This last stage uses a multi-level incinerator of 100 t/d, supplied with post combustion, a wet scrubber tower for fumes, dust collector and continuous emission analyser. The sludge resulting from the treatment process can reach 30,000 t/a with 75% moisture. Wastewater treatment plants play a fundamental role in the water supply chain as they enable water sanitation and reuse. Wastewater treatment is the process where organic and inorganic pollutants are removed from the sewage. Wastewater cannot be released directly into the environment as soil, sea, rivers, and lakes are unable to degrade quantities of polluting substances higher than their own disposal capacity. The main pollutants that can be removed following treatment are biodegradable organics (e.g., biochemical oxygen demand or BOD), suspended solids, nitrates, phosphates, and pathogenic bacteria. With the current emphasis on environmental health and water scarcity affecting some European countries, there is a growing awareness of the need to dispose of such waste in a safe and beneficial way, as instructed by the Directive 91/271/EU on urban wastewater treatment, and Directive 2013/39/EU on monitoring micro-pollutants. Due to risks on human health and the environment, the reuse of water has strong limitations in the existing EU, at national and regional regulation of water and waste water. More efficient reuse of water will be essential in the transition towards a CE. There are currently several projects and initiatives to reuse wastewater all over Europe. Mainly, there are currently projects and initiatives to reuse wastewater, after treatment, in the same productive sector (e.g. reuse of water in the textile production process). Due to legislative and technological barriers, wastewater from industrial production activities for irrigation and agricultural use is not possible at this time. Differences in member state and regional regulation lead to differences in the possibilities for cities to investigate and use existing knowledge. Current barriers identified are among others:

- i) Wastewater from industrial production activities has more regulatory limitation to be reused than urban waste water.
- ii) Most cities have a unique system for collection waste water, including waste water from industries and commercial activities which results in the limitation for these cities to reuse water.
- iii) Lack of quality standards for production processes using recycled water.

PEC has identified a need for highlighting the potential for better use of water in EU, member states and city policy, taking into account that the proposal of changes in European regulations could be an important step towards better water efficiency.

Therefore, CE in Prato also means the reuse and the transformation of existing buildings ("Rethinking the City"), in particular those unused ones situated in industrial areas, with the logic to: i) create new economic and social opportunities without consuming new land (following the paradigm of the "zero volume" growth); ii) improve the environmental performance of buildings and infrastructures in their entire life cycle; iii) propose new urban scenarios. At this regard, it is also worthwhile mentioning that Prato has three major urban redevelopment projects in this sector: the Integrated Urban Plan (PIU) financed by ERDF funds of the Regional Operational Programme of Tuscany, the Plan for the redevelopment of Degraded Areas (PAD) and the Plan for Urban Renewal and the Security (PRIUS) both financed by national funds. PAD aims to regenerate a degraded area subject to marginalization and social degradation. The Plan includes an integrated set of interventions that aim to improve the urban quality by redeveloping/recovering public spaces for leisure, outdoor spaces (including a park by the river side of Bisenzio), social housing opportunities and new services offices for the citizens. PRIUS aims to redevelop/recover an area of the City of Prato that is also subject to marginalization and social degradation (the area is contiguous to the one of PAD and includes the area external to the walls of the old town). Similarly, the objective of PIU is to regenerate the wide industrial area called "Macrolotto Zero", characterised by a high density of Chinese nationality population, by enhancing the public space and the collective assets of the industrial district, through the emergence of new urban polarities, by triggering environmental and socio-economic transformations of the area for a greater sustainability and cohesion of the urban development. These interventions aim to regenerate parts of the historical centre and areas next to the historical walls through high quality architectural projects that recover public space and reverse the current trend towards degradation and neglect. The areas will be newly available for the citizens by recovering existing buildings and creating new public spaces. Main purposes of these areas will be recreation and service (e.g. shops, public offices, green areas, bus lines etc.). The projects also stimulate new patterns of urban vehicular and pedo-cycle traffic, in line with the Urban Plan for Sustainable Mobility (PUMS). Along with the above-mentioned projects, the City also launched a call for projects to demolish the former and now unutilised hospital with the aim to creating a central public green area. The Prato Central Park project (see figure 2) operates an innovative selective demolition of the hospital that integrates elements of the dismissed building in the park, in line with the productive circularity concept. The winning project provides a convincing solution for the future of the area, which draws perspective from the re-integration of works (e.g. contemporary sculptures) of the Museo Pecci collection. The three hectares mostly open area of the park will become a focal point for the vitality of the city outside the walls.

Figure 2. Project rendering of Prato Central Park



Source: Municipality of Prato (<http://www.ilparcocentralediPrato.it/>)

The Urban Master Plan of the City defines specific strategies aimed at "recycling" existing buildings by means of reuse and transformation, according to local specificities. The places of industrial archaeology buildings within the old town (along the historical walls of the city and in the ancient areas of expansion for the old town) to be reconsidered for public and public / private functions in order to integrate and enhance the existing public functions and services.

4. Conclusions

This paper aimed to outline the role of the MoP within the EU Urban Agenda partnership and their main policies on CE. In fact, the City of Prato can be conceived as a great experimental re-cycle district; a model of development and management under the principles of the CE as a paradigm to have citizens taking care of their territory and institutions closer to citizens' needs. The adoption of a holistic and systematic governance with the three proposed pillars ("Reducing waste", Rethinking the city", "Rebuilding social cohesion"), in the long period, will contribute to a progressive improvement at urban level of the experiences on this topic. More, this approach will contribute to enhance the engagement of citizens and NGOs exploring the potential of innovations and co-design of new business models for circularity.

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