

# BDC

Università degli Studi di Napoli Federico II

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### **Circular City and Cultural Heritage Interplay**



# BDC

Università degli Studi di Napoli Federico II

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## **TOWARDS A CIRCULAR PORT-CITY DEVELOPMENT MODEL: A PILOT STUDY IN POZZUOLI, ITALY**

*Francesca Nocca, Antonia Gravagnuolo*

### **Abstract**

Today we live in an increasingly urbanized world. Half of humanity lives in cities and this trend is expected to continue. Many of the world's largest cities are also port cities and, today, the relationship between port and city is becoming a central issue in the debate on local sustainable development. A new regenerative model of urban development is required. The circular economy model can be proposed to operationalize the regenerative model of port-city development. This paper is positioned in the transition phase from linear to circular development models and proposes, in particular, first steps to integrate cultural heritage as a key element of circularization processes in historic cities. The aim of this paper is to explore emerging "circular" models of urban development and to test potential and limitations in the case study of Pozzuoli (Naples, Italy) highlighting whether and how cultural heritage can be a driver of circular regeneration in the port-city interface.

Keywords: port-city system, circular economy, circular city

## **VERSO UN MODELLO CIRCOLARE DI SVILUPPO PORTO-CITTÀ': UNO STUDIO PILOTA A POZZUOLI, ITALIA**

### **Sommario**

Oggi viviamo in un mondo sempre più urbanizzato. La metà dell'umanità vive nelle città e questo trend dovrebbe continuare. Molte delle città più grandi del mondo sono anche città portuali e, oggi, il rapporto tra porto e città sta diventando una questione centrale nel dibattito sullo sviluppo sostenibile locale. È necessario un nuovo modello rigenerativo di sviluppo urbano. Il modello di economia circolare può essere proposto per rendere operativo il modello rigenerativo dello sviluppo delle città portuali. Il paper si inserisce nella fase di transizione da modelli di sviluppo lineari a circolari e propone, in particolare, i primi passi per integrare il patrimonio culturale come elemento chiave dei processi di circolarizzazione nelle città storiche. L'obiettivo del paper è quello di esplorare modelli "circolari" emergenti di sviluppo urbano e testare potenzialità e limiti nel caso di studio di Pozzuoli (Napoli, Italia) evidenziando se e in che modo il patrimonio culturale può essere un motore di rigenerazione circolare nell'interfaccia portuale.

Parole chiave: sistema porto-città, economia circolare, città circolare

## 1. Setting the scene: towards a sustainable urban development model in metropolitan port cities

### 1.1 The metropolitan port cities development: challenges and opportunities

Today we live in an increasingly urbanized world. Half of humanity, about 3.5 billion people, lives in cities and this trend is expected to continue. More than 70% of the world population will be located in urban areas by 2050 (United Nations, 2015a). According to Eurostat, 72% of the European population currently lives in cities and metropolitan areas and it is foreseen that, by the year 2050, this figure will reach 80%.

The UN Agenda 2030 for Sustainable Development (United Nations, 2015b) has set up 17 Sustainable Development Goals and many of them can be achieved in metropolitan cities, and especially in metropolitan port cities.

Many cities worldwide are rapidly growing, incorporating the surrounding urban areas and becoming large “metropolitan” agglomeration (Hamilton, 2014; Trapero *et al.*, 2015).

Many of the world’s largest cities are also port cities (Fusco Girard, 2013). Ports and cities are historically strongly linked, but the link between port and city growth has become weaker. Today, the relationship between port and city is becoming a central issue in the debate about local sustainable development.

Although world’s port cities are different each other’s, common challenges can be recognized: climate change, the development of “disruptive” technologies and the promotion of energy transition (Daamen and Vries, 2016).

In Europe, the decline of many port cities represents an important challenge for sustainable growth (European Council, 2014).

In port cities strong development potential and contradictions take place; in fact, they are the place where the economic wealth is produced, but also where negative environmental and social impacts are localized. Ports worldwide have been organized according to the needs of the “oil-centric” economy, creating “Petroleumscares” (Hein, 2011; 2015). These landscapes are losing their productivity, especially in small and medium-sized ports, due to the geographical concentration of port operations, “leading to the loss of their economic functions and the deterioration of port areas and the urban areas linked to them” (European Committee of the Regions, 2017). The ongoing process of containerisation and the geographical concentration of port functions challenge port cities, and especially the intermediate ports

Port cities represent key places where population, economic strength, competitiveness, human capital and global appeal are increasingly concentrated. They can be “laboratories of creativity”, stimulated by their specific cultural historic landscapes (Fusco Girard *et al.*, 2012). They play a fundamental role in leading the way in terms of economic strength: 14 out of the 20 economically strongest cities in the world are port cities and 36 of the 50 most competitive cities are port cities (The Economist Intelligence Unit, 2012; Fusco Girard, 2013). Furthermore, 14 of the top 20 cities ranked according to the Human Capital Indicators are port cities (The Economist Intelligence Unit, 2012; Fusco Girard, 2013).

In metropolitan cities, which agglomerations include a core urban area and peripheral/commuting zones (OECD, 2012), multiple administrative entities (municipalities) are interrelated, and the system of port areas represents a specific metropolitan sub-system that should be put in relationship with the complex urban system/landscape. Metropolitan port cities can be considered as a system of many other

systems and subsystems: natural/environmental/ecological system; residential system; productive/industrial system; energy system; logistic system; cultural system; economic system; social system.

Commercial, industrial, logistic, tourist and fishing activities/functions are concentrated in port area, making it a driving force for economic wealth. Port areas can represent the entry point for the city regeneration (Fusco Girard, 2013; Nocca and Fusco Girard, 2017) and a core place for sustainable development for the comprehensive urban/metropolitan/regional system.

However, economic benefits often spill over to other regions, whereas negative impacts are mainly localized in the port city (Merk, 2013). In metropolitan cities, and especially in ecologically vulnerable coastal/port metropolitan cities, there is a strong risk that agglomeration economies can be turned into agglomeration dis-economies (Fusco Girard, 2014), resulting in pollution, congestion, over-exploitation of resources, but also in a decrease of perceived well-being. Metropolitan port areas are therefore exposed to the risk of a decrease of overall productivity, even in social terms.

Many common issues can be recognized for the development of the port-city system (Fusco Girard, 2016; Fusco Girard *et al.*, 2017):

- the increasing separation between the city system and the port system;
- the waste of energy, water, natural resources;
- real estate market characterized by speculative components;
- the loss of local identity;
- lack of accountability, transparency and effectiveness in the local governance;
- increasing in costs, decreasing effectiveness and productivity.

The European Committee of the Regions has highlighted the potential of “new continental and sustainable markets like the circular economy and bioeconomy” as important requisites for economic growth (European Committee of the Regions, 2017). Thus, synergic effects in port-city relations need to be identified and enhanced, through the valorisation of their “economic, cultural and historical lifelines to rural, island and peripheral areas”. It calls for the diversification of port activities, re-functionalization and creation of synergies between port area and the city, and “emphasises that many European sea and inland waterway ports have major cultural assets and, in view of their specific features, require special activities under programmes and projects designed to conserve European cultural heritage”. Furthermore, a positive role of local communities is advocated for the involvement of ports in the life of port cities.

Moreover, AIVP (the Worldwide Network of Port Cities) highlights the need of involving the community in identifying the more suitable and potentially successful functions to be implemented in the regenerated port areas. In line with the European Committee of the Regions, the AIVP highlights three main challenges for port cities (Matis, 2017):

- transforming city-port interfaces and former port sites;
- dealing with the consequences for port cities of current changes to the maritime, port and logistics industries;
- port city governance and the place of citizens in the new city-port relationship.

More inclusive governance models are needed: the assessment of the needs of stakeholders, through engagement processes and the systematic analysis of the demand of new uses/functions in port areas, helps to reduce the risk of investment in development projects.

## 1.2 The need for a new metropolitan economy model in port cities

A critical aspect of metropolitan development is linked to the improvement of local productivity. A new metropolitan economy is based on the use of all local resources (cultural heritage, cultural landscape, local knowledge, local entrepreneurship, commons, local energy) and the specific localization of functions in port areas, including creative activities, to increase the attractiveness of the metropolitan city and its competitive capacity, creating an attractive environment for investments.

This new urban economy should be more and more characterized by “circular” processes; they are characterized by the 6Rs (reduce, recover, reuse, recycle, regeneration, renewables) for reducing congestion/pollution costs, and activate synergies, complementarities, symbioses (Mirata and Emtairah, 2005; Wijkman and Skånberg, 2015; Moreau *et al.*, 2017).

Urban planning should be able to stimulate this circular/virtuous processes between the metropolitan city and the broader territory, through a systemic approach, evoking the approaches and tools of industrial ecology characterized by the attention on the flow analysis between the city and the territory, the urban metabolism, the synergistic exchanges between resources flows due to spatial/geographic proximity (Chertow, 2000).

A regenerative model of urban development reshapes the interpretation of the sustainable city not only conserving all forms of capital, but regenerating the different forms of capital, imitating the wisdom of natural systems, closing the loops, and thus facing the damages of “petropolis” (Girardet, 2013).

This model is characterized by circular organizational processes. It regenerates not only resources, energy, water, the natural ecosystems (on which the human life depends), but also the social and institutional relationships that allow the systems to work, and on which the wellbeing of populations depends (Moreau *et al.*, 2017).

A new regenerative model for port-city development includes a functional asset able to enhance symbioses and synergies between the port system and the city, the metropolitan built space and the agricultural territory, together with the conservation/valorization of cultural landscape (Fusco Girard, 2013; 2014b). Alignment of port and city planning is essential to ensure that port and city mutually reinforce themselves rather than oppose each other (Ferrari *et al.*, 2012; Merk, 2013).

A regenerative strategy for sustainable development of metropolitan port cities should adopt the “landscape” perspective and strongly integrate a landscape approach in planning because all the values and interests of a society are reflected in the landscape (Fusco Girard, 2014a; 2014b).

The landscape stimulates an integrated systemic paradigm, because in the landscape research all hard and soft sciences/disciplines are involved. The landscape perspective offers a holistic, symbiotic and systemic approach to analyze urban transformations in urban planning towards sustainable development.

This paper is positioned in the transition phase from linear to circular development models and proposes first steps to integrate cultural heritage as a key element of circularization processes in historic cities.

Therefore, the aim of the paper is to explore whether and how cultural heritage can trigger new circular port-city development and to test the potential and limitations of this model in the case study of Pozzuoli, Italy.

The pilot study carried out in this paper is positioned in the transition phase towards the

new circular economy model, aiming at understanding the current gaps between theory and practical implementation in port cities, identifying relevant pathways for further research. Section 2 analyses the definitions of circular economy and the circular urban development models that are emerging in recent researches and planning/management practices in international cities. Section 3 presents the participative methodology proposed to assess which new uses/functions could be more suitable to implement a circular development model in Pozzuoli. Section 4 describes the evaluation criteria and methods applied for the assessment. Section 5 discusses the results, positioning them in a transition perspective, and proposed a set of possible actions to go forward a “circular Pozzuoli”, to boost the transition towards the circular city, enhancing the circularity and synergistic principles in port-city regeneration and strengthening the role of cultural heritage/ landscape as driver sustainable development. Finally, Section 6 highlights possible pathways for further research.

## 2. The circular economy model and the circular city development model

The circular economy model, based on the principle that in nature nothing is “waste” and everything can become a “resource”, can be proposed to operationalize the regenerative model of port-city development.

The circular economy is based on the ideally infinite enlargement of the life of goods, exploitation of renewable energy sources and on the general concept of synergy/symbiosis - between business sectors and social actors, to provide positive social and environmental impacts through economic activities.

The concept of circular economy has been developed starting from the industrial sector (Chertow, 2000), integrating the concept of synergies/symbioses with the Social and Solidarity Economy models (Moreau *et al.*, 2017), to develop a wider concept of circular urban development (Ellen MacArthur Foundation, 2017; Prendeville and Bocken, 2017). It has been defined in the industrial sector as “restructuring the industrial systems to support ecosystems through the adoption of methods to maximize the efficient use of resources by recycling and minimizing emissions and waste” (Preston, 2012). It is referred to how resources’ flows can be closed (Chertow, 2000).

Thanks to circular economy processes, contrary to the current linear processes of production-consumption-waste, inputs are minimized and, at the same time, outputs are maximized, preserving as long as possible the value of natural (and cultural) resources (Preston, 2012).

The United Nations have introduced in the New Urban Agenda (paragraphs 71-74) the notion of circular economy as a general development model that produces positive impacts on natural and social contexts, while generating new economic wealth (United Nations, 2016). The circular economy represents “a tangible set of solutions for reaching sustainable patterns of production and consumption”. It affects economy (e.g. Bio-economy, Blue economy, Green economy, Energy economy), jobs and the environmental system.

The European Commission has adopted a package to support the EU’s transition to the circular economy, including legislative proposals aimed at stimulating the European route towards the circular economy (European Commission, 2015). It is a fundamental contribution to the European efforts to develop a “sustainable, low carbon, resource efficient and competitive economy”. The objective is to boost economic growth, making it more sustainable and competitive in the long term. It considers circular economy as a mean

for contributing to innovation, sustainable growth and job creation.

According to Ellen MacArthur Foundation definition, the circular economy, that provides multiple value-creation mechanisms, is based on three principles: preservation and enhancement of natural capital, optimization of resources by circulating products, components, and materials, fostering system effectiveness by revealing and designing out negative externalities (Ellen MacArthur Foundation, 2015). This stimulates an indefinite enlargement of the lifetime of resources and their use value and promotes circuits of cooperation among different actors.

However, the concept of circularization processes can be applied also to wider issues, as economic patterns of investment/re-investment, or political systems of participative multi-level partnership governance or knowledge (Wijkman and Skånberg, 2015; Angrisano *et al.*, 2016; Moreau *et al.*, 2017).

The circular processes are based on synergies among system components, as among public institutions, financial institutions, public and private institutions, different enterprises, private enterprises and research institutions, etc. Synergy is a principle for development of creative learning, self-organization, strategic thinking and shared intelligence, which can be applied to urban, economic, social, cultural, ecological and political systems.

Circular economy is the re-generative economy of materials, but also of natural, cultural and social resources, energy, water, etc. It contributes to strengthen/regenerate bonds/relationships; it produces wealth and job opportunities, thus contributing to the human dimension of urban development.

Recent studies stress the role that the Social and Solidarity Economy (SSE) has in the implementation of a circular development model (Moreau *et al.*, 2017), highlighting the social dimension in the development of new models of shared value creation (Porter and Kramer, 2011).

Circular economy, based on cooperation, synergies and symbioses, requires relational values among people, among human being and nature, among human and society, promoting resilience and creativity and then sustainability of the city system (Fusco Girard, 2010; 2013).

## 2.1 Industrial ecology, industrial symbioses and urban symbioses

In the search of new models overcoming the linear processes, recent research has been focused on industrial ecology models highlighting the concept of symbiosis Ohnishi *et al.*, 2016). Industrial symbiosis could be widen from industrial field to urban and social sphere. (Fujita *et al.*, 2013).

Symbioses are based on circular processes and on density of synergies/relationships. They are collaborative relationships among elements that “help” each other’s. Symbiosis means “live together”, relationships and collaboration, reciprocal exchange: the product of an element becomes a nutrient for another one. It creates bonds. They create a high level of interconnection and integration among the different system components, as demonstrated by the symbioses existing in nature (i.e. lichens, sea anemones, hermit crab that show the advantages resulting from the symbiotic relationships).

Different forms of symbiosis can be observed in the industrial sector. Industrial symbiosis, as defined by Chertow (Chertow, 2000), is an activity that “engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products. The keys to industrial symbiosis are

collaboration and the synergistic possibilities offered by geographic proximity". It is part of the wider industrial ecology (of which it is a direct application) that, by optimizing the materials cycle, produces impacts on planning, environmental management and economic development (Ohnishi *et al.*, 2016).

An extension of industrial symbiosis is the urban symbiosis, activity that turns municipal solid waste into inputs for industries. It was introduced by van Berkel *et al.* (2009) to indicate the recycling activities that find their reason for being in geographical proximity and the synergistic relationships between producers of municipal solid waste and industries. The concept of urban symbiosis is closely linked "to the use of by-products (waste) from the cities (or urban areas) as alternative raw materials or energy sources for industrial operations" (van Berkel *et al.*, 2009), with the consequent reduction of polluting emissions and recovery of raw materials. Wider territorial symbioses can be implemented linking the city with the surrounding suburban and rural areas (Fujita *et al.*, 2013).

## 2.2 Different approaches to a circular city model

The circular economy could be recognized as a general development model, able to turn the linear urban metabolism into a new urban circular metabolism, in which input and output flows are "closed". The first implementations of circular economy processes have taken place in port areas, as Kalundborg (Denmark), Muroran (Japan), Kawasaki (Japan), etc. These areas have played a central role in the implementation of this model (van Berkel *et al.*, 2009; Fujita *et al.*, 2013; Dong *et al.*, 2016).

Many cities, such as Amsterdam, Rotterdam, Paris are moving towards the "circular city model". Although the vision for circular urban development has been proposed in many cities (e.g. Amsterdam, Paris, Rotterdam, Glasgow, Lisbon), there is still ambiguity around this concept (Prendeville and Bocken, 2017). Cities worldwide are experimenting circular models of urban development/regeneration, which include elements such as: a built environment designed to be recyclable and reusable, and to contribute to the production of energy and food, imitating natural cycles; energy systems that are resilient, renewable, localized and distributed; multi-modal urban mobility systems integrating public transportation and on-demand electric cars and reducing the excessive road infrastructure by reusing them for new functions; an urban bioeconomy based on closed nutrient cycles with urban food production and organic waste treatment; production systems that encourage the creation of "local value loops", through maker-labs for reuse/recycling/repair of goods and local productions (Ellen MacArthur Foundation, 2017).

Port cities offer a lot of opportunities to make circular economy concrete, through recycling, sharing, re-using, designing, up-cycling (Fusco Girard, 2013). They can become cities of symbioses: symbiosis between industrial/logistic economy and touristic economy, industrial system and urban system, cultural heritage/landscape conservation and economic development, etc. (Fujita *et al.*, 2013; Fusco Girard, 2013).

Technologies assume a central role in circular economy implementation. They are the nervous infrastructure of the system; they support decision-making processes. In addition to new technologies, social innovation and the related engagement of citizens represent a great challenge for many port cities (Daamen and Vries, 2016; Matis, 2017). It is important to consider that while 25% innovation success is determined by tech, 75% innovation success is determined by social innovation (Volberda, 2016).

Therefore, the success of this model mainly depends on the community/policy-makers

mind-set and technology.

The achievement of circularity strategy, and thus the transition towards the circular city model, requires (a long) time. Therefore, it is necessary to consider two different phases in this pathway: the transition process and the achievement and implementation of circularity strategies.

In both phases, technological innovations, but especially socio-institutional changes, are fundamental for the implementation of circularity strategies.

### 2.3 Culture-led strategies for port-city regeneration

Port cities are historically the places where cultural heritage is localized (Fusco Girard *et al.*, 2014). They house a wealth of remains from the past: warehouses, waterfront landscapes, historical atmosphere, lighthouses, industrial architecture, etc. Many of European port cities are characterized by a relevant cultural landscape. Many port landscapes, most of which with a considerable industrial architecture, are even recognized as UNESCO sites. In Italy, two thirds of metropolitan port cities are recognized as UNESCO World Heritage sites.

Cultural heritage is subject to constant change, continuous hybridization processes to adapt itself throughout history: each square, each building, each church expresses the “graft” of new points of view, new styles etc. in the historical tradition.

In historic port cities, the ecological economy of the port needs to integrate with the economy of culture. Here, there is a strong conflict between conservation of historic-cultural values and technological economic interests. In order to manage conflicts between new and old values, and private and public interests, creativity and flexibility are necessary. Culture-led strategies become important to sustain new regeneration processes in port cities/areas: the landscape itself reflects the culture of inhabitants (their way of life, their capacity to cooperate, their priorities, etc.).

In this perspective, the circular economy model allows conserving the use-value and the intrinsic value of heritage, through the regeneration of resources. In this way, it produces multidimensional benefits: cultural benefits (conserving “alive” a symbol of community identity), economic benefits (in terms of increase of productivity), environmental benefits (i.e. reduction of resources and land consumption) and social benefits (i.e. new employment opportunities).

In order to move towards sustainable development in historic urban landscapes, it is necessary to integrate conservation and development in a circular process, adopting a dynamic and ever-changing perspective, while ensuring the preservation of integrity and authenticity values (Bandarin and van Oers, 2012, 2014; Fusco Girard, 2014b). In this dynamic and synergistic perspective, cultural heritage conservation/valorization becomes a productive activity (Forte, 1977; Di Stefano, 1979), able of producing plus values in multiple dimensions, such as economic prosperity, environmental quality and social vitality (Fusco Girard *et al.*, 2014). This concept of “conservation through compatible change” has been underlined by the UNESCO Recommendation on Historic Urban Landscape (UNESCO, 2011).

The circular economy can represent an economic perspective that can be proposed for integrating conservation and development (Fusco Girard, 2014b). The reuse, rehabilitation, recover of cultural heritage and landscape are part of the circular economy process (Cerreta and De Toro, 2012). Cultural heritage/landscape can represent a ciclyfier in the flow-city

system able to trigger circularization processes (Fusco Girard *et al.*, 2014; Nocca and Fusco Girard, 2017), integrating import capability (attractiveness for tourists, talents, capitals, people) and export capability (handcrafts products, art, local identity products/knowledge products, innovative services) in a wealth creation process (Fusco Girard, 2013).

Maintenance, reuse, restoration, rehabilitation, but also valorization and regeneration are key words and they are improved through circular processes.

In the cultural heritage/landscape perspective, the re-functionalization represents a way to transform principles of circular economy into practice. Circular economy processes are able to produce a reduction of costs (management and operating costs, environmental and socio-cultural costs) (Wijkman and Skånberg, 2015) and thus, the current “cost” of non-used cultural heritage can be turned into an “investment”, through creative functional re-use (CHCfE Consortium, 2015; Historic England, 2016).

Circular processes and the principles of synergy can be implemented in the space of the city/territory, through planning. Planning represents the institutional tool to change the existing city organization. Integrated urban planning improves the city complex landscape, creating new values.

Applying circularization in urban planning means to plan for multi-functionality and flexibility, recovering abandoned areas and turning unused areas into focal points of circularity through new functions linked to circular urban processes (e.g. materials collective resource banks, spaces of sustainable local production, co-working and co-housing, public spaces enhancing relationships). The wealth of the city depends on the new organizational structure that can be improved through cultural-led/strategic planning, if suitable institutional capital (i.e. rules, norms, laws, standards, etc.) is available.

In this perspective, public authorities play a central role, as they can guide, plan and implement choices and actions moving towards this new model. Many actors are involved in this complex system; the relationships and interactions among them contribute to make system more efficient and resilient cities.

### **3. Towards a circular development model for port-city system: the case of Pozzuoli in the metropolitan city of Naples, Italy**

A proposal for circular port-city development has been elaborated and tested in the case study of Pozzuoli, a medium-sized historic port city (81,661 inhabitants) located in the metropolitan city of Naples, in Southern Italy. Pozzuoli has an important but still undervalued cultural and natural heritage (Fig. 1), especially on the coastal zone, which can become a driver of port-city regeneration, if integrated in the planning instruments for the development of the port area.

A participative methodology (UNESCO 2016; Smit, 2011) has been developed and tested to assess the knowledge and up-take of local stakeholders in relation to the circular model of port-city development, taking into account the role of cultural heritage in a systemic port-city landscape perspective.

The experimentation has started from the assessment of existing planning tools, highlighting the “linear” organizational models and trying to define a set of possible new uses (functions) to be integrated in the port masterplan to trigger circular processes of port-city development.

The results of the evaluation phase have been analysed and discussed, highlighting whether and how the functions identified by the involved stakeholders can be framed in a circular

development model. Possible actions to shift towards a circular port-city development model in Pozzuoli have been proposed, including the valorization of cultural heritage.

**Fig. 1 - Ex Sofer area and the main cultural/natural heritage of Pozzuoli**



### 3.1 The case study of Pozzuoli

A redevelopment plan is foreseen for the port area of the city and in particular for the site currently occupied by the abandoned plants of ex “Sofer”, an industrial plant which dates back to the 1800s and closed in 2003 (after more than 100 years of activity), today representing a physical barrier between the city and the sea, a “concrete wall” of abandoned industries.

The urban redevelopment of the ex Sofer area is regulated by laws for the protection of natural and archaeological resources and is included in the Masterplan of Pozzuoli Coastline, designed by Eisenman Architects, Interplan Seconda Srl and AZ Studio. It is a plan for waterfront regeneration aiming at the redevelopment/revitalization of the coastline through the enhancement and valorization of the archaeological heritage, the disposal of industrial buildings and the redevelopment of the waterfront through the introduction of new facilities and the conversion of the port for tourism functions.

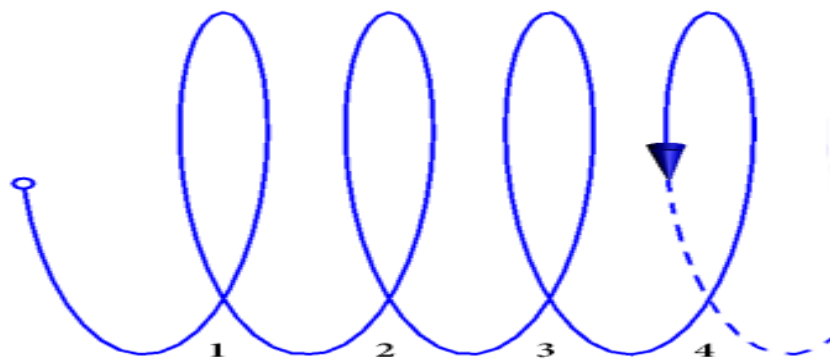
### 3.2 Methodology: the participative approach to engage stakeholders towards a “circular Pozzuoli”

A participative methodology has been developed and tested, involving key stakeholders at local level (De Toro and Nocca, 2017; Nocca, 2017) to identify new uses for the post-industrial port area of ex-Sofer, able to trigger synergistic relationships between the port and the city.

The choice of a participative methodology is aimed at the engagement of key territorial actors (local government, planners and practitioners, port authority and residents) in the discussion on the circular economy/circular city models, trying to creatively hybridize the academic knowledge with the practice knowledge of stakeholders and their visions and needs for port-city regeneration. Multicriteria evaluation tools have been applied to support the process of co-learning and co-design towards a proposal of new shared masterplan of the port area of Pozzuoli.

The evaluation process has taken the characteristic of an iterative process, where different levels of stakeholders' involvement and in-depth analysis have been carried out in each phase, leading to a final result which is still to be considered an intermediary step of the ongoing process of circular port-city model definition (Fig. 2).

**Fig. 2 - The iterative process of stakeholders' involvement and evaluation**



(1) knowledge; (2) Focus groups and questionnaires; (3) evaluation; (4) further stakeholders involvement and evaluation

The methodology is structured in three main stages:

1. Knowledge phase:
  - analysis of the context, including attributes and values of the site and historic layering of the port area and Pozzuoli in general;
  - analysis of the existing regulatory and planning instruments and the existing proposals for port area refunctionalization.
  - this stage has led to the identification of a primary set of functions to be discussed and integrated through the subsequent stages of the methodology.
2. Participatory phase and data collection:
  - identification of key stakeholders: local government representatives, urban planners and practitioners, port authority representatives and local community;
  - realization of half-day face-to-face focus group sessions with local authorities, planners and practitioners, aimed at the identification of circular development strategies for port-city synergic development. This phase has been necessary to

ensure that all involved actors have the same level of knowledge regarding potentialities and barriers in the implementation of a circular port-city development model, and to identify additional functions for circular port-city regeneration;

- development and administration of semi-structured questionnaires targeting the local community (residents and members of citizens' associations), aimed at identification of additional functions for circular port-city regeneration – potentially supported by application of NAIADE evaluation method for the identification of possible synergies/coalitions and/or conflicts among the different territorial actors.

### 3. Evaluation phase:

- prioritization of proposed functions for the port area through application of MacBeth evaluation method, aiming at assessing the demand of new uses of the port area considering the potential impact/contribution of each function to the overall goal of increasing the city productivity in multiple dimensions: economic, environmental, social and cultural dimensions.

Data collection and analysis have been structured according to the multicriteria evaluation methods employed. NAIADE (Novel Approach to Imprecise Assessment and Decision Environments) is a discrete multicriteria evaluation method through which it is possible to analyze the preferences expressed by a heterogeneous group of actors in relation to a set of given options, identifying possible synergies (coalitions) among different subjects based on the preferences expressed by each group (Munda, 2001).

Although different stakeholders' categories have been invited to the focus groups and have received the questionnaire, only residents completed the semi-structured online questionnaire proposed, thus the application of NAIADE for the identification of coalitions/synergies between stakeholders' remained limited in this specific case study.

The small number of subjects in the participative stage and the consequent limited possibility to apply the NAIADE method to analyse possible coalitions/synergies among stakeholders' groups is a limitation of this study.

Given a primary set of functions (starting from the current regulations), additional functions have been identified throughout the stakeholders' involvement phase during the focus group sessions and the open sections of the questionnaire.

The MacBeth evaluation method (Measuring Attractiveness by a Categorical Based Evaluation Technique) (Bana e Costa and Vansnick, 1999) has been applied to prioritize the selected functions in relation with the overall objective of circular port-city development (to increase the city productivity in multiple dimensions). The choice of this specific method is linked to the possibility of applying qualitative synthetic judgments to a set of options (functions) in relation to multiple criteria that define the overall goal.

The following section shows the methods employed and the results obtained in each stage of the methodology, focusing on the MacBeth application for the final identification of priorities for the selected port-city potentially synergic functions.

## 4. Results: application of the methodology to the case study of Pozzuoli.

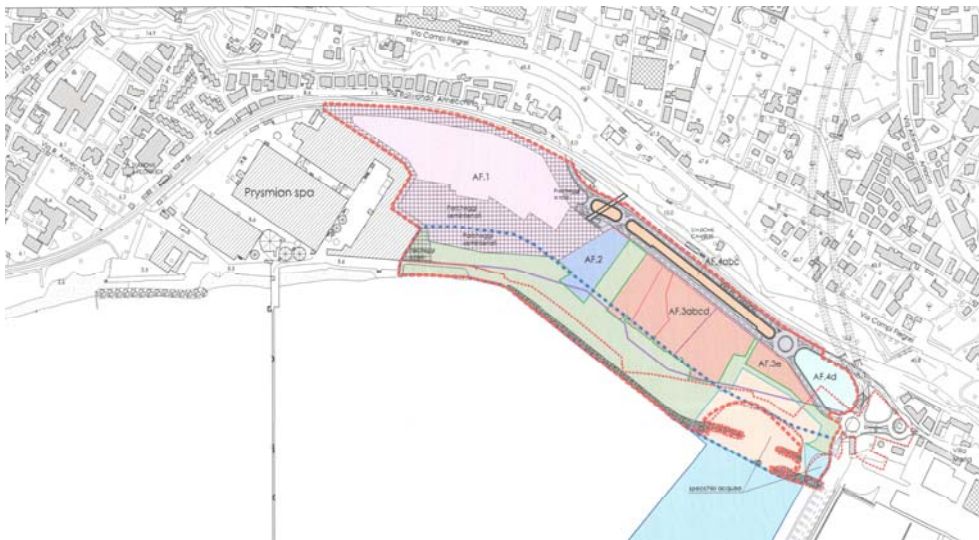
### 4.1 Knowledge phase

The first step of the methodology has been to analyse the context and identify a set of primary functions proposed in the current planning tools. The approved Urban Implementation Plan (PUA) (2009) (Fig. 3) and the "Proposal for a revision of the

approved PUA” (2015) (Fig. 4) have been the basic planning tools to identify a primary set of functions.

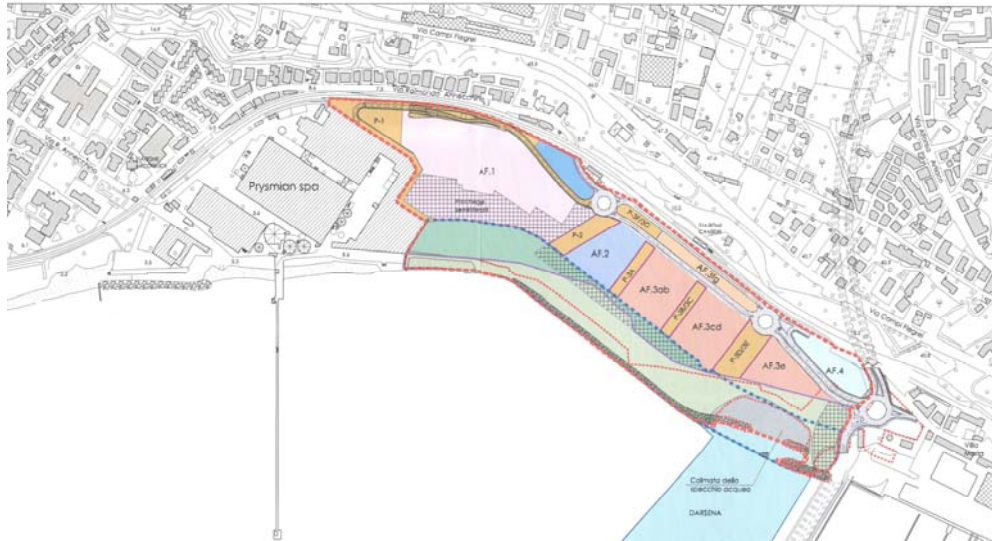
The “proposal for a revision of the approved PUA” - presented by the owner of the area, the private company Flegreo Waterfront Spa - points out to the “gravity of the economic situation that has reset every entrepreneurial expectation at startup level”, and proposes a partial change of the intended uses of the approved Urban Implementation Plan (PUA), converting a part of the activities related to technology and craft production functions and the proposed offices into residential assets (including Social Housing units).

**Fig. 3 - PUA masterplan with functional areas**



Functional area		Functional area	
AF.1	Polyfunctional complex	AF.5d	Urban Equipped Park
AF.2	Accommodation complex	AF.6a	International sail Academy
AF.3abcde	Arts and crafts centre	AF.6b	Sail boat dock
AF.4abc	Trade and services	AF.7	Infrastructures
AF.4d	Offices and services		

Source: Gnosis Architectural firm and Municipality of Pozzuoli

**Fig. 4 - Proposal for a revision of the approved PUA masterplan**

	Functional area		Functional area
<b>AF.1</b>	Services center	<b>AF.3fg</b>	Social housing
<b>AF.2</b>	Accommodation complex	<b>AF.4</b>	Offices and tertiary
<b>AF.3abcde</b>	Residential complex		

Source: Gnosis Architectural firm and Municipality of Pozzuoli

The first set of functions identified through the analysis of planning instruments and revision proposals is the following:

- A. Residential units
- B. Production industry
- C. Accommodation complex
- D. Trade/shopping
- E. Business district
- F. Scientific-technological center
- G. Urban Equipped Park
- H. Sports complex
- I. Park areas

#### 4.2 Participatory phase and data collection

The second step of the research has been developed through the involvement of stakeholders to understand their awareness about the circular economy model (and its benefits) through the identification of potential additional functions to be localized in the ex-Sofer area, able to increase, in a circular perspective, the multidimensional city

productivity. These functions are those that can mainly contribute to link the port with the city and the broader territory, considering these entities to be linked in synergic relationships.

Four main groups of stakeholders have been identified in the participatory phase:

- local governments and institutions (Campania Region, Metropolitan city, Municipality, Superintendence, Basin Authority);
- Port Authority (local Maritime Authority);
- planners and practitioners (Professional Association of Geologists, Professional Association of Architects, Professional Association of Engineers, ACEN Association of Builders Construction of Naples, Industrial Union, Trade Union);
- local community (residents and representatives of citizens' associations).

First, face-to-face focus groups have been realized with institutional stakeholders' categories: local governments and institutions, port authority and planners/practitioners. Focus groups have been aimed at the assessment of the preferences of these stakeholders' groups regarding the primary set of functions, and to discuss potential additional functions to be localized in the ex-Sofer area in relation to the circular port-city regeneration model.

Therefore, one outcome of the focus groups sessions has been the identification of a set of additional functions to be integrated in the overall list of functions for the definition of a shared masterplan.

In the later stage, a semi-structured questionnaire has been administered to assess the preferences of the larger local community regarding the proposed functions (Smit, 2011) and to identify further additional functions, which consider the valorization of cultural heritage assets.

The proposed model of circular port-city development and regeneration of cultural heritage/landscape has been presented and discussed during the focus groups with stakeholders on the basis of the existing planning proposals.

The questionnaire has aimed at the assessment of preferences on the primary set of functions and identification of additional functions. This step has been mainly implemented to include the perspective of local residents and members of civic associations in the definition of a shared masterplan for the port area. The questionnaire has been sent also to focus groups participants, although only few of them have provided complete answers.

The questionnaire has been structured in 3 main sections:

1. introduction and respondent data to explain the objectives of the survey and identify the stakeholder' category of each respondent;
2. presentation of the primary set of functions for port area redevelopment and assessment of respondent preferences based on a 1-5 values scale;
3. open section for the identification of additional functions to be integrated in the port area masterplan.

The questionnaire has been administered online, reaching a number of 41 complete answers in a time span of two weeks (Nocca, 2017), mainly from residents and representatives of citizens' associations.

Additional proposed functions arisen through the focus groups and questionnaires are:

- Shipping station;
- On-site command for the Archaeological Park of the Flegrea Area;
- Museum Center (related to cultural and natural heritage);
- Educational touristic pole;

- Research center;
- Tourist service point;
- Park areas for tourist terminal;
- Urban equipped park.

These functions have been taken into account in the following evaluation phase as possible functions to be localized in the ex-Sofer area.

### 4.3 Evaluation phase

The evaluation phase aimed at processing the data collected in previous phases to define the priorities for the functions to be included in the port area masterplan. The assessment of priorities has been conducted through the application of the MacBeth evaluation method. MacBeth is based on pairwise comparisons and adopts an interval scale (Ishizaka and Nemery, 2013). It has been chosen for the possibility of processing qualitative judgments from different data sources (focus groups and questionnaires) in a synthetic matrix, linking the options (functions) to the potential impacts on 9 identified criteria (impact categories) (Nocca, 2017). The final list of functions deduced from the previous participative phase is presented in Tab. 1.

**Tab. 1 - Final list of functions**

<b>F1</b>	<b>Urban Equipped Park</b> (beach resort, equipped seaside, heliotherapy, thalassotherapy, kiosks and bars, place of worship, green public area, urban farming)
<b>F2</b>	<b>Park areas</b>
<b>F3</b>	<b>On-site command for the Archaeological Park of the Flegrea Area</b>
<b>F4</b>	<b>Shipping station</b> (port service; information point, taxi and car rental service, shuttle service to the city center; small refreshment bar; finance and police; harbour master's office; artistic events)
<b>F5</b>	<b>Educational touristic pole</b>
<b>F6</b>	<b>Tourist service point</b> (info point, other tourist services) and <b>park areas for tourist terminal</b> (tourist bus, guided visits to the sea – submerged park)
<b>F7</b>	<b>Accommodation complex</b> (hotel, residence, spa/baths, seaside resort, meeting hall, garages)
<b>F8</b>	<b>Polyfunctional complex</b> (retail, leisure time, catering, sport, garages and parking area)
<b>F9</b>	<b>Sports complex</b>
<b>F10</b>	<b>Scientific-technological center</b>
<b>F11</b>	<b>Sailing center</b> (with sailing technological center for temporary junior and athlete residence)
<b>F12</b>	<b>Sail Academy</b> (academy, Savoia Club, park areas)
<b>F13</b>	<b>Museum Center</b> (related to cultural and natural heritage)
<b>F14</b>	<b>Sail boat dock</b> (a dock with a small service building and a connected park area; a sheet of water for docking, dock services, parking)
<b>F15</b>	<b>Production industry</b> (industries, handicrafts, etc.)
<b>F16</b>	<b>Residential units</b>
<b>F17</b>	<b>Business district</b> (Banking, insurance, private offices, professional offices, etc.).

The first step of this evaluation process has been the structuring of the evaluation problem, that is the identification of the criteria (impact categories) and sub-criteria (specific indicators) for evaluating the impact of each function to the overall goal (to increase the multidimensional productivity of the city). The criteria on which basis the impacts have been evaluated correspond to the 9 multidimensional categories of impact identified. On the base of previous studies (Fusco Girard *et al.*, 2015; Gravagnuolo and Fusco Girard, 2017; Nocca and Fusco Girard, 2017), a set of 9 main categories of multidimensional impacts has been proposed to assess the impact of each function on the overall goal (to increase city productivity in multiple dimensions):

- Tourism and Recreation;
- Creative, cultural and innovative activities;
- Typical local productions;
- Environment and Natural Capital;
- Community and Social Cohesion;
- Real estate;
- Financial return;
- Welfare/wellbeing;
- Cultural value of properties/landscape.

These categories have been divided into three groups on the base of the weight that they have in reference to the overall goal (from the group of categories with major weight to the one with less weight): (1) tourism and recreation, cultural value of properties/landscape, welfare/wellbeing; (2) creative, cultural and innovative activities, community and social cohesion, typical local productions, financial return; (3) real estate, environment and natural capital. This subdivision has been elaborated during the focus groups with the expert actors. For each category of impact, specific indicators have been identified (Tab. 2), able to express the main measurement tools for each impact category.

**Tab. 2 - Selected categories of impact and proposed indicators**

Category of impact	Proposed indicators
<i>Tourism and recreation</i>	<ul style="list-style-type: none"> <li>- tourists in hotels and non-hotel accommodations/year;</li> <li>- number of visitors/year;</li> <li>- passengers to the port - unloading and loading/year;</li> <li>- number of employees in local active units - tourism sector.</li> </ul>
<i>Creative, cultural and innovative activities</i>	<ul style="list-style-type: none"> <li>- number of active enterprises by type of activity;</li> <li>- number of employees in local active units number - typical and local production;</li> <li>- percentage of employees by sector on the total number of employees.</li> </ul>
<i>Typical local productions</i>	<ul style="list-style-type: none"> <li>- number of farms;</li> <li>- number of educational farms;</li> <li>- number of wine-firm.</li> </ul>
<i>Environment and natural capital</i>	<ul style="list-style-type: none"> <li>- amount of cars/year; amount of bus/year;</li> <li>- municipal waste production per capita.</li> </ul>

<i>Community and social cohesion</i>	- number of non-profit active units; - number of volunteers in non-profit units; - index of propensity to cooperation ( <a href="http://www.postmetropoli.it">www.postmetropoli.it</a> )
<i>Real estate</i>	- market value of residential building - good state of conservation; - number of active businesses in real estate sector; - index of residential attractiveness ( <a href="http://www.postmetropoli.it">www.postmetropoli.it</a> ).
<i>Financial return</i>	- earnings due to tickets selling; - incomes due to construction permits; - taxes related to real estate asset; - avoided expenditure for management and maintenance of cultural heritage due to increasing in private investments.
<i>Welfare/wellbeing</i>	- average income per capita; - employment rate;
<i>Cultural value of properties/landscape</i>	- Incidence of buildings in good state of conservation/total buildings; - incidence of buildings in poor state of conservation/total buildings; - potential for residential use in residential areas/total buildings.

These indicators have been extracted, through focus groups with expert actors, from the indicators matrix deduced from the analysis of good practices about cultural landscape regeneration projects (Fusco Girard *et. al.*, 2017; Nocca, 2017): key indicators for the city of Pozzuoli have been identified on the base of their relevance and availability of data.

The indicators are not only referred to the impacts in the port area, but they take into account the multidimensional impacts (economic, social, environmental and cultural) on the city and broader territorial area, in accordance to the systemic landscape perspective proposed in the UNESCO Recommendation on Historic Urban Landscape.

A judgment matrix has been elaborated making pairwise comparisons among the different functions with respect to each indicator. The impacts of each function on each category and indicator have been determined starting from the qualitative judgments expressed using the seven MacBeth semantic categories (no impact; very weak; weak; moderate; strong; very strong; extreme).

After the phase referred to each fundamental criteria and the attribution of weights, the final aggregation phase has been elaborated. Thus, a final ranking of preferences referred to the overall goal has been processed. The final ranking is showed in Tab. 3.

**Tab. 3 - Final ranking and relative scale**

Ranking	Function	MacBeth scale
<b>F1</b>	Urban Equipped Park	104,62
<b>F7</b>	Accommodation complex	92,98
<b>F8</b>	Polyfunctional complex	92,98
<b>F6</b>	Tourist service point and park areas for tourist terminal	92,35

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<b>F13</b>	Museum Center	92,23
<b>F5</b>	Educational touristic pole	82,42
<b>F3</b>	On-site command for the Archaeological Park of the Flegrea Area	65,86
<b>F4</b>	Shipping station	59,31
<b>F9</b>	Sports complex	54,47
<b>F2</b>	Park areas	52,95
<b>F17</b>	Business district	49,76
<b>F10</b>	Scientific-technological center	49,56
<b>F11</b>	Sailing center	48,21
<b>F12</b>	Sail Academy	42,44
<b>F15</b>	Production industry	42,34
<b>F16</b>	Residential units	42,34
<b>F14</b>	Sail boat dock	33,92

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## 5. Discussion

On the basis of the results of the participatory process, a hierarchy of functions has been elaborated. They are very far from the circular economy model. In fact, the results do not reveal functions strictly and explicitly linked to circular processes, despite some indications provided during the focus groups.

Certainly, the proposed functions have not to be considered as separated, but as programs that interact each other's sharing intensity (Fenton, 1985).

Furthermore, it is interesting to note that the functions that can be considered more linked to circular processes (business district, scientific-technological center, production industry) are in the last places of the ranking, denoting a lack of awareness of their potential in the implementation of the circular city model. Instead they are able to trigger circular processes, contributing also to improve resource productivity/efficiency and recycling.

For example, a circular relationship between the urban farming and restaurants, bar etc. that are localized in the area can be triggered. They can propose "zero Km menu" that encourage local economy and the work of small companies, offering food and local products.

Furthermore, as emerged from the face to face focus groups, some of buildings can be characterized by a roof garden for cultivation. The roof garden, in addition to the improvement of the interior microclimate of buildings, provides food for residents and, at the same time, guarantees vitality and contributes to the use value defining of buildings.

Additionally, there is a circular relationship between the scientific-technological center and the production industry: circularization between knowledge production and goods production.

Specific start-ups can trigger innovative technological processes, for example for management of waste materials, such as plastics coming from the city and from local shipbuilding, waste water, etc. On the other side, the polyfunctional center can hosts a

platform where enterprises can exchange their knowledge, best practices and experiences moving towards symbiosis processes. Furthermore, it is interesting to observe that the “residential units” function is placed in one of the lowest ranking positions, highlighting the lack of awareness about the capacity of the residential function to finance itself and, at the same time, to attract investments for other functions.

Whereas circularity has been weakly considered in the choices of stakeholders, a strong focus on cultural heritage has been observed in the choice of additional functions and their overall ranking. Many functions linked to the valorization of cultural heritage assets have been positioned on a high score ranking, such as “Tourist service point and park areas for tourist terminal”, “Museum Center”, “Educational touristic pole”, “On-site command for the Archaeological Park of the Flegrea Area”. The first two ranked functions, “Urban Equipped Park” and “Accommodation complex”, are rather multifunctional and show a certain link with enjoyment of natural and cultural heritage. This result encourages further research on the role of cultural heritage as enabler of circular processes in metropolitan port cities.

The experimentation of the overall participatory methodology is here interpreted as the first necessary steps towards the “cultural” transition to a circular city model in heritage port cities.

To overcome cultural barriers especially at local administrative and planning level and propose a step forward towards the implementation of a circular development model in port-city systems, a set of possible actions are absolutely necessary and here proposed.

However, as above mentioned, the repurposing of the port area cannot represent the unique solution for port-system regeneration. It is able to connect city and sea, to enhance attractive capacity of the city, but it is necessary to link it with specific actions able to trigger circular processes. These actions, which can be introduced through management rules, have an influence on the urban/strategic project/plan and can contribute to gradually modify it towards a new circular city strategic organization/asset.

### **5.1 Possible actions towards the “circular port-city” model**

As mentioned in the previous paragraphs, the circular economy can be proposed as a model able to regenerate the comprehensive city organization.

There are some initiatives that can be proposed in order to guide the city of Pozzuoli towards the implementation of the circular economy model. They have been elaborated starting from the analysis of the city and the analysis of the current reports and practices of cities that are moving towards the same direction. In particular, the White Paper on the circular economy of Greater Paris (Mairie de Paris, 2017), Circular Amsterdam (Circle Economy, 2016a), Circular Glasgow (Circle Economy, 2016b), Circular Rotterdam (Gemeente Rotterdam, 2016) and Circular London (LWARB, 2017) have been taken in consideration to elaborate this proposal.

Considering the results coming out from the participatory phase, a further phase of the research has been started involving local stakeholder, to make a step forward in the transition towards a circular port city development model in Pozzuoli. A set of actions deduced from the above-mentioned reports and practices has been discussed during further focus groups in order to identify those that could be most appropriate for the future of circular Pozzuoli. Based on previous research, the objectives of a plan for circular port-city development and a set of feasible actions able to make operational the theoretical model

have been here identified

The proposed objectives towards circular port-city development in Pozzuoli are:

- waste reduction and management;
- material and energy saving;
- sustainable production and consumption (of goods and services);
- encouraging industrial ecology and symbiosis;
- changing in institutional framework;
- approach changes in planning;
- changing in mindset and sharing knowledge.

A set of possible actions is proposed in Tab. 4.

**Tab. 4 - List of actions towards the circular city**

<b>WASTE REDUCTION AND MANAGEMENT</b>	<b>Monitoring measure</b>
Create “Wastebook”, the first social network on waste and resources Creation of a social network on new raw materials that create a network among waste owners (businesses, associations, etc.) and waste recovery firms.	Yes/no
Analyze resources, sort and recover building site waste It can be useful, before demolishing, to analyse potential waste of the demolition. The aim of this action is to identify possible materials that can be reused and so to promote the re-use of building materials and reduce the cost of operations. This material can be reused in loco or can be proposed in on-line platform to be reused elsewhere.	% (Percentage of reused materials on waste of the demolition)
Recover unsold production and food waste at municipal markets Market waste, often organic, should be sorted and recovered. In order to avoid the production of food waste, municipal markets can distribute unsold foodstuffs to charity organizations. This requires an organization for quantifying unsold production and food waste and appropriate packaging.	Yes/no
Prevent waste from catering The city of Pozzuoli can play an active role proposing solutions for optimizing the amount of the quantities purchased, prepared and served in the catering sector and encouraging users to regulate their consumption (for example through offering portions labelled according to size.	%/year (Percentage of waste produced from catering)
Develop shared platforms for the collection of food donations The creation of a “platform” to facilitate the collection and storage of food surpluses, improving the dissemination of information and supporting the organization of redistribution can be useful.	Yes/no
<b>MATERIAL and ENERGY SAVING</b> Set up a development strategy for recoverable energy at the municipal level It can be set up an authority with the task of coordinating initiatives related to recoverable energy and to support public and private projects (developers, local authorities, businesses). Furthermore, it can be set up a platform to bring together renewable and recoverable energy producers and consumers, that is where supply and demand can meet. It could connect energy producers and consumers to allow	Yes/no

consumers knowing the possibilities of using recoverable energy or local energy sources.	
Promote object repairs through a set of complementary initiatives	
Extending product life and reduce waste quantities can be achieved by the organization of training workshops and also by providing tools to facilitate repairs.	n./year (Number of repair projects)
<b>SUSTAINABLE PRODUCTION and CONSUMPTION (of goods and services)</b>	
Create a business incubator to facilitate eco-design processes	
It can be useful to create business incubators for supporting companies (start-ups, etc.) intending to produce eco-design.	Yes/no
It should contribute also to raise awareness about eco-design issues, encourage innovation and support investors and partners. This incubator can be strengthened by the support of local authorities, foundations, etc.	n./year (Number of start-ups arisen from the business incubator)
<b>ENCOURAGING INDUSTRIAL ECOLOGY AND SYMBIOSIS</b>	
Stimulate industrial symbiosis based on feedback from abroad.	n.
The identification of impediments, levers and sharing of best practices can support the city to take the road to industrial ecology and industrial symbiosis.	(Number of activated symbioses)/n. of industrial activities) %
Organize new financing models.	(Percentage of industrial symbioses developed through new financing models)
To organize new financing models to motivate stakeholders to develop industrial symbioses.	
Create a committee to support the operational development industrial symbiosis initiatives.	
A Committee for supporting the implementation of industrial symbiosis is necessary.	
Its tasks could be: network the stakeholders; disseminate best practices; supporting future leaders; directly coordinate and promote; introduce concrete synergies; conduct studies and develop methodologies.	Yes/no
<b>CHANGING IN INSTITUTIONAL FRAMEWORK</b>	
Introduce circular economy clauses in public contracts	n./year
This initiative is referred to the possibility to introduce clauses in public contracts, with particular reference to the circular economy (waste production, product use, life and reuse).	(number of public contracts with circular economy clauses)
Increase the percentage of eco-designed products in public procurement.	%
It is referred to the possibility of using labels by public purchasers in order to increase the distribution of eco-designed products and services in public procurements.	(Percentage of eco-designed products in public procurement)
Encourage product eco-design	n. or volume/year
To move towards circular economy model it needs to encourage eco-design products through incentives both for producer and consumers. At production level incentives are able to produce recyclable products.	(number of incentives for the production recyclable products or volume of eco-design products)
Promotion of new economic models for green construction	
The aim of this initiative is to encourage green construction that considers environmental and social externalities in addition to economic value.	Yes/no
Fiscal incentives (as exemption for re-used, recycled materials) and	

the production and use of a software tool for comparing different approaches (linear and circular) of the same construction project should be employed.	
Test new public project contracting practices in the circular economy The re-use of materials, the use of recycled materials, etc. can be supported by public initiatives, as modifying the rules to obtain a building permit based on circular economy criteria.	n./year
Stimulate the integration of top-down and a bottom-up approach To encourage (through a renovation of legislative and regulations framework) the integration of a top-down and a bottom-up approach, respectively referred to legislative and policy level and to referred to companies' collaborations and supply chain efforts.	n. Association/ 10000 inhab. n./year (Number of workshops/meetings for year)
<b>APPROACH CHANGES IN PLANNING</b>	
Integrate a recoverable energy vision in land planning Urban planning can play a key role for recoverable energy development, including the production of recoverable energy in urban planning projects.	n./year (Number of projects including initiatives for recoverable energy development)
Include "alternative planning" and "green construction" modules in the training of architects "Alternative planning" and "green construction" can be included in future architects and building engineers training, through module related to social and environmental issue. The city of Pozzuoli can contribute to this end proposing this training, in partnership with project managers, the Order of architects, organizations, Associations, Universities.	n./year (Number of participants at training courses including "alternative planning" and "green construction" modules)
<b>CHANGING IN MINDSET AND SHARING KNOWLEDGE</b>	
Stimulate networking and cooperation for waste prevention and recycling In terms of waste prevention and recycling, local actors (businesses, associations, local authorities) do not communicate sufficiently among themselves. To enhance the communication, a digital platform can be established. It could have the role to identify major material streams that can be reused, recycled and donated, creating a network of companies, organizations etc. that can collaborate for waste prevention and recycling. The platform can represent also a database of knowledge exchange, through best practices.	Yes/no n./year (Number of companies and organizations in the network) Ratio between of saved material and the total consumed material
Create an on-line information platform for the circular economy An on-line platform for the circular economy can be useful to raise awareness among different actors. It can become a reference on the topic and incentivizing a cooperation atmosphere (for example through newsletters). It can encourage circular economy projects through the dissemination of best practices and appropriate partnerships.	Yes/no n. (Number of access to the platform)
Create a (symbolic) circular economy site A circular economy site, supporting the above-mentioned platform, could represent a hub for knowledge awareness raising, a virtual citizens' information center and a point of reference of exchange for associations.	Yes/no

Include new and circular economy principles in educational programs Some circular economy principles can be integrated in all teaching levels (primary schools, high schools, universities, etc.). This aims to build young people with a mind-set beyond the “produce – consume – dispose”.	n. (Number of young people attending programs related to circular economy principles)
Train professionals in re-use and repair Train professionals in re-use and repair are part of the programme. Training bodies can assess the current training offer and propose new ones related to re-use and repair.	n. (Number of participants in train professional in re-use and repair)
Facilitate donations and product repair by networking Craftsmen, businesses, local authorities and associations, possibly with the coordination of metropolitan city, can propose solutions for facilitating donations and product repair (i.e. recreational events) in order to facilitate donations and product repair by networking, as by platforms for donations.	n. (Number of donation and product repair by networking)

The implementation of circular economy model necessarily requires investment in technology, innovation and knowledge that are linked to some identified functions (Circle Economy, 2016b). Furthermore, it needs to include “circular thinking” in political and socio-cultural level (Gemeente Rotterdam, 2016).

The proposed actions represent a starting point for the transition of Pozzuoli towards a circular organization. The circular model goes beyond the singular actors (i.e. company). Its inclusive approach involves multiple and different actors to actively participate (citizens, associations, local authorities and companies). The aim of these proposed initiatives is to put in a synergic relationship all actors involved in this challenge and to create a network to accelerate the transition towards circularity.

The actions proposed for the historic port city of Pozzuoli can inform stakeholders choices for future development plans of other port cities. It is also relevant to note that the stakeholders’ engagement process tested in this study is an integral and necessary step of the transition to a circular economy, enabling depth reflections at local level and therefore triggering the cultural change.

In order to move towards the implementation of the circular model, it is needed to assess and understand the status quo, assessing how current economic and urban development models are “linear” and whether they can be turned into circular ones.

Additionally, there is the need of identifying which “areas/elements/cyclifier” (both material and immaterial) can be “used” to launch the circular processes in the city of Pozzuoli: the port and cultural/natural heritage can represent two key elements of the city symbiosis able to trigger circular processes.

Based on the ongoing experimentation in international cities and the results of this study, some specific recommendation can be proposed in the transition phase towards the implementation of circular Pozzuoli.

The pathway should be characterized by some steps:

- identification of the main involved sectors/elements in the circular chains;
- identification and evaluation of the main current and potential streams/flows;
- identification of barriers hindering the implementation of the circular model;
- identification of strategies to solve/overcome the barriers and to achieve the objectives

- of the circular economy;
- identification of the actions to implement the circular model (waste reduction, materials and energy saving, etc.);
- monitoring the progress and assessing the efficiency (or not) of the model.

## 6. Conclusions

The transition towards a circular city model is a process characterized by many steps during the short, medium and long term.

A long term strategic vision is required; it is independent from the political short time objectives of the local government, linked to conserve democratic consensus.

This is the reason why, in port cities, the engine/promoter of the transition process probably can be represented by the local Port Authority (or local Maritime Authority for smaller ports, as Pozzuoli port) and not the local political government, that can be stimulated by Port Authority towards a change.

In this framework, port areas can be considered the strategic entrance point of the comprehensive circular city processes to transform waste into energy, to reduce CO<sub>2</sub> (through rail transports characterized by eco-compatible fuels, etc.), to reuse building materials coming from demolitions.

A strong institutional and cultural “resistance” to change in the circular perspective and the possibility to better act at the management level through a strong engagement of the local community (Associations, civil social networks, schools, etc.) for stimulating a systemic and circular “way of thinking” are emerged from the Pozzuoli case study.

In this perspective, civic culture plays a key role. A “cultural revolution” is absolutely necessary for moving towards the circular logic of nature.

The research suggests that new planning tools and innovative regulatory tools should be developed to support the transition to a circular urban development model in historic port cities, taking into account the role of cultural heritage as driver for enhancing synergies between the port and the city.

The implementation of the circular model requires the integration (in a circular perspective) of a top-down and a bottom-up approach in governance (Lieder and Rashid, 2016; Prendeville and Bocken, 2017). The first one is referred to legislative and policy level and the second one, while the bottom-up approach, is referred to companies’ collaborations and supply chain efforts.

It is fundamental to underline the important role that social and institutional innovation plays in the circular economy transition process.

This new model requires new behaviours of inhabitants. They should be based not only on mutual trust and respect of rules, but also on a circular “way of thinking” of all city actors (in businesses, public administration, residents, etc.). The integration of the circular economy model principles in education and training programs can represent a first step forward to support this “cultural revolution”.

Citizens can play a key role in the implementation of the circular model by sustainable lifestyle, participation in governance and creation of bottom-up innovative solutions.

However, bottom-up actions are hindered by regulatory and institutional obstacles. The current institutional capital (rules, norms, standards) often represents a barrier in the implementation of this model. It should be reviewed and strengthened to make the model really effective. A renovation of legislative and regulations framework is an absolutely

necessary condition for supporting the transition towards circularity.

Making Pozzuoli a circular city is a great challenge that requires great efforts from all actors: local authorities, Port Captaincy, private organizations, companies, community associations, etc.

The model of circular city emerged from the case study of Pozzuoli, that puts the circularization in terms of management, is based on the combination of the port area regeneration plan (urban planning) and the implementation of specific management actions strictly linked to the circular economy model.

The benefits of this model need to be shared among different sectors and actors, to ensure that everybody in the chain can benefit of this implementation. In this way, cooperation, coordination, collaboration, communication become key concrete aspects.

The proposed strategy can be transferred from the Pozzuoli municipality to other cities of the metropolitan area of Naples characterized by a port area (such as Torre Annunziata, Castellammare, Naples), recognizing in the port system an accelerator in the achievement of many targets of the SDGs.

The proposed management actions can help to shape the metropolitan strategic plan and the port system strategic plan, that are going to be elaborated.

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## References

- Angrisano M., Biancamano P.F., Bosone M., Carone P., Daldanise G., De Rosa F., Franciosa A., Gravagnuolo A., Iodice S., Nocca F., Onesti A., Panaro S., Ragozino S., Sannicandro V., Fusco Girard L. (2016), "Towards operationalizing UNESCO Recommendations on Historic Urban Landscape". *AESTIMUM*, no. 69, December 2016, pp. 165-210.
- Bana e Costa C. A., Vansnick J.-C. (1999), "The MACBETH Approach: Basic Ideas, Software, and an Application", in Meskens N., Roubens M. (ed.) *Advances in Decision Analysis. Mathematical Modelling: Theory and Applications*, vol. 4. Springer, Dordrecht, pp. 131-157.
- Bandarin F., van Oers R. (2012), *The historic urban landscape: managing heritage in an urban century*. Wiley-Blackwell, Hoboken.
- Bandarin F., van Oers R. (2014), *Reconnecting the city: the historic urban landscape approach and the future of urban heritage*. Wiley-Blackwell, Hoboken.
- Cerreta M., De Toro P. (2012), "Strategic Environmental Assessment of Port Plans in Italy: Experiences, Approaches, Tools". *Sustainability*, vol. 4, n. 12, pp. 2888-2921.
- CHCfE Consortium (2015), *Cultural Heritage Counts for Europe*, [www.blogs.encatc.org/culturalheritagecountsforeurope/outcomes/](http://www.blogs.encatc.org/culturalheritagecountsforeurope/outcomes/)

- Chertow M. R. (2000), "Industrial symbiosis: Literature and taxonomy". *Annual Review of Energy and the Environment*, no. 25, pp. 313-337.
- Circle Economy, Fabric, TNO, Gemeente Amsterdam (2016a), *Circular Amsterdam. A vision and action agenda for the city and metropolitan area*, [www.amsterdam.nl](http://www.amsterdam.nl)
- Circle Economy (2016b), *Circular Glasgow. A vision and action plan for the city of Glasgow*, [www.circle-economy.com](http://www.circle-economy.com)
- Daamen T., Vries I. (2016), "Synthesis", 15th World Conference, Cities and Ports "Crossover". Rotterdam, Nederland, October 5-7, 2016
- De Toro P., Nocca, F. (2017), "Hybrid evaluation tools for operationalizing Unesco Historic Urban Landscape approach". *BDC - Bollettino Del Centro Calza Bini*, forthcoming.
- Di Stefano R. (1979), *Il recupero dei valori. Centri storici e monumenti. Limiti della conservazione e del restauro*. Edizioni Scientifiche Italiane, Napoli.
- Dong H., Fujita T., Geng Y., Dong L., Ohnishi S., Sun L., Dou Y., Fujii M. (2016), "A review on eco-city evaluation methods and highlights for integration". *Ecological Indicators*, no. 60, pp. 1184–1191.
- Ellen MacArthur Foundation (2015), *Growth within: a circular economy vision for a competitive Europe*, [www.ellenmacarthurfoundation.org](http://www.ellenmacarthurfoundation.org)
- Ellen MacArthur Foundation (2017), *Cities in the Circular Economy: An Initial Exploration*, [www.ellenmacarthurfoundation.org](http://www.ellenmacarthurfoundation.org)
- European Commission (2015), *Closing the loop – An EU action plan for the circular economy*, [www.eur-lex.europa.eu](http://www.eur-lex.europa.eu)
- European Committee of the Regions (2017), *Opinion - The Regeneration of Port Cities and Port Areas*, [www.cor.europa.eu/en/activities/opinions](http://www.cor.europa.eu/en/activities/opinions).
- European Council (2014), *Directive 2014/89/EU of The European Parliament and of The Council Of 23 July 2014 Establishing a Framework for Maritime Spatial Planning*, [www.eur-lex.europa.eu](http://www.eur-lex.europa.eu)
- Fenton J. (1985), *Hybrid buildings*. Princeton Architectural Press, New York.
- Ferrari C., Merk O., Bottasso A., Conti M., Tei A. (2012), "Ports and Regional Development: A European Perspective". *OECD Regional Development Working Papers*, no. 7.
- Forte C. (1977), "Valore di scambio e valore d'uso sociale dei beni culturali immobiliari". *Restauro*, n0. 35.
- Fujita T., Ohnishi S., Liang D., Fujii M., (2013). "Eco-Industrial Development As A Circularization Policy Framework Toward Sustainable Industrial Cities. Lesson And Suggestions From The Eco Town Program In Japan". *BDC. Bollettino Del Centro Calza Bini*, vol. 13, no. 1, pp. 35-52.
- Fusco Girard L. (2010), "Sustainability, creativity, resilience: toward new development strategies of port areas through evaluation processes". *International Journal Of Sustainable Development*, n. 13, pp. 161–184.
- Fusco Girard L. (2013), "Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the Historic Urban Landscape Approach". *Sustainability*, vol. 5, no. 10, pp. 4329-4348.
- Fusco Girard L. (2014a), "Creative Initiatives in Small Cities Management: The Landscape as an Engine for Local Development". *Built Environment*, vol. 40, no. 4, pp. 475-496.
- Fusco Girard L. (2014b), "The regenerative city and wealth creation/conservation: the role

- of urban planning". *International Journal of Global Environmental Issues*, vol. 13, no. 2/3/4, pp. 118-140.
- Fusco Girard L., Gravagnuolo A., Nocca F., Angrisano M., Bosone M. (2015), "Towards an economic impact assessment framework for Historic Urban Landscape conservation and regeneration projects". *BDC - Bollettino Del Centro Calza Bini*, vol. 15, no. 2, pp. 1-29.
- Fusco Girard L. (2016), *Metropolitan city: which development strategies? Which governance tools?*, [www.slideshare.net](http://www.slideshare.net)
- Fusco Girard L., Baycan T., Nijkamp P. (2012), *Sustainable city and creativity: promoting creative urban initiatives*. Routledge, Taylor & Francis Group, UK.
- Fusco Girard L., Cerreta M., De Toro P. (2017), "Towards a Local Comprehensive Productive Development Strategy: A Methodological Proposal for the Metropolitan City of Naples". *Quality Innovation Prosperity*, vol. 21, no. 1, p. 223-240.
- Fusco Girard L., Kourtit K., Nijkamp P. (2014), "Waterfront Areas as Hotspots of Sustainable and Creative Development of Cities". *Sustainability*, vol. 6, no. 7, pp. 4580-4586.
- Fusco Girard L., De Rosa F., Nocca F. (2014), "Verso il piano strategico di una città storica: Viterbo". *BDC - Bollettino Del Centro Calza Bini*, vol. 14, no. 1, pp. 11-38.
- Geemente Rotterdam (2016), *Roadmap Circular Economy Rotterdam*, [www.rotterdamclimateinitiative.nl](http://www.rotterdamclimateinitiative.nl)
- Girardet H. (2013), *Towards the regenerative city. Expert Commission on Cities and Climate Change*, [www.worldfuturecouncil.org](http://www.worldfuturecouncil.org)
- Gravagnuolo A., Fusco Girard L. (2017), "Multicriteria Tools for the Implementation of Historic Urban Landscape". *Quality Innovation Prosperity*, vol. 21, no. 1, pp. 186-201.
- Hamilton D.K. (2014), *Governing Metropolitan Areas: Growth and Change in a Networked Age*. Routledge, Taylor & Francis Group, UK.
- Hein C. (2011), *Port cities: dynamic landscapes and global networks*. Routledge, UK.
- Hein C. (2015), "Exploring architectural history through the Petroleumsapes of the Randstad to imagine new fossil-free futures". *Bulletin Vereniging van Nederlandse Kunsthistorici*, vol. 26, no. 3.
- Historic England (2016), *HERITAGE COUNTS. Heritage and the Economy 2016*, [www.content.historicengland.org.uk](http://www.content.historicengland.org.uk)
- Ishizaka A., Nemery P. (2013), *Multi-criteria decision analysis: methods and software*. Wiley-Blackwell, Hoboken.
- Lieder M. Rashid A. (2016), "Towards circular economy implementation: a comprehensive review in context of manufacturing industry". *Journal of Cleaner Production*, no. 115, pp. 36-51.
- LWARB (2017), *London's circular economy route map – Circular London*. London, [www.lwarb.gov.uk/what-we-do/circular-london/circular-economy-route-map/](http://www.lwarb.gov.uk/what-we-do/circular-london/circular-economy-route-map/)
- Mairie de Paris (2017), *White paper on the circular economy of greater Paris*, [www.api-site.paris.fr/images/77050](http://www.api-site.paris.fr/images/77050)
- Matthis P. (2017), "Promoting Ports and Cities Synergies to achieve Integrated Territorial Development", Joint CoR/MT Presidency Workshop, *Regeneration of Port Cities and Port Areas*. Brussels, Belgium, May 16, 2017.
- Merk O. (2013), "The competitiveness of global port-cities: synthesis report". *OECD Regional Development Working Papers*, no. 13.

- Mirata M., Emtairah T. (2005), "Industrial Symbiosis Networks and the Contribution to Environmental Innovation: The Case of the Landskrona Industrial Symbiosis Programme". *Journal of Cleaner Production*, no. 12, pp. 993-1002.
- Moreau V., Sahakian M., van Griethuysen P., Vuille F. (2017), "Coming Full Circle: Why Social and Institutional Dimensions Matter for the Circular Economy". *Journal of Industrial Ecology*, vol. 21, no. 3, pp. 497-506.
- Munda G. (2001), A NAIADE based Approach for Sustainability Benchmarking, *International Journal of Environmental Technology and Management*. *International Journal of Environmental Technology and Management*, vol. 6, issue 1-2.
- Nocca F. (2017), "Hybrid evaluation tools for operationalizing Unesco Historic Urban Landscape approach". PhD Dissertation. University of Naples Federico II, Italy.
- Nocca F., Fusco Girard L. (2017), "Towards an integrated evaluation approach for cultural urban landscape conservation/regeneration". *Region*, forthcoming.
- OECD (2012), *Redefining 'Urban': A New Way to Measure Metropolitan Areas*, [www.oecd-ilibrary.org](http://www.oecd-ilibrary.org)
- Ohnishi S., Fujii M., Fujita T., Matsumoto T., Donga L., Akiyama H., Donga H. (2016), "Comparative analysis of recycling industry development in Japan following the Eco-Town program for eco-industrial development". *Journal of Cleaner Production*, no. 114, pp. 95-102.
- Porter M.E., Kramer M.R. (2011), "Creating Shared Value". *Harvard Business Review*, vol. 89, no. 1-2, pp. 62-77.
- Prendeville S., Bocken, N. (2017), "Circular Cities: Mapping Six Cities in Transition". *Environmental Innovation and Societal Transitions*, forthcoming.
- Preston F. (2012), "A Global Redesign? Shaping the Circular Economy". *Energy, Environment and Resource Governance*, no. 2.
- Smit A. J. (2011), "The Influence of District Visual Quality on Location Decisions of Creative Entrepreneurs". *Journal of the American Planning Association*, vol. 77, no. 2, pp. 167-184.
- The Economist Intelligence Unit - EIU (2012), *The Economist Intelligence Unit*, <http://www.eiu.com/home.aspx>
- Trapero E.S., Mohino Sanz I., de Urena Frances J.M. (2015), "Global Metropolitan-Regional Scale in Evolution: Metropolitan Intermediary Cities and Metropolitan Cities". *European Planning Studies*, vol. 23, no. 3, pp. 568-596.
- UNESCO (2011), *Recommendation on the Historic Urban Landscape, including a glossary of definitions*, [www.portal.unesco.org](http://www.portal.unesco.org)
- UNESCO (2016), *The HUL Guidebook. Managing heritage in dynamic and constantly changing urban environments. A practical guide to UNESCO's Recommendation on the Historic Urban Landscape*, <http://historicurbanlandscape.com/themes/196/userfiles/download/2016/6/7/wirey5prpznidqx.pdf>
- United Nations (2015a), *World Urbanization Prospects. The 2015 Revision Highlights. Key findings and advanced tables*, [https://esa.un.org/unpd/wpp/publications/files/key\\_findings\\_wpp\\_2015.pdf](https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf)
- United Nations (2015b), *Transforming Our World: The 2030 Agenda for Sustainable Development*, [www.sustainabledevelopment.un.org](http://www.sustainabledevelopment.un.org)
- United Nations (2016), *HABITAT III. Draft New Urban Agenda*, <http://habitat3.org/>

- van Berkel R., Fujita T, Hashimoto S, Geng Y. (2009), “Industrial and urban symbiosis in Japan: Analysis of the eco-town”. *Journal of Environmental Management*, vol. 90, no. 3, pp. 1544-1556.
- Volberda H. (2016), “How can port cities enhance social innovation, develop new skills and raise the profile and image of the port?”, 15th World Conference, *Cities and Ports “Crossover”*. Rotterdam, Nederland, October 5-7, 2016
- Wijkman A., Skånberg K. (2015), *The Circular Economy and Benefits for Society - Swedish Case Study Shows Jobs and Climate as Clear Winners*, [www.clubofrome.org](http://www.clubofrome.org).

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