City-Port Circular Model: Towards a Methodological Framework for Indicators Selection

Maria Cerreta(✉), Eugenio Muccio, Giuliano Poli, Stefania Regalbuto, and Francesca Romano

Department of Architecture, University of Naples Federico II, Via Toledo 402, 80134 Naples, Italy
{maria.cerreta, giuliano.poli, stefania.regalbuto}@unina.it, eugenio.muccio@gmail.com, romano.fra5@gmail.com

Abstract. Maritime transport technologies and infrastructures development fostering global economies since the second half of the 20th century, conditioning the reshaping of the territorial system in terms of social and spatial organisation, detaching port functions from urban ones and weakening their relationships. The reorganisation of the same activities, often within larger areas of the existing urban structure, has emphasised the so-called misalignment of the City-Port, given by dynamics having benefits at the regional scope and localised negative impacts. The European recommendations provided by both the Sustainable Development Goals (SDGs) framework and the Maritime Spatial Planning European Directive 2014/89, within the theoretical and methodological framework provided by Circular City Model (CCM) approach, define the context to reconsider City-Port dynamics, leading to a regeneration of both the port and the city. To identify sustainable design strategies' portfolio for Naples City-Port, in Italy, as pivotal action to trigger the regenerative process, the selection of a suitable set of indicators, within a multidimensional and multi-scale decision support system, has been developed. The study is part of the Italian research Project of Relevant National Interest (PRIN, 2015), "Metropolitan cities: territorial economic strategies, financial constraints, and circular regeneration", coordinated by the Polytechnic of Milan, Italy.

Keywords: Circular Economy · City-Port model · SDGs · Indicators selection · Decision support system

1 Introduction

Strongly influenced by dynamics and urban morphology, port areas, over centuries, have been the economic and social driving force of cities [1], deploying effects both locally and regionally [2]. Nevertheless, the development of maritime transport technologies and infrastructures, fostering global economies since the second half of the 20th century, has been reshaping the territorial system in terms of social and spatial organisation, detaching port functions from urban ones and weakening their relationships. In response

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to the growing need for autonomy and expansion spaces, in the major European ports, there has been decentralisation and relocation of activities no longer compatible with the urban structure [3, 4]. In Italy, instead, the reorganisation of the same activities, often within more extensive areas of the existing urban structure [5], has emphasised the so-called misalignment of the port-city, given by dynamics having benefits at the regional scope and localised negative impacts. Indeed, if on one hand commercial ports as nodes of the logistic system for international exchange, play a decisive role for the economic development of the territory and the nation, on the other hand, have significant environmental, social and economic impacts on the urban scale [6], influencing well-being and quality of life.

In this perspective, the Circular City Model (CCM) approach [7–9] has been assumed as the theoretical and methodological framework supporting paradigm shift in the context of which to rephrase City-Port development processes [10, 11], following Circular Economy (CE) principles [12, 13]. Furthermore, a significant correlation between the SDGs and the CE indicators has been noticed [14].

Considering long-term horizon where the guidelines for urban planning unfold as well as environmental, economic and socio-cultural impacts that these actions have on the territories, a "place-based" and "use-inspired" approach to transition [15, 16] has been adopted. In this perspective, the City-Port system identifies a specific enabling context [17]. Moreover, it is felt that reconsidering City-Port dynamics within a sustainable approach can support to redefine the relationship between the port and the urban region that surrounds it, leading to a regeneration of both the port and the city [18]. In order to overtake arisen conflicts within City-Port context, the research intends to operationalising the European recommendations provided by both the Sustainable Development Goals (SDGs) framework [11] and the Maritime Spatial Planning European Directive 2014/89, that, coherently with the European principles for integrated urban development [19], aim to implement a multidimensional decision support system working with multi-scale indicators within the theoretical and methodological framework provided by CCM approach.

In the context of literature, a growing body of research related to Sustainable Development Indicators already occurs. Due to the complexity of its context, hence the significant number of considered indicators derives, analysis capabilities of sustainable development indicators system have been often questioned [20].

As part of the decision-making problem in maritime spatial planning, the selection of a consistent set of indicators has been assumed as crucial both for detection of the context features, other than for the evaluation of City-Port system development scenarios.

In order to identify a suitable set of Sustainable Development Indicators, a place-based approach [21] wherein the main characters of the place have been spelt out including both theme-based and field-based indicators, within CCM approach, has been assumed. Therefore, reaping recommendations provided by global policies as the starting point for defining the goal steering transition towards the CE, and considering, at once, local interventions as crucial to turn a goal into reality, multiple dimensions, other than multiple scales have been assumed as part of decision support system. The contribution aims to identify a methodological framework for the selection of suitable indicators, which are useful to describe the City-Port system and evaluate the impacts of likely transformations. The proposed methodological approach has been implemented

on the focus area located in the eastern part of Naples City-Port, in the South of Italy, including both the commercial port and the neighbourhood urban settlement. The focus area has been selected based on information, data and issues developed within Master's Degree Course Level II in "Sustainable planning and design of port areas" of the Department of Architecture (DiARC), University of Naples Federico II, Italy.

The paper articulation proceeds as follows: the first part (Sect. 2) highlights the content analysis of selected paper undertaken to identify the most appropriate methodological approach for qualitative indicators' selection; the second part (Sect. 3) shows the methodological approach; the third one (Sect. 4) introduces the case study in order to test the indicators' selection process; and the fourth one (Sect. 5) points out preliminary outcomes, highlighting potentials and shortcomings.

2 Indicators Selection: Approaches and Criteria

Assessing urban sustainability processes for planning new multi-scale strategies, policies and actions means dealing with a wide dashboard of indicators, which are affected by mutual interrelationships at once. As the Sustainable Development Indicators set is still comprehensive, it is necessary to identify criteria for selecting them [22, 23]. As early as 1998 Meadows identified a set of desirable features of sustainable development indicators. Later, other criteria for the selection of sustainability indicators have been proposed [24–26].

Although multiple evaluation methods to foster sustainable development have been experimenting for more than three decades, some conceptual and operational difficulties have to be still addressed [27]. Considering a place-based approach, in an example, the broad availability of indicators at the global scale generally does not correspond to site-specific data and monitoring. Therefore, the availability of information has to be verified at multiple investigation scales.

Moreover, a consistent selection of criteria and indicators at the local scale, within defined theoretical and analytical bounds, is the pivotal step for the effectiveness of sustainability assessments in different contexts [28]. On the one hand, it has been deemed that in social, economic and environmental features of urban systems a certain potential to become circular lies, on the other, CE principles, indeed, had to comply with the peculiarities of the context [29].

According to Munda [30], indeed, the evaluation of a consistent set of indicators can be performed, grouping them into two main categories considering their local and global priorities for sustainability. In this perspective, a methodological approach for indicators' selection has to be chosen in order to manage complex information better, avoiding redundancies. Many authors [31–34] have been tracing back the sustainability indicators selection methods to two main approaches, according to the focused research goals. The approaches mentioned above involve:

- aggregating single indicators into composite indices for judging the sustainability degree;
- managing a system, or dataset, of multidimensional indicators which measure separate features of sustainable development.

Nevertheless, these approaches are not able to solve the selection problem, which, generally, is referred to as internal choices or unilateral decision. At the same time, a partial selection process could lead to misunderstandings and incorrect interpretation of results. In this regard, preliminary operations aiming at indicators' refinement are addressed to check matching with the common criteria of appropriateness, comprehensibility, validity, simplicity, reliability, availability, measurability and sensitivity [35]. In particular, it is crucial evaluating data availability at the local scale, combining soft and hard information at once [36–38]. Evaluating the relationships among SDGs - along with their related indicators - and available local data in qualitative terms is a way to operationalise and internalise the sustainability issues [39].

About the criteria of appropriateness, sensitivity and simplicity, the selection procedures can be performed through qualitative and quantitative methods, according to the grain and quality of available indicators. One of the most recurring methods involves the design of surveys with qualitative evaluation scale to rate indicators respect to their importance on sustainability issues [40]. The respondents can be experts or citizens depending on the type of preferences to be elicited, and the indicators feature to be assessed. Moreover, other authors extend the use of SWOT analysis not only to short-term sustainable operational objectives' evaluation but also to the selection of key indicators of socio-economic monitoring [41]. The primary skills of SWOT analysis, indeed, are inherent to its simplicity and the feasible comparison of internal and external factors of sustainability within groups of people with different expertise. The hybridisation of the methods mentioned above, furthermore, allows the experts to score the indicators and determine their influence degree.

3 The Case Study: East Naples City-Port

Located in the eastern part of Naples City-Port, in the South of Italy, the focus area selected to implement the CCM approach lies on the East coastal zone including both the commercial port and the neighbourhood urban settlement. The area with original agricultural characterisation, as a result of Naples-Portici passenger railway construction, dates back to 1839, experienced a changing pattern in land use. A growing urbanisation process that reached its maximal peak in buildings stock development during the industrial age. Due to its economic and social features, the focus area became a driver for the whole urban settlement. Later, the substantial decrease in demand for industrial activities occurring during the process of de-industrialisation, caused the emergence of abandoned industrial buildings and brownfields, making the coastline even more neglected and inaccessible. Still today there is an unemployment rate of 36,5%. Bordered to the North, to the West and the East by urban landmark (respectively the industrial area, the central railway station of Naples and the Vesuvian municipalities) and bathed to the South by the Tyrrhenian Sea, the port area, localised in San Giovanni a Teduccio neighbourhood has been selected basing on information, data and issues developed within Master's Degree Course Level II in "Sustainable planning and design of port areas" of the Department of Architecture (DiARC), University of Naples Federico II (Fig. 1).

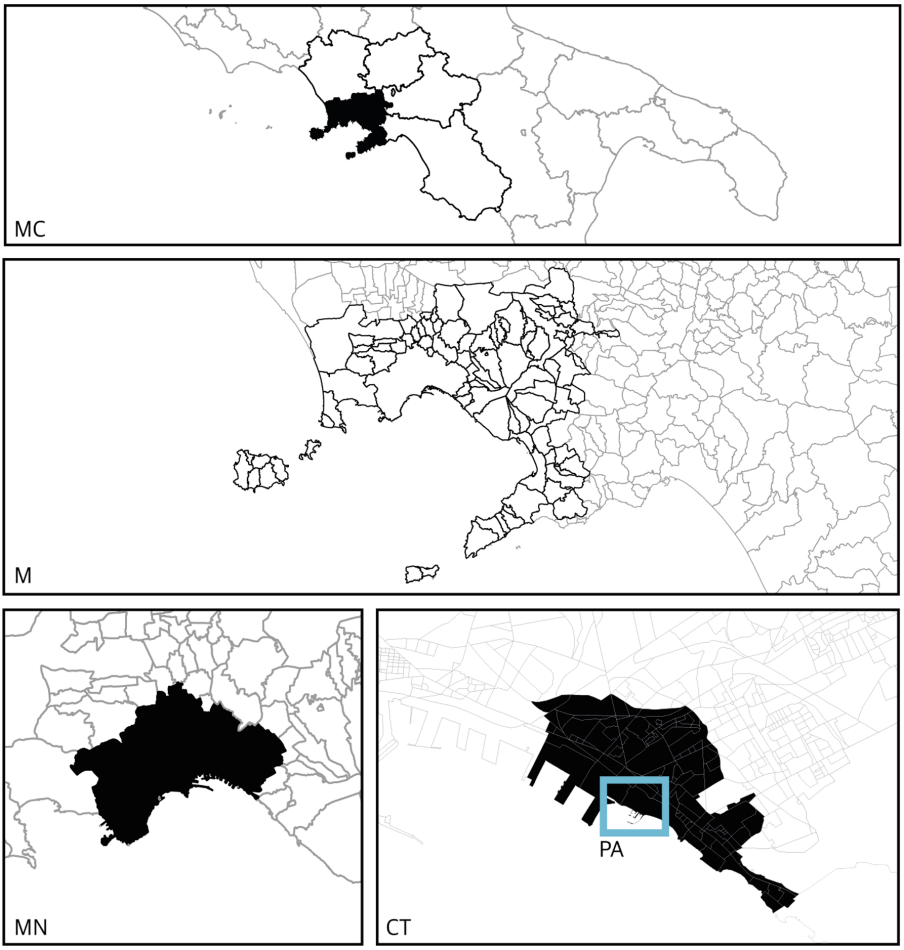


Fig. 1. The East Naples City-Port

Taking into account both the administrative boundaries and the geographical scale covered by the available data, in line with the approach proposed within the Italian research Project of Relevant National Interest (PRIN, 2015), "Metropolitan cities: territorial economic strategies, financial constraints, and circular regeneration", coordinated by the Polytechnic of Milan, the focus area has been furthermore explored according to five levels of analysis corresponding to five different spatial scales related to Metropolitan City (MC), Municipalities (M), Municipality of Naples (MN), Census Tracts (CT) and Port Area (PA). Already recognised as relevant by both Municipality and Port Authority System; indeed, the area is considered strategic for the development of the territorial system that includes the city of Naples, the Metropolitan City and also the Campania Region.

4 Materials and Methods

The research aims to identify a methodological framework for the selection of suitable indicators, which are useful to describe the City-Port system and evaluate the impacts of likely transformations. Therefore, assuming indicators as crucial tools in the evaluative process, a methodological approach (Fig. 2) combining theoretical background and place-based studies has been adopted in order to restore the system of relationships in Naples City-Port, within the perspective provided by CE framework. The study is articulated into four main phases: 1. the identification of a preliminary dashboard of indicators; 2. the decision-making problem structuring; 3. the hybrid qualitative method; 4. Outcome.

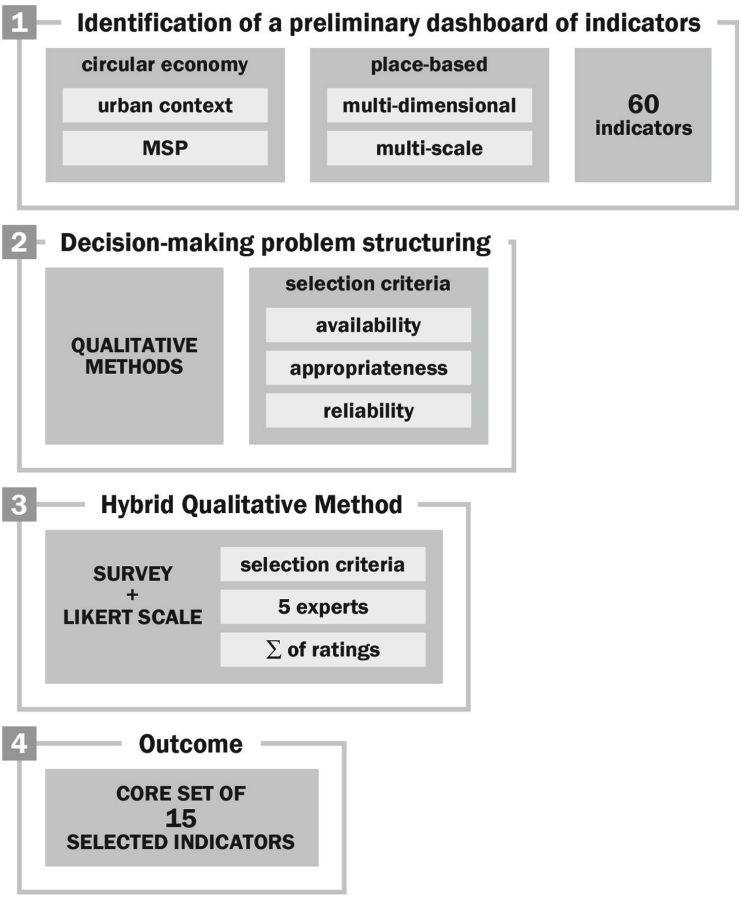


Fig. 2. The methodological approach for selecting a set of suitable indicators

The main research question underlying the decision-making problem leverages on how to choose an appropriate set of indicators for Naples City-Port sustainable transition. In this context, CE principles have been assumed as both theoretical and

operative framework in order to reach Sustainable Development. The proposed methodological approach (Fig. 2) leverages on the selection of indicators as a pivotal step in the context of sustainable development assessment. The following paragraphs will specifically show the operating steps of the methodological framework.

4.1 The Identification of a Preliminary Dashboard of Indicators

A preliminary dashboard of indicators has been deduced combining results obtained from research related to the urban context and maritime spatial planning within CE perspective, and the actual data availability found on the ground. Consisting of a long-term strategy aimed at reducing the inefficiency of resources and social exclusion in specific places, the place-based approach, which aims at promoting made-to-measure development policies [16], has been assumed as the operational framework of the indicators' selection process, considering:

- multiple dimensions gathered into the three main categories: environmental, economic and socio-cultural;
- cross-scale perspective consists of five levels of analysis.

A preliminary dashboard of 60 indicators has been thus identified.

4.2 The Decision-Making Problem Structuring

In structuring the decision-making problem, three main dimensions of Naples City-Port corresponding to "Urban and Environmental Quality", "Economic Development" and "Innovation and Culture", has been assumed as strategic fields into which gather indicators. As the preliminary dashboard of indicators related to Sustainable Development is still comprehensive, the definition of selection criteria for structuring a feasible set of indicators has been provided. Considering both topics identified within the scientific literature and peculiarities related to the focus area, three main criteria concerning to "availability", "appropriateness" and "reliability" have been assumed as discriminating factor for indicators' selection.

4.3 The Hybrid Qualitative Method

For the selection of a core set of Sustainable Development Indicators, a combination of survey method and Likert scale evaluation has been employed. The preliminary dashboard including 60 indicators has been discussed within a group of five experts, each of whom, using Likert scale, have assigned a score between 1 and 5 to each of three of them (from 1 = least important, 3 = important and 5 = most important). According to the aforementioned set of selection criteria including "availability", "appropriateness" and "reliability", from the preliminary dashboard of indicators, a core set has been carried out. Considering that the maximum score for each criterion corresponds to 25 and that the minimum score is equal to 5, the threshold for selection was placed at the value of 20. Therefore, only the indicators whose criteria have been assigned a score of at least 20 have been selected. This has allowed the identification of a core set of 15 Sustainable Development Indicators.

5 Outcome

Considering both the theoretical background provided by scientific literature suitably selected and the actual data availability offered by the national database at the different spatial scale of analysis, preliminary dashboard indicators gathered as follows has been obtained:

- environmental dimension, 16 indicators (Fig. 3);
- economic dimension, 17 indicators (Fig. 4);
- socio-cultural dimension, 26 indicators (Fig. 5).

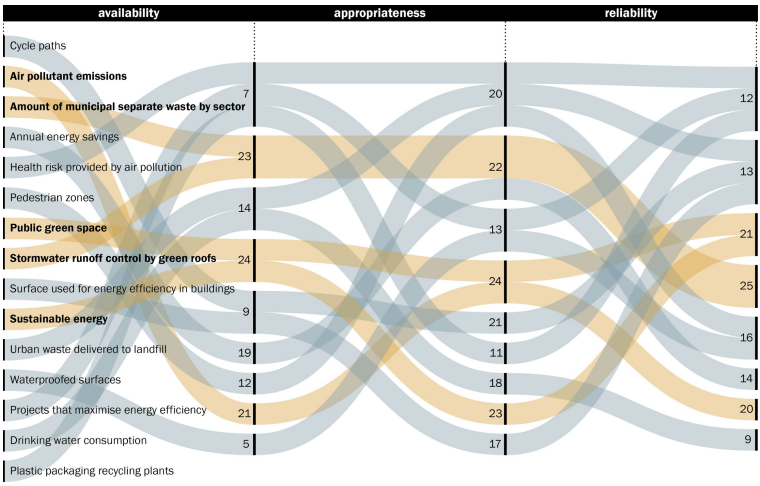


Fig. 3. Environmental indicators selection (16 indicators).

The process of qualitative selection described above defines the 15 selected indicators that have been therefore gathered into three domains corresponding to the strategic objectives already identified in the context of the decision tree (Table 1).

The domains are:

- Urban and Environmental Quality (corresponding to the previous environmental one);
- Economic Development (corresponding to the previous economic one);
- Innovation and Culture (corresponding to the previous socio-cultural one).

The three domains previously identified, have been, indeed, renamed taking into account the features described from the selected indicators. In addition to that, the core set includes indicators related to the spatial scales of analysis previously described, according to a cross-scale perspective. The indicators have been selected both from national databases (ASIA, Borsino Immobiliare, Tagliacarne Institute, Porth System Authority of the Central Tyrrhenian Sea, BES, ISTAT) and scientific literature. Among databases mainly consulted are those of ISTAT and the Port Authority System of the

Central Tyrrhenian Sea (ADSP). In particular, ISTAT - Italian National Institute of Statistics - is the main producer of official statistics in Italy. Its activity includes a census of the population other than social, economic and environmental analyses. Among that, there is BES report aiming to evaluate the quality of well-being in Italy within a multidimensional approach. AdSP, meanwhile, is the public authority dealing with the management of Naples, Salerno and Castellammare di Stabia ports.

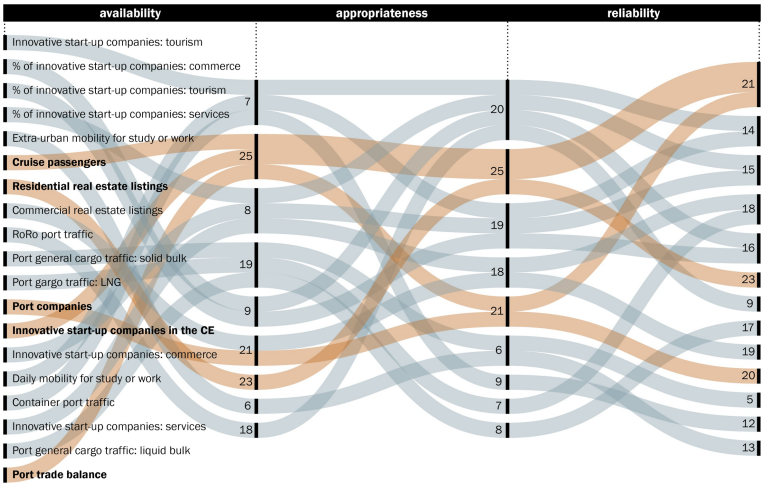


Fig. 4. Economic indicators selection (17 indicators).

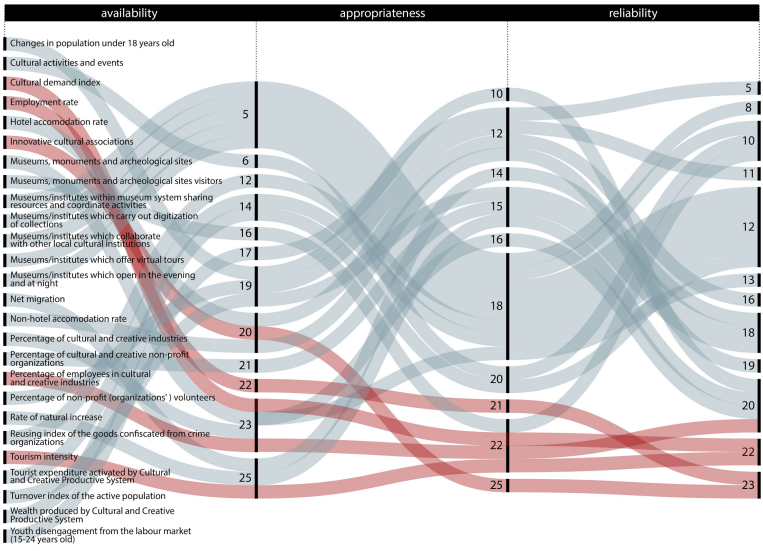


Fig. 5. Socio-cultural indicators selection (26 indicators).

It has administrative and financial autonomy, and it is responsible for the entire area belonging to the port. Its statistical studies, therefore, concern the port mentioned above areas mainly in terms of cargo-handling and traffic fleeting. ASIA is a company in the Campania Region that carries out environmental hygiene services such as separate collection, sweeping and transportation of waste to treatment plants.

Table 1. The core set of indicators

Domain	Indicator	UM	Scale	Data source	Year
Urban and Environmental Quality	Sustainable energy	%	Metropolitan City	BES	2016
	Air pollutant emission	Ton/year	Port Area	Authors elaboration	2018
	Public green space	Square metres per inhabitant	Municipality of Naples	BES	2017
	Amount of municipal separate waste by sector	Ton/year	Municipality of Naples	ASIA	2017
	Stormwater runoff control by green roofs	%/year	Port Area	Authors elaboration	2019
Economic Development	Port trade balance	Ton/year	Port Area	AdSP del Mar Tirreno Centrale	2018
	Port companies	n.	Port Area	AdSP del Mar Tirreno Centrale	2019
	Innovative start-up companies in the circular economy	n.	Municipality of Naples	Elaboration Istituto Guglielmo Tagliacarne on Istat data	2018
	Cruise passengers	n./year	Port Area	AdSP del Mar Tirreno Centrale	2018
	Residential real estate listings	€/square metres	Census Tracts	Borsino Immobiliare	2018

(*continued*)

Table 1. (*continued*)

Domain	Indicator	UM	Scale	Data source	Year
Innovation and Culture	Employment rate	%	Municipalities	ISTAT	2011
	Percentage of employees in cultural and creative industries	%	Municipalities	ISTAT	2011
	Innovative cultural associations	n.	Municipality of Naples	Authors elaboration	2019
	Tourism intensity	n.	Metropolitan City	ISTAT	2017
	Demand for cultural heritage	n.	Metropolitan City	ISTAT	2017

The data are published online on its statistical platform. Borsino Immobiliare, a property price list, publishes continuously updated statistical values according to the price fluctuations collected at the local and national level. Finally, Tagliacarne Institute which provides training and research in economics.

6 Conclusions

The methodological process allowed to identify a set of relevant indicators able to analysing the specificities of the context and assessing the possible transformations. Eliciting weights from the preferences of different stakeholders has been representing an open issue within decision-making theories for a long time. This contribution is an attempt to operationalise a simple - even though not comprehensive - methodology for indicators' selection through a scoring technique. The main advantages concerning the proposed approach are inherent to its simplicity, intelligibility and, especially, flexibility in revising the weights faster, whether the stakeholders preference changes. Some limitations of the methodology refer to the linearity of the weighted sum, which supposes independence among variables (criteria) to be assessed. In this regard, it does not include in all the cases the interrelationships among criteria. Moreover, the weights are strongly affected by the expertise of decision-makers, and this makes it complex to elicit different ways of thinking, preferences and trade-offs, so far as the positions are multiple and divergent. Nevertheless, the first shortcoming has been solved by choice of few and separated criteria, e.g. the availability of an indicator does not necessarily exclude its appropriateness or reliability.

The purpose of combining Sustainable Development Goals (SDGs) framework and the Maritime Spatial Planning European Directive 2014/89, within the theoretical and methodological context provided by Circular City Model (CCM) approach, defines the

context to reconsider City-Port dynamics and to develop a decision-making process open to complex analysis and description of the City-Port system and to evaluate the impacts of possible transformations. The integration of different domains for indicators identification and selection allows us to consider a plural perspective, in which different specificities converge, including synergistic perspectives and knowledge.

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