Measuring Urban Competitiveness Through the Lens of Sustainability: An Application at the Urban Districts Level in the City of Naples (Italy)

Sabrina Sgambati, Gerardo Carpentieri[✉], and Carmela Gargiulo

Department of Civil, Building and Environmental Engineering, University of Naples Federico II, P.le Tecchio 80, 80125 Naples, Italy

{sabrina.sgamabati,gerardo.carpentieri,gargiulo}@unina.it

Abstract. Urban competitiveness, the study of which has broadened significantly in recent decades, is the ability of a city to attract investments, people and new activities. It depends on a multitude of closely interrelated factors that characterise urban areas. The multidimensional approach, which is typical of urban competitiveness studies, allows the attitude to sustainability to be considered as one of the possible measures of competitiveness. This work aims to evaluate, at the local level, the relationship between urban competitiveness and the achievement of the Sustainable Development Goals adopted with Agenda 2030. The paper proposes a composite index structured in several dimensions that are useful to compare the competitive performance of cities' districts in relation to social, economic and environmental sustainability features, providing a multidimensional ranking. The application phase focuses on the municipality of Naples, in Italy, chosen for the heterogeneity of its districts. The overall competitive performance of the city's districts is highlighted, and their strengths and shortcomings in the different dimensions are considered. The results aim to emphasise the main components of competitiveness of the Neapolitan districts and support decision-makers in improving competitiveness in line with the Sustainable Development Goals.

Keywords: Urban competitiveness · Sustainable development goals · Urban districts

1 Introduction

Since the end of the last century, with the advent of globalisation, the progressive liberalisation of markets and the territorial relocation of businesses, the concept of competitiveness has taken on an increasingly important role, including in the context of the governance of urban and territorial transformations [1, 2]. It is now common for cities, regions and nations to assess, improve and publicise their competitive standing with other places [3, 41]. The use of the concept of competitiveness at the territorial level has led to a wide-reaching debate in the scientific community, sparking dissent among

scholars such as Krugman and Lall, who underlined how the application of the concept of economic competitiveness on a territorial scale generates both conceptual and applicative criticism. These statements are mainly based on an assessment of the numerous differences between companies and territorial contexts from the point of view of both the organisational structure and the objectives pursued. A rigid transfer of the concept of competitiveness from economic activities to territorial contexts risks not adequately taking into account the complexity of the latter. Therefore, the innumerable elements and relationships which compose these contexts may be neglected, making such analyses unreliable or even harmful in supporting choices [4, 5].

Later studies have further investigated these critical issues, providing a different interpretative key. This has highlighted the need to apply the concept of competitiveness to urban and territorial systems [6–8]. Further advancement is provided by Camagni (2002), who states that it is possible to consider phenomena such as globalisation and internationalisation as part of a shared heritage because all regions can be affected by the possible benefits and threats deriving from these phenomena depending on their extrinsic characteristics [9]. This highlights how the specificities of each region can be essential elements of the competition between different territorial entities [10]. These characteristics include aspects such as human capital, innovation capacities, geomorphological characteristics of the region, types of infrastructures and all the other factors [11, 12] that contribute to the multidimensional nature of urban competitiveness. The economic and social importance of this competition has made competitiveness a topic of great interest, especially for those involved in the governance of urban and regional transformations.

The multidimensional approach, which is typical of urban competitiveness studies, allows considering sustainability as one of the main components of competitiveness. In this regard, this work examines the relationship between urban competitiveness and the achievement of the Sustainable Development Goals adopted by the United Nation with the document Agenda 2030. This relationship takes on particular implications at the city scale. The paper aims at developing a composite index structured in several dimensions useful to compare the competitive performance of cities' districts in terms of social, economic and environmental sustainability. The index has been tested through an application to the municipality of Naples, in Italy. The city was chosen for the heterogeneity of its districts which differently contribute to the overall level of competitiveness of the municipality. The objective is to emphasize the competitive advantage provided by the city's districts and highlight their strengths and shortcomings in the different dimensions considered. The results aim to emphasise the main components of competitiveness of the Neapolitan districts and support decision-makers in improving competitiveness in line with the Sustainable Development Goals.

2   The Multidimensionality of Urban Competitiveness

The growing interest in advancing the research which tries to integrate the themes of competitiveness and urban development is motivated by the central role that cities play in modern society [13]. These territorial contexts have become the reference point for global economic and social development [14]. In recent years, cities all over the world

have started a competition among themselves in order to offer the best conditions to attract investments, citizens and new skills. In this context of global competition, the traditional approach that envisaged the exclusive study of the relationships between a city and its neighbouring territorial context is now outdated. Today, thanks to new communication and transport technologies, cities are able to interact, materially and immaterially, with other territorial entities, even ones that are geographically distant. This has enabled urban entities, located a considerable distance away from each other, to compete in the most diverse sectors, from the production of goods and the provision of specific services to environmental protection.

Large cities such as New York, London and Tokyo are increasingly orienting their future development choices by pursuing the priority objective of dealing with competition from other international urban entities of the same size, neglecting internal competition within their respective national borders [15]. In Europe, with the creation of the European common market and the free movement of goods and people, cities have become more attentive to the opportunities and threats arising from the European integration process in order to affirm their European leadership in the various sectors of competition. In Asia, in order for the city of Hong Kong to increase its importance as a reference economic-financial centre for the continent, it must compete with other Asian cities that aim to play the same role, such as Guangzhou and Shanghai [16–19].

One of the most common definitions of urban competitiveness in the literature states that this concept represents a city's ability to confirm and/or improve its competitiveness within a specific area or context (regional, national or international) [20]. Urban competition takes place between similar territorial contexts that pursue the same objectives in order to preserve the resources and improve the well-being of the members of their cities through optimal management of the many external and internal factors that can influence the cities' development.

Before the concept of competitiveness reached its full application in the urban planning field, numerous scholars sought to develop an adequate theoretical support base. In the first studies on territorial competitiveness, only the economic aspects capable of making a specific urban context attractive for companies, investors and the marketing of the goods produced were taken into consideration [21]. Kresl (1999) states that a vision of urban competitiveness aimed at identifying the factors capable of attracting productive investments is made up of two components: the economic and the strategic [22]. The first includes aspects related to production, infrastructure, location, economic structure and urban services. The second component includes aspects such as government efficiency, urban development strategy, cooperation between the public and private sectors and institutional flexibility. Factors that are not preparatory to businesses are excluded from this type of consideration.

Martin and Simmie (2008) contribute to broadening the scientific debate on this issue, defining urban competitiveness as "the ability of cities to continually upgrade their business environment, skill base, and physical, social and cultural infrastructures, so as to attract and retain high-growth, innovative and profitable firms, and an educated, creative and entrepreneurial workforce, to thereby enable it to achieve a high rate of productivity, high employment rate, high wages, high GDP per capita, and low levels of income inequality and social exclusion" [23].

Further in-depth studies have expanded the field of study with the inclusion of other tangible and intangible aspects (environmental, cultural, technological, human capital, artistic beauty, etc.) that can, directly and indirectly, influence the localisation choices of both businesses and citizens choosing an urban environment in which to reside and/or invest in order to satisfy their needs and aspirations [24, 25].

Over the years, different scientific disciplines have paid particular attention to developing (quantitative and/or qualitative) methods that can provide a measure of the level of competition between cities. This has been motivated primarily by the interest of public and private decision-makers in identifying adequate information support to guide future development choices [26]. Measuring the level of competitiveness of a territorial system (region, province, metropolitan city and city) is very complicated. The phenomena which typify such systems are characterised by a multiplicity of "facets" (such as the degree of well-being, quality of life, infrastructural endowment, services, etc.) and therefore can be difficult to measure [27, 28].

In assessing cities' level of competitiveness, the analyses obtained through measurement tools which use single indicators cannot be considered exhaustive. There is a need to use large sets of indicators that can measure a great number of characteristic aspects.

For cities, it is now evident that satisfying individual and collective needs in order to improve citizens' quality of life is crucial element of urban competitiveness [29]. These new needs have gradually transformed the competitive priorities of cities from exclusive support of the productive sector (such as technical infrastructures or investment incentives) to the promotion of development oriented towards the well-being of the individual from a sustainable perspective. This evolution of the concept of urban competitiveness was well summarised by Porter, who formulated four development phases for this theme [30]: 1) competitiveness aimed at the promotion of production, 2) competitiveness aimed at encouraging investments, 3) competitiveness aimed at innovation and 4) competitiveness aimed at improving quality of life.

3 Urban Competitiveness and Sustainable Cities

The current trends of urban population growth, changing lifestyles, unsustainable production patterns and consumption of services and goods increase the pressures on the social and environmental components of cities. By 2030, the global share of the urban population is projected to rise to 60% and it is estimated that a third of the global population will be living in cities with at least half a million inhabitants [30]. Satisfying the basic needs of urban populations while ensuring the integrity of the environment, and promoting economic development and social inclusion is one of the principal targets of our time. Urban communities face many problems that make sustainable development a difficult target to achieve but a necessary goal.

In the context of competitiveness aimed at the governance of urban and regional transformations, scientific literature and professional practice have highlighted how it is possible to achieve an improvement in the ability to compete through implementing specific infrastructural and functional solutions that can intervene in both critical issues and in the improvement of the characteristics on which the competition is based [31]. However, in estimating the competitive advantages deriving from the implementation

of specific solutions, it must be taken into account that their effectiveness is also linked to the local characteristics of the territorial context of intervention and to those of the supra-urban context within which the competition takes place. Furthermore, it is also necessary to consider the possible impacts of external events (economic crises, climate change, difficulties in the procurement of resources, health emergencies, etc.), which can significantly reduce their effectiveness [32]. The occurrence of these local and global events can also affect the full functioning of a city, with possible negative repercussions for all components of the urban system. In order to minimise these criticalities that influence urban competitiveness, it is important to intervene through a sustainable approach [33, 34].

The direct and indirect benefits that can be generated through the implementation of solutions aimed at improving urban sustainability are manifold. Different researchers have shown that making a city sustainable reduces the negative environmental, social and economic consequences of calamitous events. The implementation of interventions capable of influencing the mitigation of and/or adaptation to natural and anthropogenic phenomena and, at the same time, influencing sustainable development can allow cities to achieve better performance in economic, social and environmental terms compared to other similar regional contexts, in both ordinary and extraordinary conditions [35].

For cities, improving their ability to promote social, economic and environmental sustainability can also allow them to attract new citizens and more investment [36]. The advantages of living and carrying out economic and social activities in a city that has invested in sustainability can motivate individuals' and economic operators' choices of location.

On the basis of these considerations, over the years, an increasing number of studies aimed at ranking urban competitiveness have given greater weight to aspects related to sustainability. Orienting the governance of urban transformations towards the implementation of intervention solutions aimed at improving urban sustainability offers the opportunity for cities to improve the quality of life and safety of their citizens and economic operators [37]. Being able to live and work in a regional context that offers adequate guarantees in terms of safety, services, job opportunities and environmental quality is now a fundamental element of localisation and investment choices [38]. From the point of view of companies and investors, locating one's business in an area where disasters can compromise the functionality of the settlement system constitutes an unsustainable risk factor for a private economic operator [23].

4 GIS-Based Methodology

4.1 The Components of Urban Competitiveness

This research intends to analyse the competitiveness of urban districts in relation to sustainability, as it was intended in Agenda 2030 [39]. One of the expected results is the construction of a ranking.

Urban competitiveness is a multidimensional concept made up of different components. Therefore, its study requires a systemic and integrated approach. First, we have to consider which urban features are most meaningful and effective in gaining a competitive advantage. This consideration hinges on two factors. On the one hand, the choice

of urban characteristics depends on the general framework of the research, which, in this case, aims at analysing the relationship between competitiveness and the achievement of Agenda 2030 sustainability objectives. On the other hand, the selected urban characteristics must reflect the territorial scale of the study, in this case, the local level.

Considering the intersection between sustainability and competitiveness, intended as the ability to attract investments, business, activities and people, we identified seven categories encapsulating a certain number of variables. The categories refer to some of the Sustainable Development Goals (SDGs) that we considered significant for improving the competitiveness of cities' districts from an urban planning perspective. Specifically, they refer to:

– Goal 3: Good health and well-being;
– Goal 4: Quality education;
– Goal 8: Decent work and economic growth;
– Goal 10: Reduced inequalities;
– Goal 11: Sustainable cities and communities;
– Goal 12: Responsible consumption and production;
– Goal 13: Climate action.

SDG 3 is aligned with indicators linked to the overall level of well-being of the population. This has a considerable influence on districts' competitiveness, since districts that can ensure high-quality health services, sports facilities and a better quality of life are, in general, the most attractive. Goal 4 is linked to the level of education of people—which is a social component of competitiveness—and to the availability and accessibility of schools and educational services. Goal 8 relates to urban competitiveness in terms of the distribution of job opportunities and the quality of working life (e.g., travel time to work, number of commercial activities, etc.). Goal 10 is connected to the necessity of eliminating disparities among territories, favouring social justice and reducing marginalisation to build more inclusive and attractive districts. This is also linked to Goal 11, which addresses making urban areas places of prosperity and growth. Goal 12 entails indicators linked to sustainable energy and resources consumption. Urban areas have a key role in this sector, and cities that are successful in saving energy are competitive. Finally, Goal 13 is connected to climate resilience: Climate compatible cities attract more business and investments and guarantee safety for their inhabitants.

4.2   The Indicators

The categories consist of a flexible number of indicators which reflect the characteristics that make a city competitive at an international level. We selected 39 indicators on the basis of their meaningfulness and the availability, accessibility, measurability and coverage of data.

The normalisation of indicators was necessary to make characteristics comparable and aggregable. We used the min-max method (1) because it is applicable to indicators with positive, negative or zero values and because it allows one to widen the variability

of indicators lying within a small interval:

$$y_{SCi} = \frac{x_{SCi} - min(x_{SCi})}{\max(x_{SCi}) - min(x_{SCi})} \tag{1}$$

where S indicates the statistical unit, C the category and i the indicator.

The distances created with normalisation represent the absolute measurements of the gap between each single statistical unit and the "ideal" one. We considered negative those indicators that have a negative impact on competitiveness.

For the finalisation of the dataset, a correlation analysis is also necessary to evaluate the relationships between indicators and verify their impact on the overall structure of indicators.

4.3 Building a SDG Urban Competitiveness Index

We proceeded with the aggregation of normalised indicators belonging to the different categories. In the literature, there are numerous criteria for weighting and then aggregating variables, ranging from systems of weights attributable ex ante to criteria that infer the meaningfulness of indicators from the analysis of the data (e.g., implementing multivariate statistical analysis). However, sometimes these methods of aggregation implicitly have a degree of subjectivity. We did not develop a system of weights since this paper represents a first approach to the research. Furthermore, we wanted to develop an innovative application to the district scale. Therefore, we put forward the hypothesis of interchangeability between dimensions, giving equal importance to different indicators.

Hence, we used simple averages to calculate a partial indicator of competitiveness for single categories (SC) (2). This operation is conceptually equivalent to putting all indicators on an equal footing.

$$M_{SCj} = \frac{x_{SC1} + x_{SC2} + \ldots + x_{SCn}}{n} = \frac{\sum_{I=1}^{n} x_{SCI}}{n} \tag{2}$$

Subsequently, in order to obtain a general measurement of competitiveness, we proceeded with the aggregation of the M_{scj} indexes, which represent the competitiveness of statistical units within single categories. We obtained a composite index that represents the competitiveness of districts as a result of their performance in sustainable development.

$$I_{UCSDG} = \frac{M_{S1} + M_{S1} + \ldots + M_{SM}}{m} = \frac{\sum_{C=1}^{m} M_{SC}}{m} \tag{3}$$

While M_{scj} indicates the level of competitiveness in the C category, I_{UCSDG} shows the level of competitiveness of the S district, taking into account all the categories of the model. The results can be represented in GIS and in bar graphs.

Table 1. The system of indicators.

| Sustainable Development Goals	ID	Indicator
Goal 3: Good health and well-being	01	Infant mortality
	02	Disease mortality
	03	Inadequate hospitalisation
	04	Public hospitals
	05	Integrated home care
	06	Infantile vaccination coverage
	07	Health index
	08	Incidence of disease
Goal 4: Quality education	09	Absence of education
	10	Tertiary education
	11	Gender education gap
	12	Gender work gap
Goal 8: Decent work and economic growth	13	Employment rate
	14	Firms
	15	Employees
Goal 10: Reduced inequalities	16	Average income per capita
	17	Born from working mothers
	18	Adolescent fertility rate
	19	Dependent drug users
Goal 11: Sustainable cities and communities	20	State of conservation of buildings
	21	Public busses density
	22	Railway density
	23	Cultural facilities
	24	Schools
	25	Areas of historical, artistic and cultural interest
	26	Public areas
	27	Urban safety
	28	Road deaths
Goal 12: Responsible consumption and production	29	Residential energy consumption
	30	Non-residential energy consumption

Table 1. (*continued*)

Sustainable Development Goals	ID	Indicator
Goal 13: Climate action	31	Protected areas
	32	Forest fires
	33	Contaminated sites
	34	Green urban areas

5   The Application

For the application of the proposed methodology, we chose the municipality of Naples, Italy. This case study was selected because of the wide heterogeneity of resources and characteristics of the 31 districts of the city. Naples is the third most populous city in Italy, with about 900,000 inhabitants, an average population density of 8,000 inhabitants/Km^2 and a municipal area of 112 Km^2. The urban structure of the city can be divided in three main urban zones: the "periphery zone", which includes districts that took shape during the 80s and some ex-industrial areas in the east area; the "inner zone", which includes the most populous residential area and the principal business districts; and the "central zone", which is the most densely populated area and the historical area of the city that coincides with the UNESCO perimeter.

Due to this heterogeneity, we expected that some districts would be more competitive in certain categories of "sustainable competitiveness", while other districts would
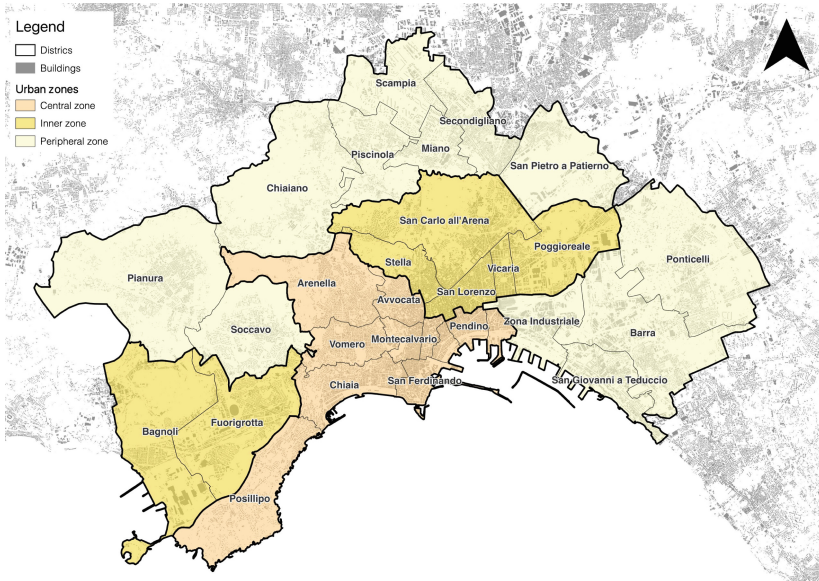
Fig. 1. The 31 districts and the three urban zones in the city of Naples.

distinguish themselves in different categories. We also expected interesting results from the combination of the single categories of competitiveness (Fig. 1).

5.1 The Set of Indicators

To define the final set of indicators, we considered 0.8 as the threshold value for correlation coefficients in deleting indicators that were too correlated. This led to a restricted set of 34 indicators, listed in Table 1. The indicators were divided into the seven SDG categories.

5.2 Results and Discussion

Through applying the proposed methodology, we obtained the final score for competitiveness of each district in the city of Naples. The normalised value of competitiveness for the city is 41.72 on 100. Chiaia is the district with the maximum value of competitiveness (100) and Miano is the district with the minimum value (0).
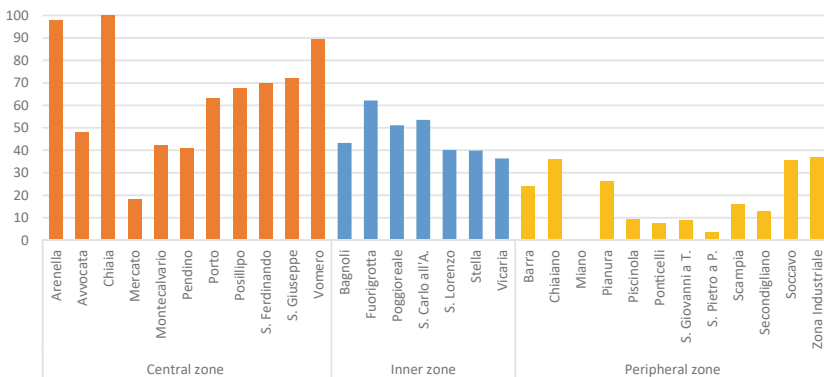
Fig. 2. Bar diagram showing the final score for competitiveness of the 31 districts of Naples.

The results shown in Fig. 2 reveal that the peripheral districts are less competitive than the central districts. Specifically, the less competitive districts are those located in the north of the peripheral zone (Miano, Piscinola, San Pietro a Patierno, Secondigliano and Scampia) and in the east of this zone (Ponticelli and San Giovanni a Teduccio). The most competitive districts of the city are Chiaia, Arenella and Vomero. The district with the lowest score for competitiveness in the central zone is Mercato.

The objective of this application is not only to evaluate the competitiveness of the city of Naples but also to highlight the shortcomings and the favourable aspects of each district in different sectors, in order to support decision-makers in improving sustainability and competitiveness. Therefore, it is worth discussing the scores obtained in the different categories that correspond to the SDGs of Agenda 2030. Regarding "good health and well-being" (Fig. 3a), the distribution of scores is more uniform. This can be traced back to a uniform distribution of health services and homogenous accessibility
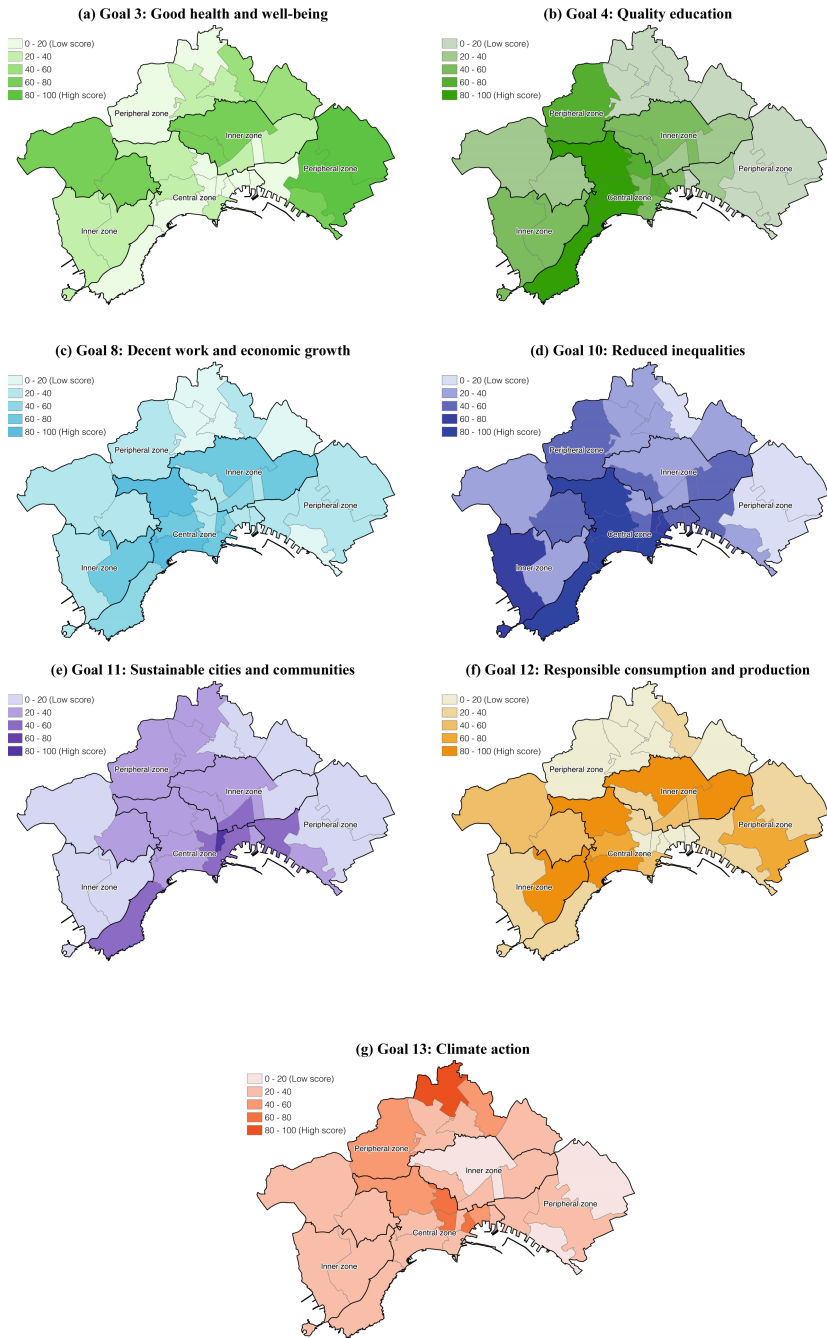
Fig. 3. A representation of the results obtained for each SDG category for the 31 districts in the city of Naples.

to healthcare. The category "quality education" (Fig. 3b) reflects the same trend of "re-duced inequalities", a sign of how the level of education influences the distribution of social and economic well-being and, so, competitiveness. Regarding the category "re-duced inequalities", the coastal and hillside districts (Chiaia, Posillipo, San Ferdinando, Vomero and Arenella) score the highest (Fig. 3d) since they host wealthy populations and are less subjected to gender and social inequalities. The middle-income districts are Montecalvario and San Giuseppe, located in the historical centre, and the residential districts of Fuorigrotta and Bagnoli. The east and north areas are characterised by high levels of poverty and inequalities. The only exception is the districts of the historic centre, where perhaps the proximity to university facilities supports tertiary education. Regard-ing the category "decent work and economic growth", Chiaia, Vomero and Arenella, along with the district of the city centre, distinguish themselves again for their wide range of job opportunities and low rate of unemployment. Fuorigrotta also achieves a high score because of its high concentration of enterprises, institutions and workers. The category "sustainable cities and communities", which takes into account the urban structure, presents a peak for San Giuseppe, which is at the core of the city centre, and a depression for San Pietro a Patierno, due to the presence of the airport. The category "climate action" is highly affected by the distribution of green areas. This determines the primacy of Chiaiano and Arenella in this category, thanks to the presence of the Camaldoli park, followed by the hill district of Posillipo and the district of San Carlo all'Arena, characterised by the presence of Capodimonte park. The eastern districts, along with Bagnoli, have lower scores because of the presence of contaminated sites due to the decommissioning of industrial plants. Soccavo is also less competitive in terms of the fight against climate change. Figures 4 and 5 show the results for the districts of Mercato (central zone) and Miano (peripheral zone) in comparison to the mean values of the SDG categories for the city of Naples. The two districts have the lowest scores in the central and peripheral zones. This diagram could therefore be useful to policymakers and technicians to help identify priority categories to improve the urban competitiveness of districts with an approach oriented towards sustainability development.
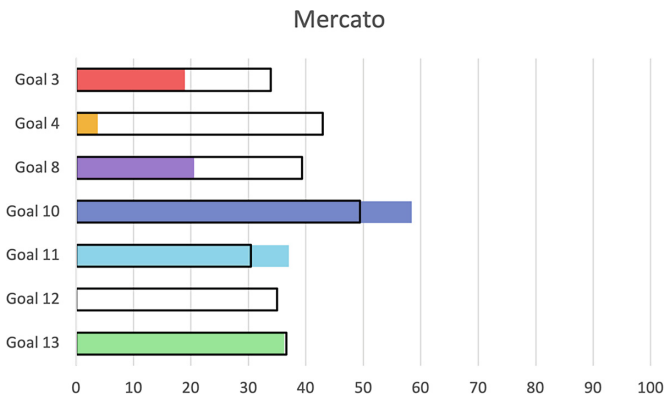
Fig. 4. The results for the SDG categories for the Mercato district in the central zone of Naples (in black the values of the SDG categories for the greater city).
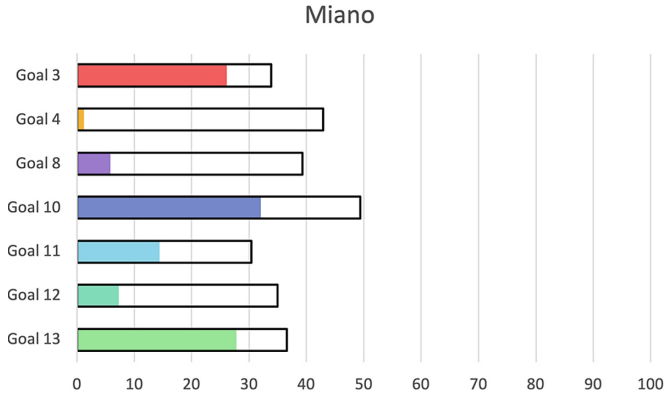
Fig. 5. The results for the SDG categories for the Miano district in the peripheral zone of Naples (in black the values of the SDG categories for the greater city).

6   Conclusion

The study of competitiveness has significantly broadened in recent decades, becoming a pivotal aspect of the governance of territorial and urban transformation. Due to the increasing importance of the urban contexts in global growth, urban areas are now competing with each other to attract resources, investments, people and activities. Cities are able to compete in many sectors thanks to the opportunities offered by communication and transport technologies, and different aspects contribute to their attractiveness. Scholars agree that numerous features influence the localisation of new business and the choices of citizens and users. In this sense, urban competitiveness is made up of different interrelated components that make it multidimensional.

The multidimensional approach, typical of urban competitiveness studies, allows sustainability to be considered as one of the components influencing the attractiveness and magnetism of urban areas. Satisfying the basic needs of citizens, promoting equal economic development, ensuring a high-quality environment and mitigating and adapting to climate change are some of the principal targets of the model of urban sustainability, with an evident impact on the competitiveness of urban areas. As a matter of fact, the achievement of sustainability goals and the implementation of sustainable actions can support cities' performance in economic, social and environmental terms. Orienting urban development towards sustainability offers the opportunity for cities to improve the quality of life and safety of their citizens and economic operators.

In recent decades, an increasing number of studies aimed at ranking the competitiveness of cities have given greater weight to aspects related to sustainability. Many urban sustainability rankings have also been proposed by the scientific community, a sign of how cities are called upon to compete by developing their own strategies to face the challenges of sustainability [40]. Although many of these studies focus on the regional or metropolitan scale, we found it interesting to consider the resources for sustainability at the district scale to measure urban competitiveness according to the peculiarities of single districts.

Given this scientific framework, it is worth analysing the competitiveness of urban districts according to their level of sustainability. In order to achieve this objective, we developed a simple methodology to compare the competitiveness of the districts of a city in terms of sustainability. To build the system of components and indicators useful for the comparison, we referred to some of the SDGs of Agenda 2030 since they represent objectives that are shared by many countries. We defined an algorithm to calculate a composite index that measures a district's competitiveness in relation to its sustainable features, and we implemented the algorithm in GIS. The result was a multidimensional ranking that can be visualised on digital maps or on radar graphs, enabling a comparison of both a city's overall score and its performance in one of the chosen components.

For the application of the proposed method, we chose the municipality of Naples in Italy, which is characterised by the high heterogeneity of its districts in terms of resources, vocations and sustainable development. We found a great disparity between central districts and suburban areas. Specifically, the less competitive districts are the northern suburbs (such as Scampia, Miano, San Pietro a Patierno and Secondigliano), which are affected by social and economic problems, together with the eastern suburbs (such as Barra, Ponticelli and San Giovanni), whose marginality is the result of the decommissioning of industrial sites and the lack of adequate governance of urban transformation. The most competitive districts are Chiaia, Vomero and Arenella, followed by San Giuseppe, San Ferdinando and Posillipo, which are known to be the wealthiest districts in the city. We also studied the differences among the different components in order to highlight the strengths and weaknesses of the districts. The aim of this was to support decision-makers in improving sustainability and competitiveness.

This study aimed to provide a basic comparison of the sustainability characteristics of districts for competitiveness purposes. In this sense, it represents the first step of a wider study on the subject that will focus on the integration of sustainable development and competitive advantages. Future developments of the research will regard the structure of the methodology especially for what concerns the system of weightings. Furthermore, another application to a different city may confirm the replicability of the Index also for other contexts.

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