Are Italian cities already 15-minute? Presenting a glocal proximity index, based on open data

Beatrice Olivari[1,*] and Angela Cimini[2,3]

[1] Department of Business Innovation & Development, Deda Next srl, Bolonga, Italy; beatrice.olivari@dedagroup.it
[2] Department of Architecture and Project, University of Rome La Sapienza, Piazza Borghese 9, 00186 Roma, Italy; angela.cimini@uniroma1.it
[3] Italian Institute for Environmental Protection and Research (ISPRA), Department of Networks and Environmental Information Systems (SINA), Via Vitaliano Brancati 48, 00144 Rome, Italy

* Author to whom correspondence should be addressed.
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In recent years, the concept of proximity has gathered significant attention and the best-known model dealing with this concept is Carlos Moreno's 15-minute city, where citizens can easily reach any essential service through a 15 minutes' walk (or bike ride) [1]. This city model presents numerous advantages, including reductions in car traffic and carbon footprint, improvement in citizens' health and safety, enhancement of the economy in the whole city, improvement of accessibility and so on. However, transitioning to a 15-minute city is not a straightforward undertaking and for this process to succeed it is best to rely on data-driven assessments of its developments. Deda Next developed an index of proximity [2], to help municipalities monitor the accessibility of their territory and develop targeted policies to improve mobility.

The Next Proximity Index (NEXI) is entirely based on OpenStreetMap data and capable of measuring the level of local proximity to services by walking, according to the principles of the 15-minute city. The goal of the index is to identify which of the different areas of a given territory already follow the 15-minute paradigm and its implementation is made available as an interactive map where the index is computed on a hexagonal grid and thematized according to its value.

In the last few years, some proximity indexes have been developed. With respect to the existing solutions that we were able to analyze, the added value of our index is given by three main characteristics:

- Scalability - the index computation algorithm can process runs at different scales without relevant performance issues. It is in fact available for the entirety of Italy.
- Replicability - thanks to OSM data, the index is easy to replicate in different areas and regions. It can also be customized, according to the needs of the municipality.

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- Interoperability - the index is not only accessible as interactive web map, but the output data are also available through interoperable web protocols, as required by the European Directive 2007/2/CE (INSPIRE), with endpoints offering WMS (ISO19128) and WFS (ISO19142).

Finally, the Next Proximity Index was designed to be glocal: thanks to the world-wide availability of OSM data, it can be replicated everywhere (global), but it is also granular enough to be able to evaluate the proximity at a small scale (local) [3].

The Index calculation begins with the step of data downloading. Particularly, two types of input data are required, both downloaded from OSM, using Pandana, a Python library for network analysis.

- Services data - we identified eight categories of essential services: education, entertainment, grocery, health, posts and banks, green public areas, sustenance, shops. For most of these categories we adopted the categorization provided by OSM wiki.
- Road network data - calculating the accessibility to those services means considering the routes to follow to get there.

After downloading the data, the index is computed. First, we measure the time to reach the closest POI of each category, starting from all the nodes of the network. However, the information about accessibility of nodes is too granular, as the goal of the index is to identify the proximity of areas, not nodes. Therefore, the index provides a hexagonal grid (with 125m-sided hexagons). For each hexagon we aggregate the distances and assign a unique value of proximity.

The output of the Index for Italy is available as an interactive map (https://www.dedanext.it/topic-citta-15-minuti). It provides a view by category (accessible by the top-left menu) that shows the proximity of single categories of services. Otherwise, it shows a general categorization in five levels: 15-minute, 30-minute, 60-minute, low proximity and not measurable. Figure 1 represents the general index in the city of Rome.

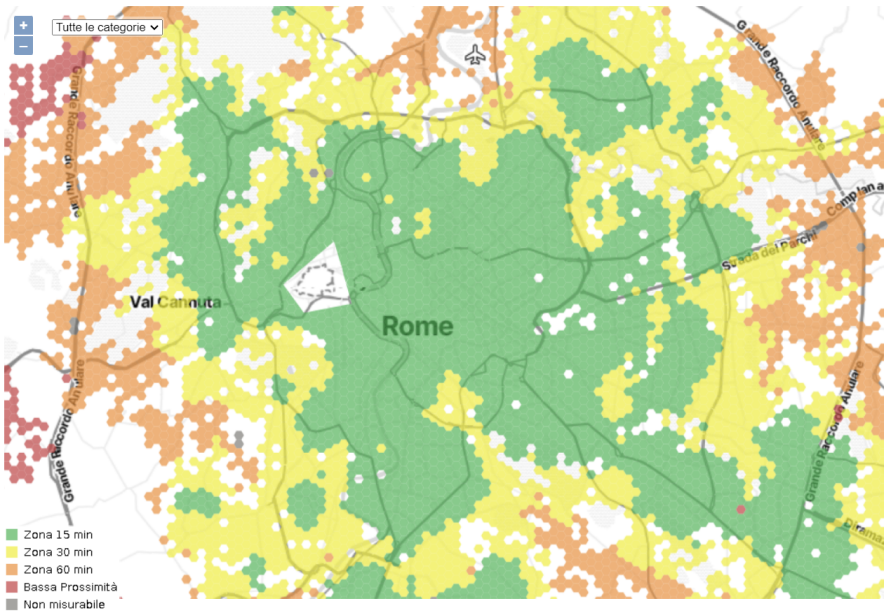

Figure 1. 15-minute index - City of Rome

Custom analyses have been performed in collaboration with municipalities and organizations:

- With the municipality of Ferrara, the data from the index were combined with population data, to highlight those areas where the lack of services was affecting more people.
- The municipality of Bologna asked us to integrate their open data in the index and add two custom categories.
- In partnership with the Italian Institute for Environmental Protection and Research (ISPRA), we are exploiting the index algorithm to develop an indicator of accessibility of green public spaces in Italy. The indicator will also be included in the next edition of ISPRA's Report "Land consumption, territorial dynamics and ecosystem services", aimed at the assessment of the UN Sustainable Development Goal (SDG) 11.7.1 indicator (https://unhabitat.org/sites/default/files/2022/08/sdg_indicator_metadata-11.7.1.pdf), which analyzes the presence of public spaces in urban areas in terms of the "Share of urban population without green urban areas in their neighborhood".

The Next Proximity Index is intended as a support tool for municipalities that are implementing new mobility strategies and to help them make data-informed decisions. The main goal is to develop an Index with world-wide replicability. Getting the required data from local administrations worldwide would be too challenging and it would also require complicated activities to integrate such datasets with mutually inhomogeneous structures. Therefore, the adoption of OSM data is crucial for reaching the goal. Moreover, the size and reliability of OSM is also responsible for a positive feedback effect regarding data coverage: so many public and private actors rely on it that they are stimulated to keep it updated and expand its coverage, so as to maintain the benefits they have from using it [4].

Even though OSM is the largest volunteer geographic information project in the world, OSM data is not always evenly available around the globe and the index is sensitive to the non-uniformity of data. To try to overcome this issue, we partnered with the municipality of Bologna, to integrate their more uniform and up-to-date data into the index, obtaining very promising results. In particular, the municipality of Bologna was interested in analyzing the proximity related to two new categories of services: "community services" (such as services for young people and citizen helpdesks) and "access to public transport" (basically represented by the distribution of public transport access points - stops - within the city). Therefore, these two categories were added alongside the eight categories of the standard implementation of NEXI, so that the corresponding levels of proximity could be analyzed. Another customization of the NEXI was requested concerning the parks category. The municipality was not satisfied by the corresponding OSM data as it included, in addition to the actual public parks, also some very small patches of green that could not be considered as parks. Therefore, OSM parks data were replaced by municipalities data.

During the collaboration with the municipality of Bologna, we found the topic of public urban greenery to be particularly interesting and suitable for experimentation. Therefore we started a partnership on this topic with ISPRA. When considering accessibility to green public spaces, it is essential to exclude private gardens and small portions of greenery that do not fall in the category. Moreover, parks can have multiple access points that are not indicated in OSM and this could affect the results of the index. With this respect, the ITO map classification system is considered, with reference to areas larger than one

hectare [5], but the identification of further appropriate supplementary information for the correct monitoring of the SDGs would provide useful indications to maximize the use of OSM data. This last aspect is the object of the collaboration between Deda Next and ISPRA for the evaluation of the UN SDG 11.7.1 indicator [5–7].

When it comes to walkability (or bikeability), it would be useful to integrate the index with morphological data to consider the slope as a factor of road's accessibility. Unfortunately, at the moment, the OSM road's incline tag is only available for a small percentage of OSM roads (around 0.01%). Therefore, as a future work we intend to integrate an orography dataset (https://tinitaly.pi.ingv.it). It would also be possible to organize campaigns in some partner cities, like Bologna or Ferrara, to involve local volunteers and add this data in OpenStreetMap.

Additionally, we explored the integration of demographic data into the index. We found it particularly relevant to compare data about accessibility to services with population density in the area. Currently, our collaboration with the municipality of Ferrara has furnished us with population data; nevertheless, our aspiration would be to expand this analysis to the entire Italian territory, incorporating a broader demographic dataset (https://data.humdata.org/dataset/kontur-population-dataset?).

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