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THE TIMES THEY ARE A-CHANGIN'

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3 (2019)

The cover image is a photo of impacts on transport infrastructure of typhoon Hagibis in Japan (October, 2019)

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ABSTRACT

The progressive ageing of population requires rethinking the spatial planning of the urban spaces and activities to guarantee the best accessibility and usability to urban services of interest for the elderly segment of the population. In this perspective, the paper provides a methodology oriented to reorganize the urban services to better satisfy the renewed needs of over 65, by classifying the areas of a city according to (i) the levels of urban accessibility and (ii) the Functional Accessibility Soft zones (FASzones). In fact, the FASzones are the parts of the city where elderly can easily reach their services of interest due to the presence of "optimal" pedestrian routes fitting their behaviours. The results provide local decision-makers with useful suggestions for deciding where and how to in on the distribution and location of services, in order to increase urban accessibility for the over 65 by improving their quality of life.

This methodological aim represents a first step in the broader MOBILAGE research work aimed at defining strategies, tools and actions to improve the pedestrian accessibility to urban services and places for elderly users.

ELDERS' QUALITY OF LIFE

A METHOD TO OPTIMIZE PEDESTRIAN ACCESSIBILITY TO URBAN SERVICES

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摘要

人口逐渐老龄化是每个城市如今在满足相关的新承诺时必须应对的挑战。回应老年人的需求意味着要重新考虑城市空间的整治与规划，以确保老年人群对感兴趣的城市服务享有最佳的可达性和可用性。从这个角度来看，本文提供了一种根据 65 岁以上人口的流动性和城市服务水平对城市区域进行分类的方法。该方法学的目标代表了一项更广泛的研究工作的第一步，后者的目的在于确定策略、工具和行动，以便提高老年人在城市中获得服务和前往各种场所的机会。

老年人生活质量与城市可达性：空间规划的方法建议

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1   INTRODUCTION

Over the last twenty years, improvements in quality of life and scientific and technological advances have led to an increase in life expectancy.

In some countries, such as Italy, the rise in life expectancy combined with the low birth rate has completely altered the age structure of the population. Taking into account the life expectancy statistics of the last four decades, it can be observed that the age for males increased from 69.6 in 1976 to 80.6 in 2016 and for females from 76.1 to 85.1; the percentage of people over 65 rose from 15% in 1991 (it was 8.2% in 1951) to 22.3% as of 1 January 2017, and in parallel also the percentage of the "older old" (90 plus) went from 0.06% in 1951 and 0.4% in 1991 to the current percentage of 1.2% of the total Italian residents (723000 people) (ISTAT, 2015). This new demographic trend requires many changes: (i) a social change, which could enable older people to "exercise their skills and maintain or establish solidarity relationships" (Ombuen, 2017), recognizing them as a resource and no longer as a burden for a cohesive development of society; (ii) an economic change, because the rise in life expectancy and the increasingly unfavorable relationship between the active and non-active population will also led to an increase in the health and social security expenses mainly for the elderly, causing the so-called longevity shock, recently underlined by the International Monetary Fund; (iii) an urban change, since a better organization of the spaces, channels and activities will increase the possibility of movement of the elderly. In this perspective, to make local decision-makers aware of the needs of this segment of the population, in 2006 the WHO addressed the problem of population aging (through the "Global Age-friendly Cities" project) by identifying the basis for developing age-friendly cities and communities.

In this study, urban accessibility depends not only on the physical characteristics (places) and functional features (activities) of a city, but also on people's behaviours (lifestyles). In this logic, the paper tries to integrate and overcome the more traditional studies referring to place-accessibility and acitivity-based approaches, by introducing the variable of "needs" linked to the behavior of specific population segments. Therefore, in addition to the common consideration of urban places and activities, accessibility levels are defined by a system of relationships referring to spaces, activities and needs of the people who use them, according to the abilities of individuals and not only to their expectations.

The scientific community addresses the issue of improving the accessibility of the elderly by intervening mainly on the transport networks. In fact, scholars have focused extensively on how to increase the supply of local public transport and on identifying some geomorphological factors influencing the decision of people over 65 to get around the city, (such as the slope of the territory) (Arentze et al., 2008; Frochen et al., 2019; Padeiro, 2018). Few studies have focused on identifying the physical and functional features of the city that influence the pedestrian accessibility (walkability) of the elderly (Elsawahli et al., 2014).

To this end, the MOBILAGE project is aimed at defining a decision support tool for public administrations to improve elders' pedestrian accessibility to services, thus contributing to enhance their quality of life. This paper, which represents a step of the research project, has a twofold objectives: the first concerns the classification of urban areas, after defining physical and functional accessibility levels; the second refers to the definition of the Functional Accessibility Soft zones (FASZones) that identify the urban portions where services can be reached by suitable pedestrian routes for elderly (Cottrill et al., 2020). This work allow to support local decision makers in defining interventions oriented to improve the urban accessibility of the over 65. Against the scientific literature that provides a plethora of interpretations of accessibility, because of its interdisciplinary nature (e.g. Cheng et al., 2007; Litman, 2017; Sola et al., 2018), this study refers to the "urban accessibility" concept according to the holistic-systemic approach of the governance of urban transformations. Urban accessibility can be meant as the possibility of a person with any ability to reach and make use of places and activities of interest without barriers. In other words, the defining elements of urban accessibility are the services reachable on the urban level (functional component of urban accessibility) and the set of pedestrian

networks (physical component of urban accessibility), in close proximity to houses, all of them related to the behaviour of the older users.

Improving both the distribution of urban places and services and the usability of the paths to reach all of them results in contributing to increase the quality of life of the elderly by intervening on urban accessibility.

The paper is articulated as follows: the first section proposes a review of the scientific literature on the issue of accessibility for the elderly population; the second section presents a methodology to define the different levels of urban accessibility; the third section outlines the application of this method in the GIS environment to the Fifth Municipality (Vomero and Arenella districts) of the city of Naples; the fourth section describes the results obtained.

2   POPULATION AGING AND URBAN ACCESSIBILITY

Even though the influence of built environment on people habits, behaviors, expectations and aspirations has been debated by several authors for decades (see, e.g. Edwards et al, 1998; Grzeskowiak et al., 2003; Steinfeld and Maisel, 2012), just in the last years this discussion has been focusing on the "late life" segment of the population by connecting it with the spatial and urban accessibility field (Boudiny, 2012; Bricocoli et al., 2018; Henkin and Zapf, 2006; Pinto and Sufineyestani, 2018; Yuen, 2018).

The duality in the relation between the habits of the elderly (demand) and the organization of the urban system (supply) has prompted scientific debate on how to improve both the accessibility to urban places and services and the pedestrian network, given that soft mobility is the preferred transport mode among elder people: elders aged 60-74 years walk and cycle (64% of trips) more frequently than they drive within urban areas and for short distances (EC, 2012; Eurostat, 2017; Rosenbloom, 2004;). However, few studies have dealt with integrating the above matters, due to the complex spatial relationships between activities and mobility. In particular, Guagliardo (2004), Mao and Nekorchuk (2013) Wang (2012; 2015) and Zhu et al. (2019) have simultaneously focused on the two issues with the aim of measuring the "spatial accessibility to public services, especially healthcare services" (Tao and Cheng, 2018) and mainly by private transport. Such studies use a new accessibility indicator which, by measuring some characteristics (such as the travel distance to reach a specific activity and the related journey time), allows identifying those areas characterized by a lack of services. The possibility of reaching places and services, as well as the use of local public transport and the pedestrian network represent important steps towards improving overall urban accessibility and reducing social exclusion (Gargiulo, 2014; Khosravi et al, 2015; Zali et al., 2016). In this regard, there is an extensive body of scientific literature concerning the increase of the local public transport supply. Some of the studies developed (Broome et al., 2012; Fobker and Grotz, 2006; Kotval, 2017; Morency et al., 2011; Wong et al., 2017) have deepened the issues of the most frequent and preferred transport mode for the elderly (mainly the bus) and the quality of public transport offered. These studies were based on surveys conducted through questionnaires that provide information on the lifestyles of the elderly population, on the use of multivariate statistical techniques for assigning weights and the correlated identification of significant variables, and on the application of accessibility models, in order to understand how the elderly can reach a specific transport service. For example, the extensive scientific literature aimed at understanding the key factors influencing travel decisions among people aged 65 and older – which relate to the spatio-temporal constraints in achieving a given service of interest (Hildebrand, 2003; Szeto et al., 2017; Witten et al., 2003;) - makes wide use of this type of statistical methods. Even the most recent research segment concerning the reorganization of outdoor spaces (not specifically aimed at encouraging "active aging"), adopts multivariate statistical techniques to determine the impact of the built environment on the accessibility to places. In fact, the scientific community has dedicated particular attention to identifying, on a neighborhood scale, the physical and environmental characteristics that influence the participation and social aggregation of the elderly (Curvers et al., 2018;

Hawkesworth et al., 2018; Siu, 2019). Other studies have highlighted the physical and environmental characteristics of the built environment to detect which factors influence the "walkability" of the elderly (Feng et al., 2018; Meshur, 2016; Tseng and Wu, 2018; Van Cauwenberg et al 2011; Wang and Cao, 2017; Zang et al., 2018), so as to provide useful information for improving the pedestrian accessibility of the road network. Within the scientific framework of reference, very few studies link the needs and habits of the elderly (demand) to the matter of accessibility to urban places and services. Starting from this gap, this work intends to define the levels of urban accessibility, according to its physical and functional features, comparing them with the elderly density distribution and with the FASZones in order to identify the different demand-supply ratio degrees.

3 METHODOLOGY AND STUDY AREA

In order to classify the portions of a city according to their physical and functional accessibility levels of the older population at the neighborhood scale, a four-stage methodology was developed.

It is worth noting that this study goes a step further than a previous work (Gargiulo et al., 2018) and use a set of 13 variables classified according to the four main urban subsystems (Table 1). These 13 variables are the most significant ones due to their statistical weight, according to literature.

By referring to the performance approach (Gargiulo, 2009), the variables within the functional, physical and environmental subsystems define the supply of urban accessibility, while the variables within the socio-economic subsystem define the demand of urban accessibility of the elderly segment of the population.

The numerous services of interest for the elderly (functional subsystem) have been also geolocated in accordance with the following types of services:

− health services: hospitals, pharmacies, diagnostic centers and ASL;

− cultural and leisure services: cinema, theater and libraries, green areas;

− economic-financial services: banks and post offices;

− commercial services: supermarkets and shopping fronts.

This further classification has been introduced to cluster the numerous kind of services, as well as for facilitating the reading and the interpretations of the results obtained.

ID	VARIABLE	WEIGHT	MEASURE	SOURCE
SOCIO-ECONOMIC SUBSYSTEM				
1	Population over 60 divided into age groups (60-70,70-80,> 80)	p=-0.25 p<0.001 p=0.37 p=- 0.55	Inhabitant (Inhab.)	Istat-Municipality
2	Old index		(%)	
ENVIRONMENTAL SUBSYSTEM				
3	Orography (elevation)		m	GIS
PHYSICAL SUBSYSTEM				
4	Metro stations	p=0.7 p=0.5 p=0.3	R.i.= 500m	Geographic information system
5	Bus and tram stops	p=0.94 p=0.80 p=0.50	R.i.= 500m	GIS_Open street map
6	Network of protected paths	p=0.02 p=0.005 p=0.86	Km	GIS

FUNCTIONAL SUBSYSTEM (services of local interest)			
7	ASL		*Radius of influence (R.i.)= 500m*	
8	Pharmacies		R.i.= 500 m	
9	Poly-diagnostic center		R.i.= 560 m	
10	Local market		R.i.= 600 m	
11	Social center		R.i.= 200 m	
12	Churches		R.i.= 400 m	
13	Cinema		R.i.= 515 m	Geographic information system GIS_Open street map
14	Theater		R.i.= 1000 m	
15	Green areas	*p=0.67* *p=0.50*	R.i.= 100 m	
16	Municipal library		R.i.= 600 m	
17	Sports center		R.i.= 1000 m	
18	Post office		R.i.= 500 m	
19	Bank		R.i.= 500 m	
20	Police and Carabinieri		R.i.= 500 m	
21	Supermarket		R.i.= 500 m	
FUNCTIONAL SUBSYSTEM (services of general interest)			
22	Hospital	R.i.= 1100 m	
23	Private Clinic	R.i.= 1100 m	Geographic information system GIS_Open street map
24	Urban park	R.i.= 1000 m	
25	Museums	R.i.= 1100 m	
26	Cemetery	R.i.= 1100 m	
27	Stadium	R.i.= 1100 m	

Tab. 1. Classification and parameterization of the variable set. The variables in italic are the ones that have been introduced by authors, as they are significant for the aim of the work

The 13 variables, as well as the methodology, have been applied to the municipality of Vomero and Arenella, in the central area of the city of Naples (Figure 1). The choice of this area of study is linked to two main aspects: on the one hand; the morphological, settlement and functional characteristics, whose diversification makes these districts a significant test area for the whole MOBILAGE project. For example, the hilly orographical conformation of the area (from 150 to 375 m above sea level) influences the choices of mobility and the use of spaces and services of interest for the elderly, thus representing an important element in the definition of strategies and policies aimed at improving urban accessibility. On the other hand; the municipality of Vomero and Arenella are both characterized by an older demographic structure, which percentage of the population over 60 is higher than any other municipality of Naples, equal to 34.3% (City of Naples, 2016). The ageing index, which is the synthetic indicator of the degree of population ageing (the ratio of the population aged 65 and over and the number of people younger than 15), is above 100. In particular, in 2010, this indicator amounted to 188.8% and the value rose up to 210.2% in 2016, with a growth of 21.4%, the latter percentage being higher than any other municipality of Naples (City of Naples, 2016).

The selected variables were parameterized and geolocated, in order to measure the main urban features seen as significant both in literature and in the urban planning tools to foster ageing friendly

environments/communities. This operation made use of quantitative data, compared to previous studies that used mostly qualitative ones (Gargiulo et al., 2018).
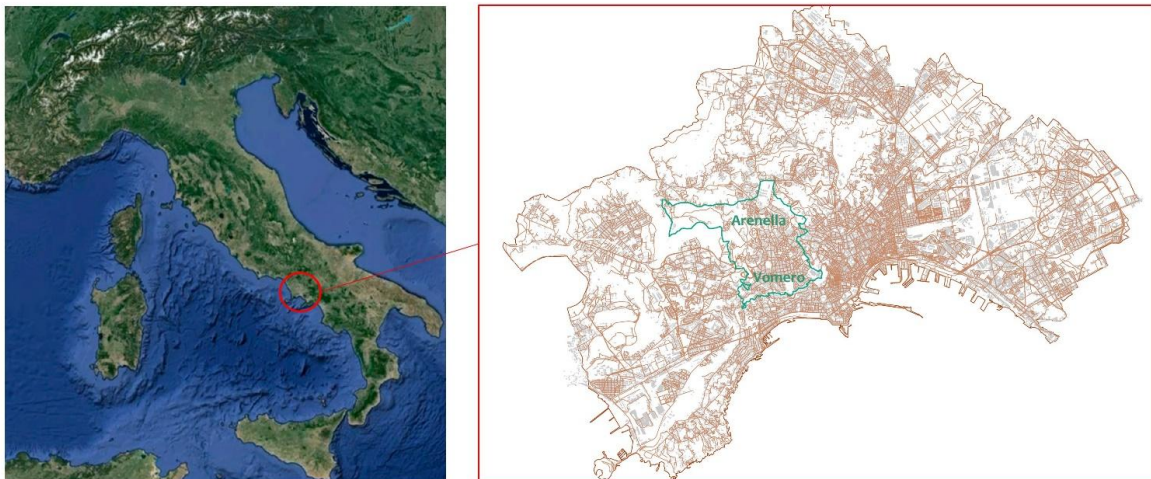
Fig. 1. The Municipality of Naples and the two districts studied

With the exception of the socio-economic subsystem - for which data are available only by consulting the databases of the National Institute of Statistics (ISTAT) - for the environmental, physical and functional subsystems quantitative data are obtained through spatial analysis in the GIS environment (Figure 2). Furthermore, all the data belong to the Open Data category, that are information collected in the form of databases by providing relevant opportunities to better design, interpret and manage the urban systems (Batty, 2012; Sui, 2014).
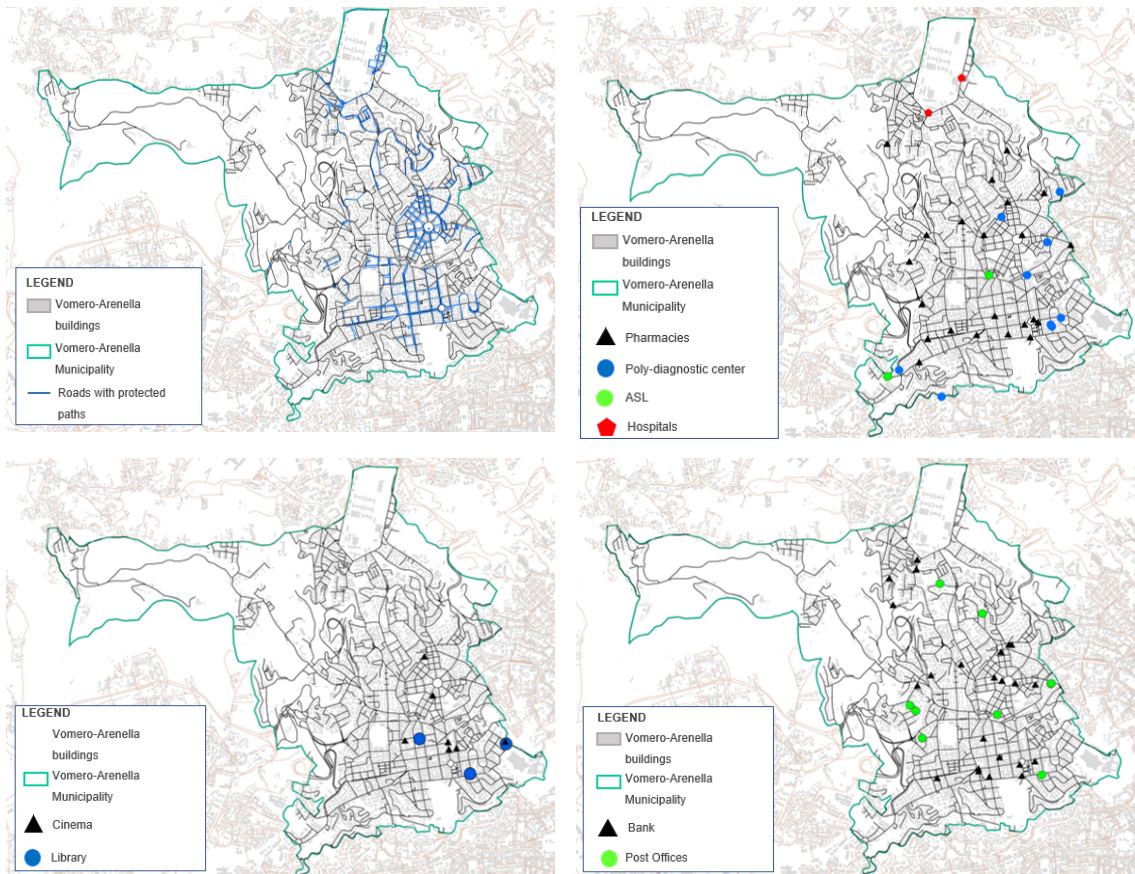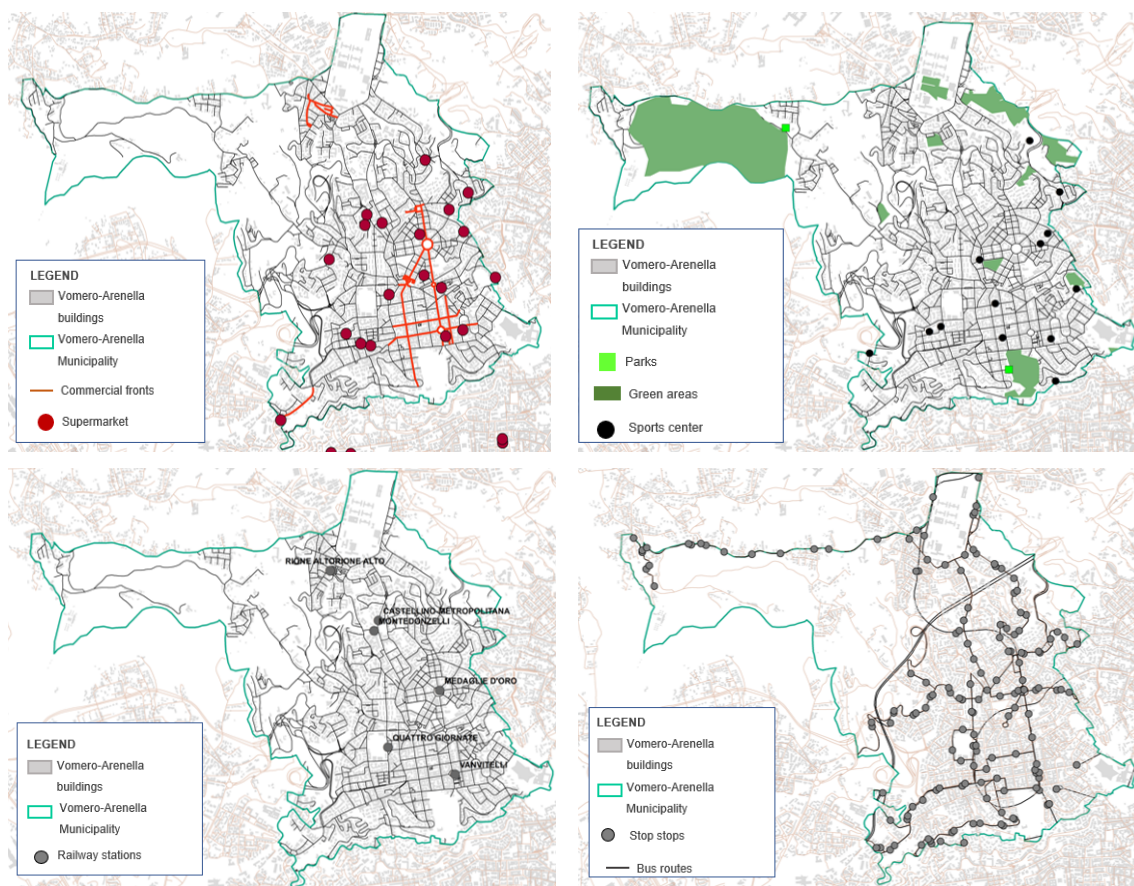
Fig. 2. Geolocalization of services of interest for the elderly and LPT supply

With regard to the physical subsystem, the variables related to the road and rail networks were geolocated by referring to the Open Data of the City of Naples, thus identifying 156 bus stops, 116 km of bus network, 6 railway stops and 1 railway line. The protected routes here are intended as the roads provided with wide sidewalks along which all the weak users can walk in safe conditions and without obstacles.

The geolocation phase of the variables of all 4 subsystems was followed by the definition of the local public transport (LPT) bus supply (Figure 2). The bus stops were classified on the basis of the service frequency of the lines which serve the study area, in order to consider the different mobility capital for the elderly.

The data of the LPT road lines were found by consulting the database of the Open Data of the City of Naples, with the respective departure and arrival times of the buses in the time slot 7:00 am - 2:00 pm. This time interval is supposedly the one in which most of the daily activities are carried out by the elderly; moreover, having a bus stop within easy walking distance favors their choice to use this mode of travel (e.g. Horgas et al., 1998; Morris et al., 2017).

The alphanumeric data collected were then associated with the related geometric elements in the GIS environment and the ones of interest were extrapolated through query operations. In particular, the following three frequency bands of the LPT bus service were determined: high frequency: < 15 minutes; medium frequency: 16-30 minutes; low frequency: > 30 minutes.

In the next step of the methodology, the service area (identifying the area where the users of that service actually reside) of each service has been defined according to the following elements: (i) the radius of influence derived from the scientific reference framework, that is the maximum pedestrian distance that a user is willing to walk to reach a specific service (Table 1), (ii) the slope of the road network determined by processing a Digital Elevation Model in the GIS environment, as this feature can contribute to reducing the distance that

elderly can walk; (iii) the walking speed that is an average value derived from the reference studies (e.g. Studenski et al., 2011; Weber, 2016) and equal to 0.7 m/s for the over 65 population.

The overlap of the "service areas" together with the concentration and distribution of each type of the services led to graduate the study area based on whether the physical and functional accessibility.

In fact, the systemization of the service areas of the LPT bus stops, classified according to the service frequency bands, and of the protected pedestrian paths led to define the following three classes of physical accessibility:

— high accessibility: when the service area of high frequency buses overlaps with the ones of the railway stations and protected routes are present in this overlay;

— medium accessibility: when the service area of medium frequency buses overlaps with the protected routes;

— low accessibility: when there are only medium/low frequency bus service areas.

An equivalent categorization led to the definition of the three classes of functional accessibility, according to the supply of each category of services considered:

— high accessibility: when at least two services are overlapped;

— medium accessibility: when there is only one service;

— low accessibility: when no service is present.

To achieve the second research objective, the research work was divided into three main phases.

In the first one, the "service areas" were deepened according to the maximum distances that the elderly can reach by walking (service distances), and to the different pedestrian speeds of the three main segments of the elderly population (65-69; 70-74; > 75) that have been identified according to studies such as Weber (2016). Thereby the functional component (services) is related to the behaviors related to each segment of the elderly population (Gargiulo et al., 2019). In the second one, the "service areas" have been redefined due to the presence of pedestrian paths with characteristics suitable for the elderly. In particular, the characteristics of pedestrian routes have been grouped into three main categories: physical characteristics, urban context characteristics and safety characteristics (Table 2).

ID	VARIABLE	MEASURE	SOURCE
PHYSICAL CHARACTERISTICS			
1	Slope of the links of the road network	>5%=0 o <5%=1	GIS
2	Sidewalk width	<1,5 m=0 >1,5m=1	Google Maps
3	State of pavement of the sidewalk	0=poor good=1	Google Maps
CHARACTERISTICS RELETED TO THE SENSE OF SECURITY			
4	Lighting density	<0,056=0 >0,056=1	GIS
5	Presence of escalators and elevators	No=0 Yes=1	Google Maps
6	Presence of parking areas	No=0 Yes =1	Google Maps
URBAN CONTEXT CHARACTERISTICS			
7	Presence of green areas	No=0 Yes =1	Google Maps
8	Presence of panoramic points	No=0 Yes =1	Google Maps
9	No-main roads	No=0 Yes =1	Google Maps

Tab. 2. The three categories of characteristics used to define the optimal pedestrian network for elderly

In the third phase, we have identifies the areas that, due to the presence of useful services for the elderly, to the physical characteristics of the routes, and to the geomorphological characteristics, are compatible with lifestyles, needs and behavior of elderly people, according to their walking willingness. These areas, defined as FASZones, are, in other words, the urban partitions where the elderly are facilitated to reach the services of interest, based on their abilities (behavior) and the characteristics of usability and attractiveness of optimal pedestrian routes.

4 TESTING AND RESULTS

The description of the results is articulated according to the two main objectives of the work: identifying (i) the levels of urban accessibility and (ii) the Functional Accessibility Soft zones (FASzones).

With regard to the first goal, the overlay of the LPT supply and of the protected pedestrian paths (physical subsystem), on the one hand, the "service areas" and the concentration and distribution of each service of interest for the elderly (functional subsystem) on the other, led to classify the Fifth Municipality of Naples (Figure 3).

In Figure 3, it is possible to identify some macro-areas characterized by a high accessibility to LPT and protected path network in both the districts of the Fifth Municipality examined: the Arenella district, the eastern area of Camaldoli which includes the zone of Rione Alto and the contiguous areas, respectively, Domenico Fontana road and Medaglie d'Oro square, and the Vomero district, the area of Vanvitelli square and Francesco Gemito road. In all these zones, there are at least 5 high-frequency service bus stops and in particular the areas of Medaglie d'Oro and Vanvitelli squares facilitate elderly walkability thanks to the protected paths. This built environment convenience for walking is due to the urban fabric planned in the second half of the nineteenth century, with its regular road mesh and wide sidewalks.

The areas lying between Domenico Fontana and Bernardo Cavallino roads (Arenella district) and between Simone Martini and Francesco Cilea roads (Vomero district) is characterized by medium accessibility with a frequency of transport service between 16-30 minutes. In these two portions of the urban area, the improvement of the road LPT supply would allow for a more efficient connection with the nearby hospital, in the first case, and with a residential area (the one near Pigna road) located in the Vomero district, in the second case.

The remaining areas of the entire territory of the Fifth Municipality, which mostly concern the Camaldoli area near Rione Alto, the area located to the right of the hospital center and the southern area of Vomero bordering the Chiaia district, are neither served by bus frequency consistent with elderly needs, nor covered by protected paths.
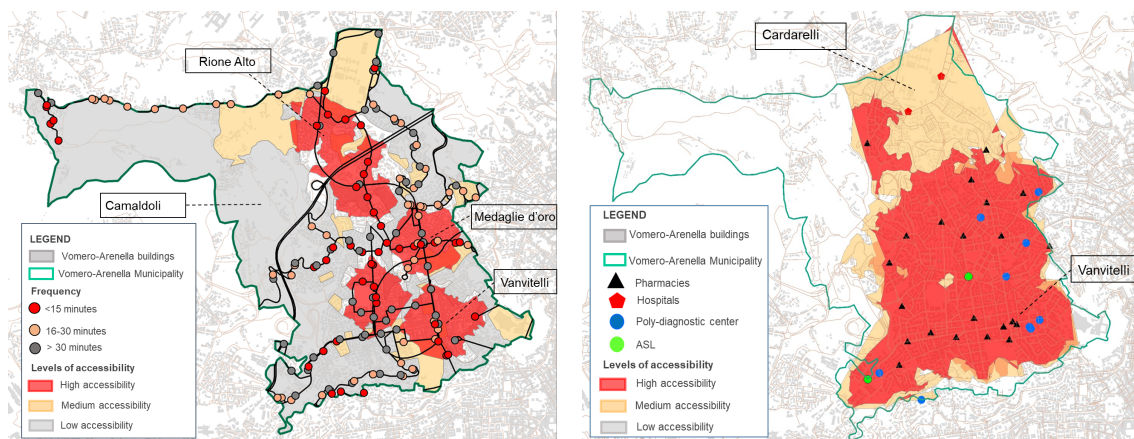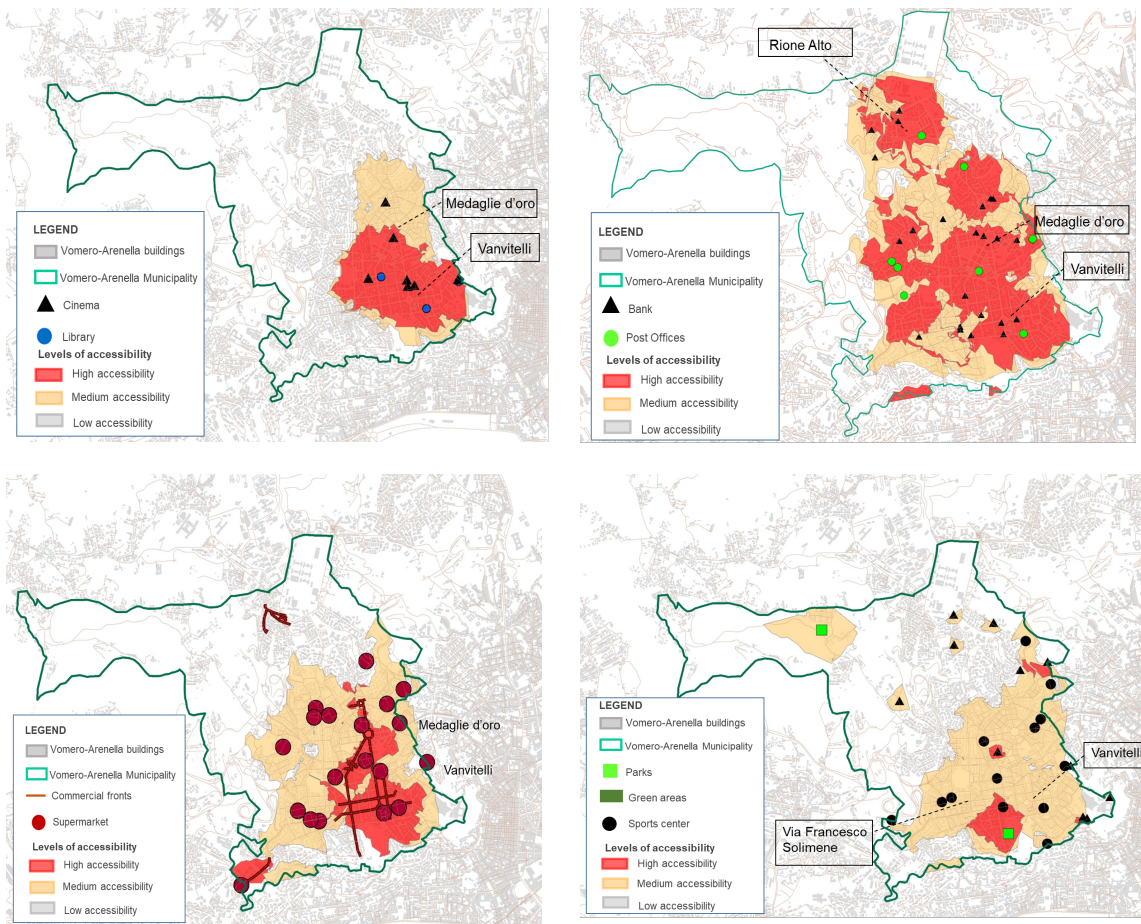
Fig. 3. Classification of the accessibility levels in Arenella and Vomero districts

With reference to the different types of services of interest for the elderly, the localization and distribution of health care services (hospitals, pharmacies, diagnostic centers and ASL) is homogeneous in those portions of urban fabric characterized by a unitary and planned design, as in the area close to the Pascale hospital center (Arenella district), the area bordering the Vomero district and almost all of the latter. Medium and low accessibility, instead, characterizes the service area of the contiguous area of the Cardarelli hospital center and the Camaldoli area.

Similar considerations apply also for financial services: their functional supply appears to satisfy the demand of most of the elderly who reside in the Fifth Municipality.

There results show that if the study area is generally characterized by a medium-high accessibility to the health and financial services, the accessibility is lacking in the commercial, cultural and recreational services. The service area of these three types of services is, in fact, almost exclusively concentrated in the area lying between Medaglie D'Oro and Vanvitelli squares, with the exception of the recreational facilities in the area between Aniello Falcone and Luca Giordano roads, where the urban park of Villa Floridiana is located. It is also worth noting that a medium accessibility also characterizes commercial and recreational services (urban park, green areas and sports facilities) in the Vomero district and in the area of the Arenella district lying between Pietro Castellino and Domenico Fontana roads, while the supply of commercial services (like supermarkets) is limited to the contiguous area between the two districts.

Taking an overall look at the six maps obtained, some "hotsposts" of physical and functional accessibility characterizing the study area seem to come up: the portion of consolidated urban fabric between Medaglie d'oro and Vanvitelli squares, and the more recent areas of Francesco Solimena road and Rione Alto. In order

to investigate the demand-supply ratio in these areas characterized by high accessibility, they were compared with the distribution of the elderly population density residing in the Fifth Municipality. In practical terms, we tried to investigate the main reasons why elderly chose these areas to live, according to urban accessibility levels. As this choice depends on numerous factors relating also the desired quality of life, the comparison of density population distribution (Figure 4) with urban accessibility maps (Figure 3) have been made by setting up demographical (population density distribution), settlement (different kinds of urban textures) and real estate value aspects, in order to provide an integrated interpretation of the overall structure, highlighting its characteristic relationships.
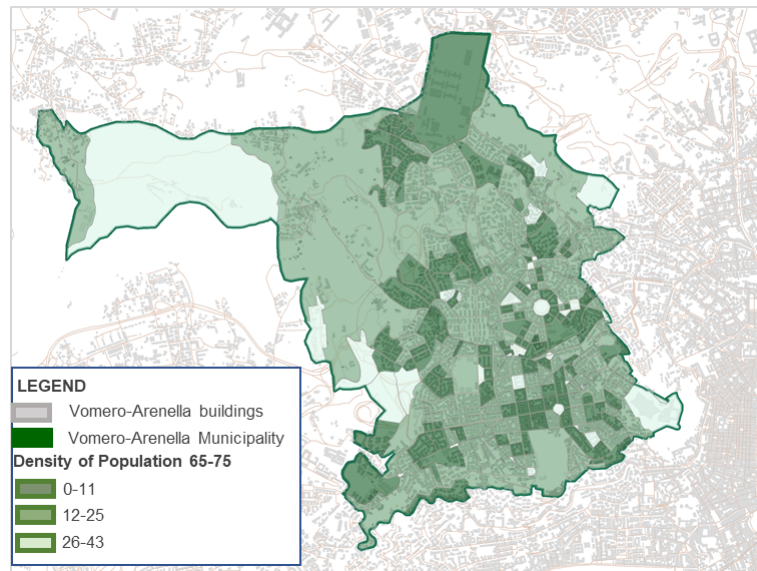

Fig. 4 Population density in Arenella and Vomero districts

The map shows that the highest population density values (about 25%) characterize the consolidated and planned portions of the urban fabric in both the Vomero and Arenella districts (Vanvitelli square, Medaglie d'Oro square, Scarlatti road). This concentration can be linked to aspects related to urban planning, as these areas are the result of an urban project aimed at improving urban quality also through the presence of services and functions compatible with residency. In fact, a diversified functional supply entails benefits in terms of accessibility (presence of several services accessible through footpaths) and also an increase in property values (as in the case of the two districts examined) because the more options there are for residents that share similar socio-economic characteristics, behaviours and lifestyles, the more they spend (Battarra et al., 2018a; Waldfogel, 2003).

The concentration of the elderly in the western part of the Arenella district (near Francesco Altamura road) can be attributed to the presence of gated communities (developed in the post-war period as unplanned building constructions) which would provide an increased sense of security and protection for this segment of the population to the detriment of low levels of accessibility both to local public transport and to cultural, recreational and commercial services.

Lastly, high density of the elderly population characterizes the area of Rione Alto, where the building process - started as a consequence of urban saturation of the "historical" areas of Vomero and Arenella - has led to a "non-uniform" improvement of the accessibility to road and railway public transport connected to the presence of the Cardarelli hospital center and also to good accessibility and financial services.

With regard to the second objective, by taking into account the results of the previous phase, the urban portions classified on the basis of physical and functional accessibility levels were compared with the FASZones. As defined in the previous sections, the FASZones have been identified within the "service areas" and are also

equipped with pedestrian paths suitable for the elderly. For this reason, the latter first ones are to be considered the areas of greatest accessibility within the "service areas", thus providing first suggestions to the public administration about the improvements to implement in the various areas. As an example, FASzones of one of the segments of the elderly population, the over 75, and for commercial and economic financial services are described.

By comparing Fig. 3 and Fig. 5, it can be seen that the "service areas" of the commercial services with high functional accessibility (in red, Fig. 3) are lack in pedestrian paths suitable for elderly. In fact, the optimal footpaths characterize only some parts of the surrounding areas of Vanvitelli square. The disparity between the functional and the physical components of urban accessibility characterizes also the economic-financial services for the area between Vanvitelli square and San Martino. From the comparison between Fig. 3 and Fig. 6, it is clear that, despite the fact that the services supply for the elderly is satisfactory, the pedestrian accessibility is lacking in a large part of the area.

Instead, for the areas of Camaldoli and Rione Alto, the comparison between Fig. 5 and Fig. 6 shows the overall significant lack of accessibility both in terms of services and pedestrian routes.
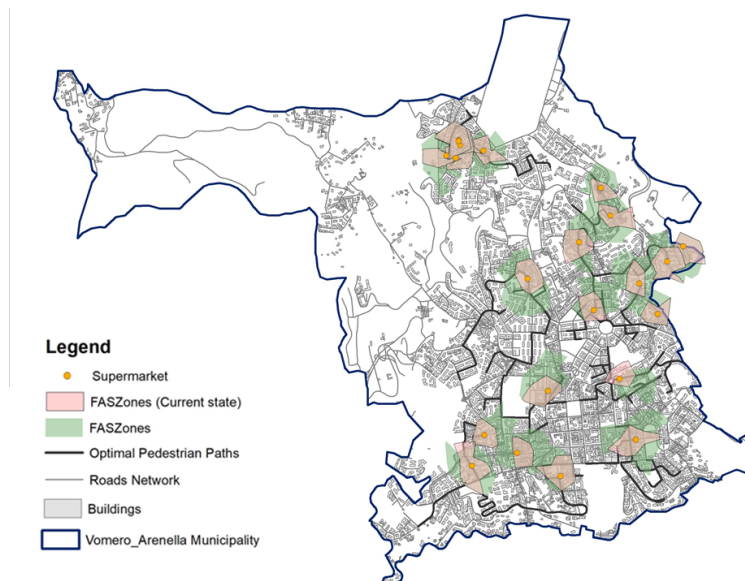

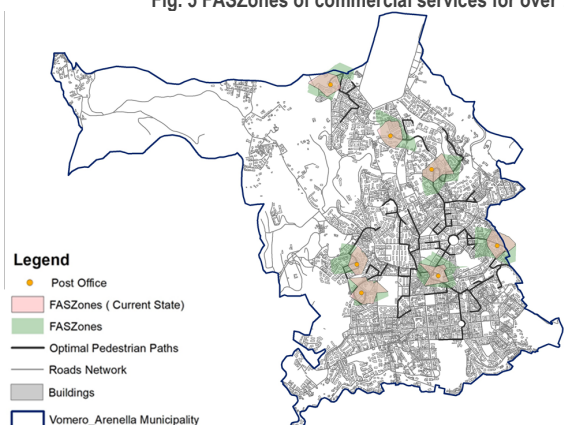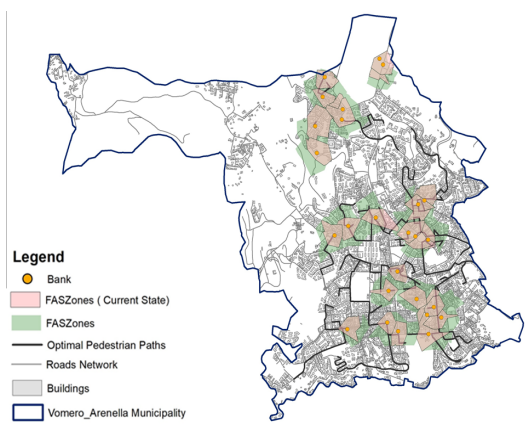Fig. 5 FASZones of commercial services for over 75

Fig. 6 FASZones of economic-financial services for over 75

5 CONCLUSIONS

This research work is a first result for the development of a decision support tool to improve urban accessibility to services of the elderly. The methodological results allowed to innovate the traditional urban planning "trade tools" by defining the "service areas" and the FASZones of services of interest for elderly. The FASzones relate the supply of main urban services to the behaviour of the older users through the suitable pedestrian network for them, according to the principles of Universal Design and the most recent theories on accessibility (Deboosere et al., 2018; Jansen et al., 2018).

The operating findings obtained show the urban portions with a supply-demand equilibrium, as well as those where it is necessary to intervene to fill this gap for elderly. For instance, the urban portions characterized by a high lack of accessibility to urban services require both areal and linear interventions, aimed respectively at increasing the supply services and improving the use of pedestrian network.

Therefore, integrated actions should be taken both on the functional and physical subsystems, in order to improve urban accessibility and guarantee social inclusion for the elderly by enabling them to actively participate in 'urban life' (Chun et al., 2018; Garin et al., 2014; Peacock-McLaughlin et al; 2018). According to Loo et al. (2017) and Wiles et al. (2009) the organization of urban spaces and services in the immediate surrounding areas near elderly's homes represent a significant element in "constituting their local activity space". In fact, a good connectivity and distribution among recreational services and 'necessary' services makes them more livable, also by promoting the sustainability of the related trips.

In this framework, if we systematize the physical and functional supply with the demand of the elderly, we can tackle the issue of urban accessibility with the systemic and performance-based approach that characterizes the governance of urban and territorial systems (Battarra et al., 2018b; Gargiulo et al., 2012).

The comparison between the urban accessibility obtained through the determination of the service areas in the GIS environment and the distribution of the elderly population density within the Fifth Municipality of the city of Naples, allows for identification of many ideas to be further investigated: (i) a more quantitative definition of accessibility levels by using indicators to be parameterized in the GIS environment; (ii) the definition of a set of punctual, linear and areal interventions to improve the distribution of urban places and services and the quality of pedestrian paths to get to them; (iii) a more detailed comparison between the real estates of the areas where the over 65 population density is high and the FASzones.

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AUTHOR CONTRIBUTIONS

Although this paper should be considered a result of the common work of the authors, F. Gaglione took primary responsibility for the section 4, C. Gargiulo for the section 3, and. F. Zucaro for the sections 1, 2 and 5.

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Fig. 1: is an elaboration of the authors

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Federica Gaglione is an engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II. Her research topic concerns the urban accessibility. The aim is to develop a decision support tool that, on an urban scale, allows to choose the most effective actions to improve urban accessibility for vulnerable users, by contributing to improve their quality of life.

Carmela Gargiulo is full professor of Urban Planning Techniques at the University of Naples Federico II. Since 1987 she has been involved in studies on the management of urban and territorial transformations. Since 2004, she has been Member of the Researcher Doctorate in Hydraulic, Transport and Territorial Systems Engineering of the University of Naples "Federico II". She is Member of the Committee of the Civil, Architectural and Environmental Engineering Department of the University of Naples "Federico II". Her research interests focus on the processes of urban requalification, on relationships between urban transformations and mobility, and on the estate exploitation produced by urban transformations. On these subjects she has co-ordinated research teams within National Project such as Progetto Finalizzato Edilizia - Sottoprogetto "Processi e procedure" (Targeted Project on Building – Subproject "Processes and procedures), from 1992 to 1994; Progetto Strategico Aree Metropolitane e Ambiente, (Strategic Project Metropolitan Areas and Environment) from 1994 to 1995; PRIN project on the "Impacts of mobility policies on urban transformability, environment and property market" from 2011 to 2013. Principal investigator of the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II, from 2012 to 2015. Scientific Responsible Unit Dicea Project by Fondazione Cariplo "MOBILAGE. Mobility and aging: daily life and welfare supportive networks at the neighborhood level" 2018-2020. Scientific Responsible Unit TeMALab Dicea ERASMUS+ Key Action2: Project "Development of a Master Programme in the Management of Industrial Entrepreneurship for Transition Countries" (MIETC), partners: University of Santiago de Compostela (leading organization), University of Ljubljana, Academy of Science of Turkmenistan, Karaganda Economic University of Kazpotrebsouz. Author of more than 140 publications. Since 2008 Associate Editor of TeMA Journal of Land Use, Mobility and Environment.

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