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THE TIMES THEY ARE A-CHANGIN'

TeMA

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Land Use, Mobility and Environment

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Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

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

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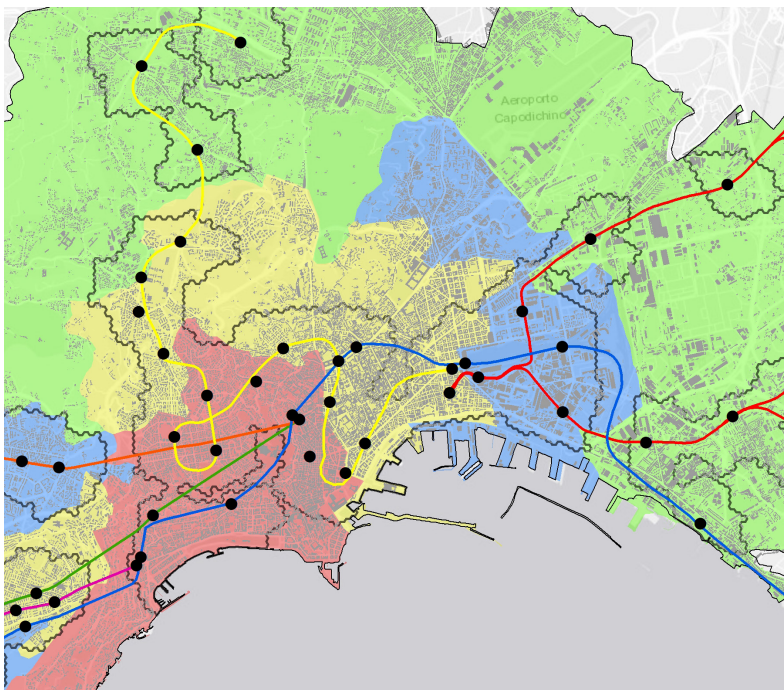
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LAND-USE AND TRANSPORT INTEGRATION POLICES AND REAL ESTATE VALUES

THE DEVELOPMENT OF A GIS METHODOLOGY AND THE
APPLICATION TO NAPLES (ITALY)

Gerardo Carpentieri^a, Carmen Guida, Paul Chorus^b

^a Department of Civil, Architectural and Environmental Engineering (DICEA)
University of Naples Federico II, Italy

^b Province Noord Holland

e-mail: {gerardo.carpentieri; carmen.guida}@unina.it; chorusp@noord-holland.nl

^a ORCID: <https://orcid.org/0000-0002-2111-650X>

ABSTRACT

The interactions between the Transport and the Land-Use Systems are complex and not widely analysed, causing uncertainties in decision-making processes. New governance tools are needed to support territorial transformations oriented to more sustainable use of soil resources, the transition towards more environmentally friendly transport modes and to greater accessibility equity to transport services. Moreover, these tools have to consider the interactions of external phenomena on the urban system, such as economic crisis and political issues. In this perspective, the research aims at developing a GIS-based methodology able to assess the impacts of interventions on the railway network and nodes on the urban environments, in terms of real estate values, as a proxy of urban requalification. The methodology consists of an ex-post spatial analysis procedure, applied to the city of Naples (Italy), where local and regional planning strategies, during the last decades, have been oriented towards an integrated approach between Transport and Land-Use Systems. The results show that in some catchment areas and concerning some types of properties, the effects of the world economic crisis on the real estate had less effect in terms of fall in prices. Moreover, the results show that the methodology is useful to quantitatively assess ex-post the main impacts of actions aimed at the integration between the Transport and Land-Use Systems, but its application could be extended to support the implementation of these strategies in different territorial context, on the basis of well-known best practices and their economic impacts on urban environment.

KEYWORDS:

Catchment Areas; Real Estate; GIS

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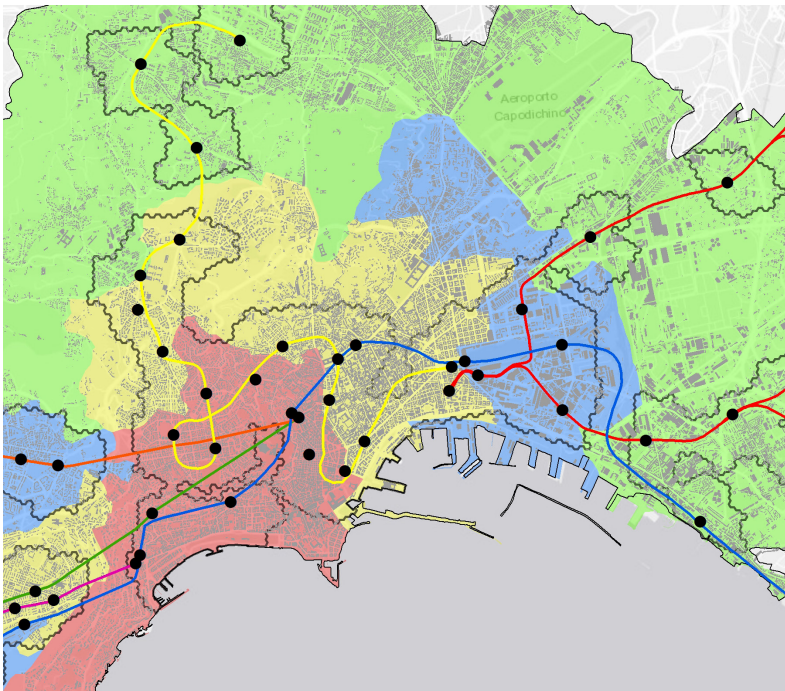
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老年人生活质量与城市可达性： 空间规划的方法建议

Gerardo Carpentieri^a, Carmen Guida, Paul Chorus^b

^a Department of Civil, Architectural and Environmental Engineering (DICEA)
University of Naples Federico II, Italy

^b Province Noord Holland

e-mail: {gerardo.carpentieri; carmen.guida}@unina.it; chorusp@noord-holland.nl

^a ORCID: <https://orcid.org/0000-0002-2111-650X>

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都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。

关键词：
老年人；空间规划；市可达；城市可达性

1 INTRODUCTION

The research is part of the scientific panorama related to the Integration of Land-Use and Transport System in decision-making processes focused on the sustainability of urban areas. The relationships between spatial organization of urban systems and transport systems are complex and not widely analysed (Deboosere et al., 2018; E. Papa & Bertolini, 2015; van Wee, 2002; Wegener & Fürst, 2004). Considering the main influences between the two subsystems, many topics need further insights, such as the sustainable use of soil resource, the effects of the transition towards more environmentally friendly transport modes, the economic crisis and issues related to a greater accessibility equity to transport services (Beyazit, 2015; Coppola & Nuzzolo, 2011; Te Brömmelstroet & Bertolini, 2010).

Even though decision-makers are now aware of the imperative to implement policies able to integrate land-use and transport planning policies, in practice it is difficult to define roles and their individual contribution as well as their nonlinear interactions, considering urban planning, transport engineering, mobility planning, etc. In view of the above, it is clear how urgent the development of new approaches and tools is, in order to quantitatively analyse the interactions between mobility and land-use domains.

The aim of this study is to develop an ex-post spatial analysis procedure, GIS-based, able to quantify, in terms of real estate values, the impacts in station areas, at micro and macro level, that have been recorded as results of the redevelopment and opening of new urban railway lines and stations, as well as of the development of urban requalification and transformation actions. This result will provide decision-makers and technicians an appropriate knowledge of the evolutive dynamics, to facilitate the decision-processes about the choice of right localization for investments, according to the interest of public authorities (improve the urban spaces and infrastructures) and to attract private investors. Moreover, a second objective is to apply the methodology to the Naples case study, in order to assess its effectiveness. The choice of this context has been prompted not only by its high urban and social complexity, but also by local and regional planning strategies (Piano delle 100 stazioni) which, during the last decades, have oriented their territorial policies towards an integrated approach between Transport and Land-Use (Cascetta et al., 2013; E. Papa, Carpentieri, & Angiello, 2018; E. Papa & Pagliara, 2006).

After this introduction, the rest of the paper is organised as follows. Section 2 outlines evidence from scientific literature of the land-use and economic impacts of urban rail investments. Section 3 describes Naples as a study case, with a focus on the GIS-based methodology that was implemented. Section 4 summarises the findings and highlights some further perspectives.

2 THE LITERATURE REVIEW

During the last decades, the growth of the number of people within urban areas resulted in an increased demand of new adapted spaces. In order to satisfy this increasing settlement request, areas characterized by a low residential density, marked mono-functionality and lack of services and infrastructures have been urbanized (Brueckner, 2000). The spread of this settlement has been promoted also by the wider use of private transport modes, that allowed a greater individual mobility freedom, causing several negative impacts on community and environment (Johnson, 2001; R. Papa & Mazzeo, 2014).

Demographic, economic and location dynamics have influenced the evolution of physical and morphological structures of urban areas, with negative impacts also for actors dwelling in this kind of contexts: (i) the unsustainable use of soil and of other unrenovable resources, the input of huge quantities of pollutants which generated negative consequences, locally and globally (Travisi et al., 2010); (ii) social exclusion phenomena linked to the lack of accessibility to services and opportunities, especially for more disadvantaged walks of life (Lucas, 2012).

In order to reduce these negative effects, decision-makers, researchers and technicians are working to guide future choices related to the urban and regional framework towards new solutions, capable to ensure a greater economic, social and environmental sustainability through practices which promote the integration of land use and transport. As highlighted by the scientific literature, practices focused on an integrated development appear to be key elements to guarantee a greater equity and sustainability to urban development actions (Duncan, 2010b; E. Papa & Pagliara, 2006; Ratner & Goetz, 2013). Examples of these actions are the realization of new urban transit lines and the physical and functional upgrading of existing ones, the improvement of accessibility levels and quality of the architectural environment and the implementation of measures to optimize the use of soil (Bonotti et al., 2015; Coppola & Nuzzolo, 2011; E. Papa & Coppola, 2012). The quantitative evaluation of socio-economic impacts related to the opening or improvement of the land-use and transport integrated projects was studied by several multidisciplinary researches (Dubé et al., 2011). These studies proposed different techniques, methods and tools to evaluate the direct and indirect impacts. Great interest was focused on the evaluation of impacts surrounding the transit and land-use integrated projects considering the different territorial contexts (urban, peri-urban, rural), the temporal evaluation time (ex-post and ex-ante) and typology of transport infrastructures (rail, metro, tram and bus).

In particular, the evaluation of economic impacts in terms of variation in real estate values was considered a fundamental issue to support the planning decision of the policymakers and investors. This issue has been deeply debated in the scientific panorama and numerous case studies were analysed, which confirmed theoretically and quantitatively these statements (Duncan, 2010a; E. Papa & Pagliara, 2006; Ryan, 1999). The main approaches are based on the assumption that saving money and time for movements influences the locational behaviour of landlords, investors, firms, and house-holds (Paul & Luca, 2011). From the quantitative point of view, it has been proved that there is a direct dependency between proximity to transport nodes and the increase of real estate values (Cervero & Kang, 2011). The preliminary research that started to study the relationships between accessibility and variation in real estate values are based on the studies developed by Alonso (1964); Mills (1972); Muth (1969). In order to define the extension of catchment area where we can evaluate the changes of real estate values related to the improvement of accessibility at a micro-scale, we did not use the simple measure of Euclidian distance from the node of transport that changes with the type of transport infrastructures (Gutiérrez & García-Palomares, 2008; E. Papa, Carpentieri, & Guida, 2018). For this study, we considered that the walking distance on the road is a more correct measure to define the catchment area extension, as it is more in line with reality. According to with the indications of 100 Station Plan, we took into consideration a maximum walking distance covered in eight and half minutes.

3 METHODS AND APPLICATION

The aim of the research is to develop a GIS-based methodology that allows to quantify temporal and spatial variations due to the policy impacts within railway station (urban and metropolitan lines) catchment areas, in urban contexts.. In order to quantify the resulting impacts of integrated Land-Use and Transport strategies, in terms of real-estate values, accurate data sources were needed. Two important criteria were considered in order to ensure the replication and the accuracy of the methodology application. In particular, open access data sources were selected so that public administrations, technicians and scholars, interested in analysing these phenomena, can easily apply the methodology. This is an important point to the dissemination of the GIS-based methodology to other academic and practical contexts. Another considered criterion concerning data choice is the scale of detail: the methodology is based on a micro-scale that requires a data aggregation for small territorial units.

According to the above criteria and the scientific literature, four different indicators were selected with respect to real estate values. The selected indicators, also used in other studies, allow to carefully evaluate how

immovable property values changed in time and space, within station catchment areas, as consequences of integrated interventions (Duncan, 2010a; Pagliara & Papa, 2011; E. Papa & Bertolini, 2015; Singh et al., 2014; Soria-Lara et al., 2015). In this study four property categories were identified to assess changes in real estate values (Residential, Tertiary, Commercial and Manufacturing). Typically, in these types of analysis the alphanumeric and spatial data are selected from different sources and characterized by a different spatial aggregation scale. In order to solve these problems a hexagonal spatial unit was introduced which allows to compare time series data (Carpentieri & Favo, 2017). The regular hexagonal shape has a 50 m side and 6,495 mq surface. The use of a regular grid is a very common technical and scientific solution in spatial phenomena studies (Yigitcanlar & Dur, 2010), since it helps comparing data computed and recorded for different spatial units and in different temporal moments. The use of the regular grid has allowed to compute variations in real estate rates linked to different territorial boundaries identified by Inland Revenue (Agenzia delle Entrate). The Inland Revenue is a national non-economic public agency that operates to collect tax revenues, inspections aimed at avoiding tax evasion, provides cadastral and geo-cartographic services. The data used to compute the variation in real estate values for each hexagonal cell is provided in euros per square meter and they are the output of a methodology developed by the Italian Inland Revenue and they are shared on the Agency website every six months. Within the municipal territory, uniform territorial zones are identified (OMI zones), and for each of them and for each property category, changes in market and rental values are assessed.

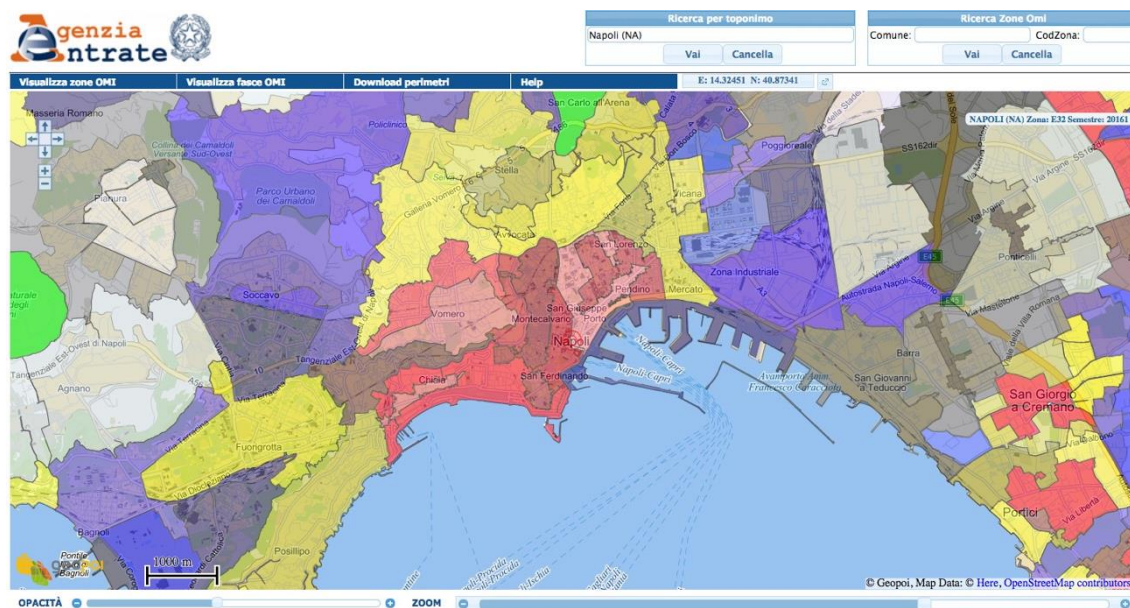


Fig. 1: Inland Revenue website page
Data provided by the Inland Revenue allowed to compute indicators for real estate values exclusively for the 2001-2011-time frame. However, in order to improve the analysis' accuracy, two other temporal moments were added i.e. 2004 and 2008. The introduction of these two additional moments permitted to better evaluate and interpret the impacts of the international economic crisis (2008), that has inevitably had an impact on real estate.

3.1 THE CASE STUDY OF NAPLES

The city of Naples was selected to apply and verify the reliability of the proposed methodology, in order to measure the real estate value impacts due to the implementation of policies aimed at integrating the Land-Use and the Transport Systems. Naples represents a significant case study to verify the GIS-based methodology's robustness, with almost 1 million inhabitants, population density of 8.273 inhab/kmq and about 500.000 of workers (ISTAT 2011). Naples is not a structured city: it is the sum of several cities, one inside the other, and balance is found through the ability to capture the new identities while keeping the well-adjusted socially static

nature (Punziano & Terracciano, 2017). Its characteristics, its shape and its history and its complexity and the clear coexistence of a variety of typical situations of degraded urban contexts, the city is a privileged laboratory in the study of urban development (Russo, 2012). The role of infrastructure is essential to manage these issues. Transport in particular, although requiring a system-wide and not a few investments, is a good basis for restarts (Gargiulo, 2008).

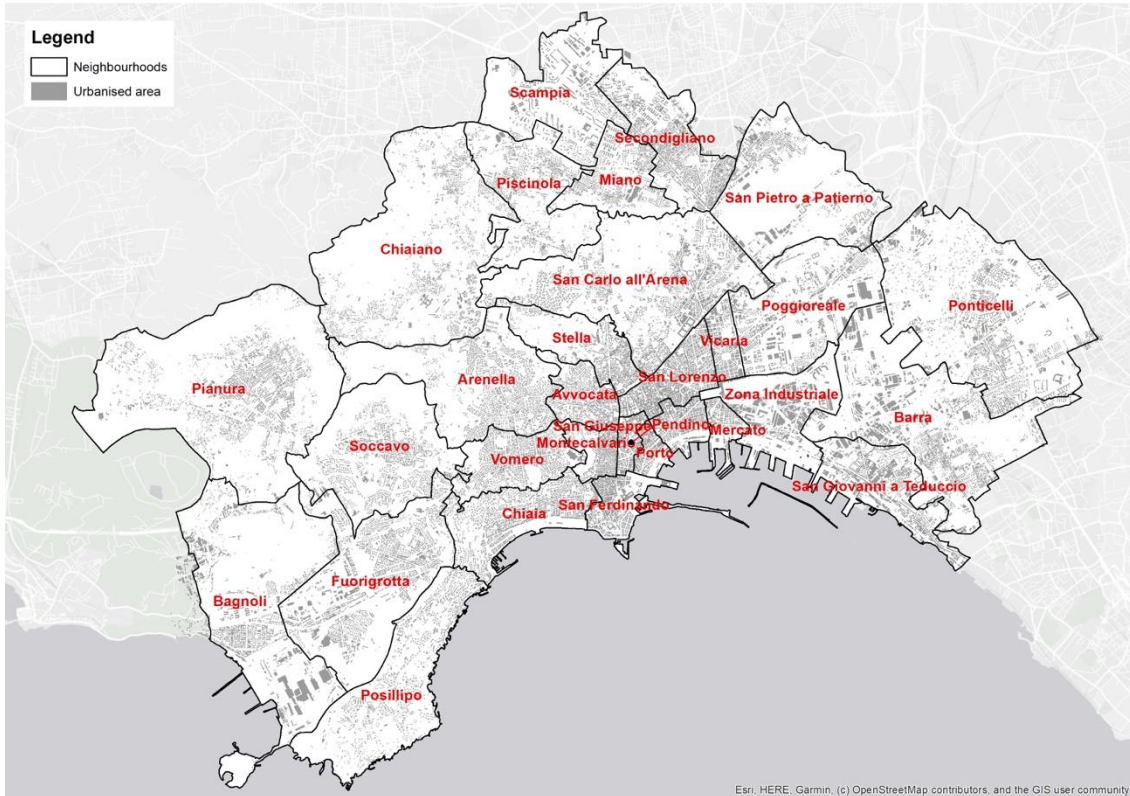


Fig. 2: The Municipal Territory of Naples, with the delimitation of each neighbourhood

A further element that influenced the choice of this case study is the knowledge of the socio-economic and settlement dynamics of the last decades (Fistola & Papa, 1998; R. Papa, 2010). This has proven extremely helpful in verifying the output of the application of the methodology. According to what is stated above, Naples is considered a good example for the implementation of integrated development policies, as demonstrated by the construction of new railway infrastructure (metro) accompanied by urban renewal interventions. The new offer of public transport services has prompted the regeneration of areas nearby transport nodes. The first programmatic document, developed by the city Municipality, was signed in 1994, and it explains the main reasons for orienting policy choices towards the integration between the Land-use and the Transport Systems. Following these general indications, in later years, the municipal administration developed further tools for the city government, such as the Municipal Transport Plan (1997), the Primary Road Network Plan (2000), the Railway Stations Plan (2003) and the Variant to the Municipal Master Plan (2004). At the same time, administrative authorities of Campania Region and Naples Metropolitan Area drafted and approved several legislative and programmatic documents, such as the Regional Law for the Mobility System Reform (2002) and the proposal of Provincial Territorial Coordination Plan (2007), that further favoured the implementation of Transport and Land-Use integration strategies. The *trait-d-union* of these documents was the will to link the transformations of urban fabric to the construction of new railway infrastructures. One of the emerging and innovative elements is the role of the public transport network which has to promote the upgrading of urban and rural areas (Cascetta & Pagliara, 2008). The whole Naples Metropolitan area has attracted large

investments concerning the building of new railway lines and modal interchange stations, thanks to this new integrated approach. This has led to an increase in urban accessibility levels, notably within stations catchment areas, promoting transformation processes that concerned large parts of the city. In the Norme di Attuazione (Implementing Rules), the new City Master Plan identifies a specific urban framework (Ambito n. 30) that includes stations as interchange nodes. These rules govern the possibility of interventions in order to allow “the greatest accessibility to the areas served , building renewal, traffic conditions and the introduction of new functions and activities that could be the engine for new commercial activities, aimed at the exploitation of interconnection places” (Comune di Napoli, 2004).

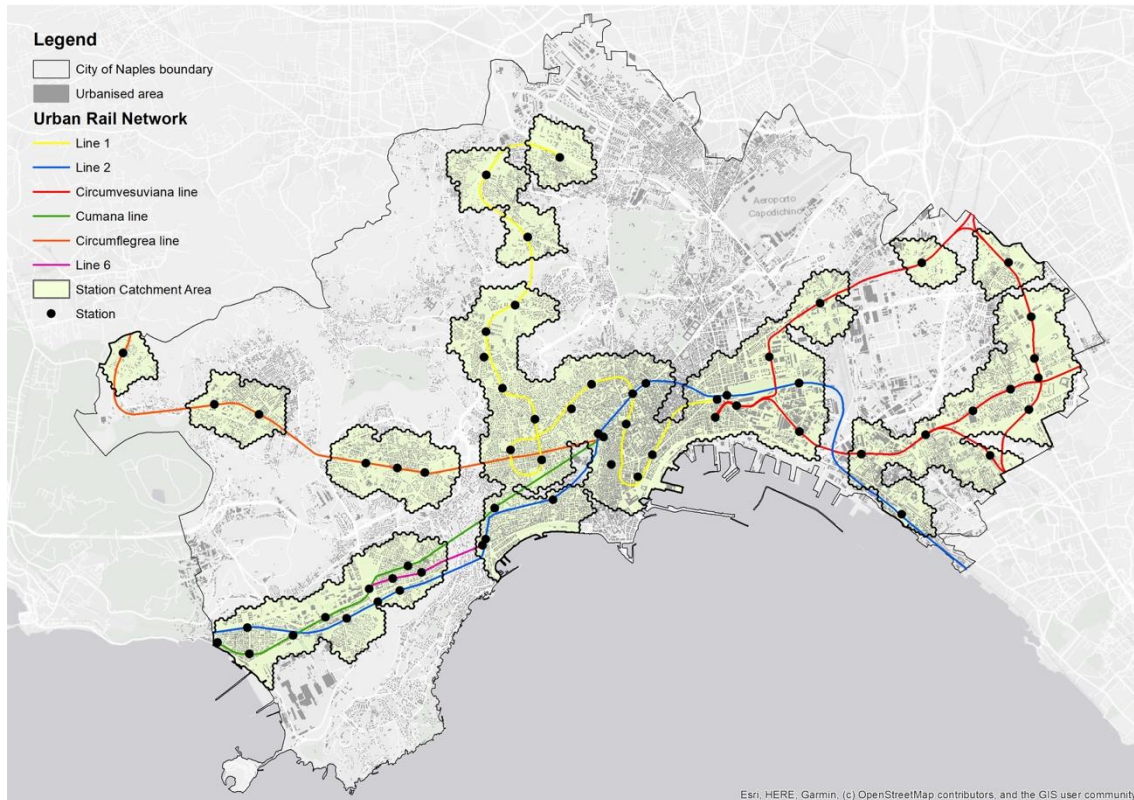


Fig. 3: Urban railway lines and stations in the city of Naples

RAILWAY LINE	NUMBER OF STATIONS	POPULATION	WORKERS	LOCAL UNITS
Line 1	18	464,594	251,487	55,823
Line 2	10	180,509	72,717	18,417
Circumvesuviana	16	162,676	71,614	13,673
Cumana	8	126,491	39,289	10,666
Circumflegrea	7	107,084	21,476	7,087
Line 6	4	70,477	24,889	7,298
Network	62	1,111,833	481,471	112,965

Tab. 1 Data referring to railway infrastructure and socio-economic characteristics, for each railway station catchment area within Naples. The data was computed from ISTAT census 2011

The main indications of the City Master Plan have been further worked out in the 100 Stations Plan, which identifies for each station its role in promoting urban redevelopment (Napoli, 2003). The principal innovation of this plan is that the renewal of urban environment is led by interventions in the railway transport network, concerning both the level of service and its building stock. The plan is focused on some significant aspects, such as the architectural and functional quality of railway stations buildings and nearby areas, that makes

these places more accessible and capable of taking new activities in. Moreover, the plan considers that not every station has the same accessibility level and that there are many contributing aspects making them distinctive from each other, such as the topography of the city, their location, the presence of infrastructure barriers, the distance to residences and, more in general, to places of interest from transport nodes (E. Papa & Trifiletti, 2010). These features mostly characterize those stations located in remote areas (architectures from 1950 and 1960, illegal (unauthorised) buildings from 1980 and 1990 or social housing), since they are distant from residences and urban facilities, and not easily accessible from the principal road network (ANCE, 2004). A key-element is the pedestrian accessibility, that is computed as the average time of access to stations, equal to eight and half minutes (Napoli, 2003). The plan describes catchment areas around railway stations and identifies several potential interventions, such as:

- Interventions on existing station buildings, in order to provide new entrances and to serve densely populated areas that suffer a steep topography, infrastructure barriers, a poor building refurbishment and renewal that should make existing constructions adequate to the mandatory removal of architectural barriers and fire safety;
- Interventions on traffic conditions around stations, through the reduction of crossings on high volume roads, the renewal of the pedestrian environment, the construction of new roads to reduce distances towards station entries;
- Third-party interventions, promoted by landlords and/or the managers of activities of public interest located in stations catchment areas, which aim at removing existing barriers to access points to the public transit network;
- Interventions to increase intramodality, through the realization of interchange parking, bus terminals for urban, rural and tourist routes.

The integrated and planned actions concern the whole municipal territory, which was divided in urban sections, as proposed by the Inland Revenue (Agenzia delle Entrate), in order to better analyse the impacts produced during last years. This territorial division was introduced by the Inland Revenue as part of studies concerning real estate values, through the detection of different areas, on the basis of their geographical location within municipal boundaries, their urban structure and the prevalent type of building (Central, Semi central, Inner Urban and Suburban zones). Figure 3(?) and table 2 show the data analysed for each urban section: the population was computed as the total number of served users, computed as the sum of the population for each cell within each station catchment area. Therefore, it is worth noting when analysing central areas there is an overlap of stations catchment areas, which are part of different railway lines. In other words, the residential population of a cell is counted twice if the cell is situated in more than one station catchment area.

URBAN ZONE	POPULATION	JOBS	WORKING UNITS
Central	204,038	84,800	26,604
Semi Central	272,387	115,458	24,186
Inner Urban	120,865	53,244	8,911
Suburban	359,570	61,488	12,444
City of Naples	956,919	314,995	72,145

Tab. 2 Data refers to 2011, for each urban section (Data processing from ISTAT 2011)

In order to verify the existence of different users' behaviours deriving from integrated actions, this study compares each indicator computed for a station catchment area with a similar type of areas outside the station catchment area.

The following paragraphs show the main results concerning indicators computed in four different temporal moments (2001, 2004, 2008, 2011), for residential, commercial, tertiary and manufacturing properties located in Naples. The first and last year correspond with the dates of the last Italian national census surveys. The

other two years are selected as intermediate time points but considering that in 2008 the global crisis of real estate started.

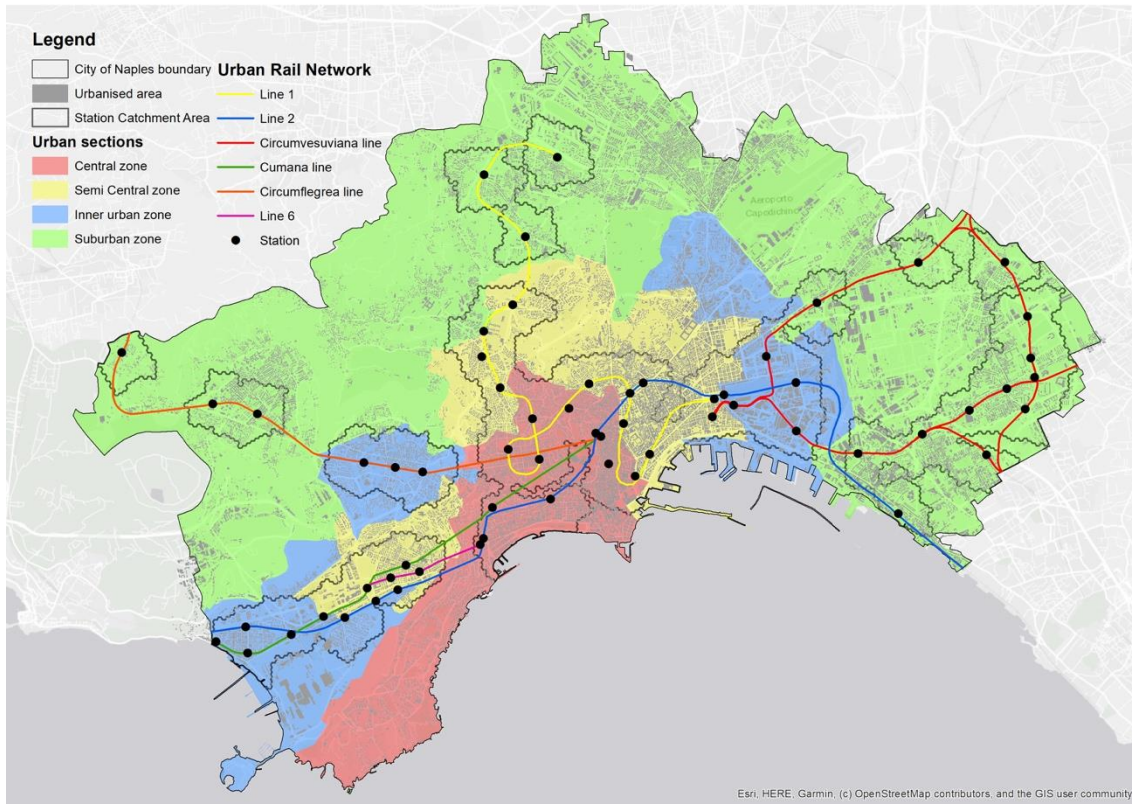


Fig. 4: Municipal division according to four urban sections identifies by the Inland Revenue

4 RESULTS AND ANALYSIS

In the following paragraphs, we present and discuss the results obtained through the application of the developed GIS-based methodology at the city of Naples for the four different category properties (Residential, Tertiary, Commercial and Manufacturing).

4.1 RESIDENTIAL PROPERTIES

This subparagraph shows the main results of the methodology applied for residential properties in Naples, with the support of tables and graphs that highlight the variation in prices of real estate, between 2001 and 2011. Analysing the values shown in Fig. 5 and Fig. 6, the trend of real estate values for each railway line is very similar to the trends recorded for the whole city. The only exceptions is the Circumvesuviana that had an upward between 2001 and 2011. Moreover, it is worth noting that values for residential properties located nearby line 1 stations recorded a greater decrease between 2008 and 2011, compared to other lines. This phenomenon is probably due to a poorer resilience to the 2008 economic crisis for these city areas. The Fig.6 shows the values for the Circumflegrea stations, and those located in General urban (Piave, Traiano and Soccavo) and Sub-urban (La Trencia, Pianura and Pisani) zones have the better performances compared to Montesanto station, which is in the central zone, according to Inland revenue classification. Tab. 3 shows that between 2008 and 2011 the only line that recorded an increase of real estate variation on prices is Circumvesuviana. For what concerns data related to the whole analysis period (2001 – 2011), it was observed that Circumflegrea shows in the residential real estate values, nineteen percentage points over the city mean. From the period 2008 to 2011 the general impact of the world economic crisis is evident, and it is related to the real estate market, whose consequences influences also this territorial context.

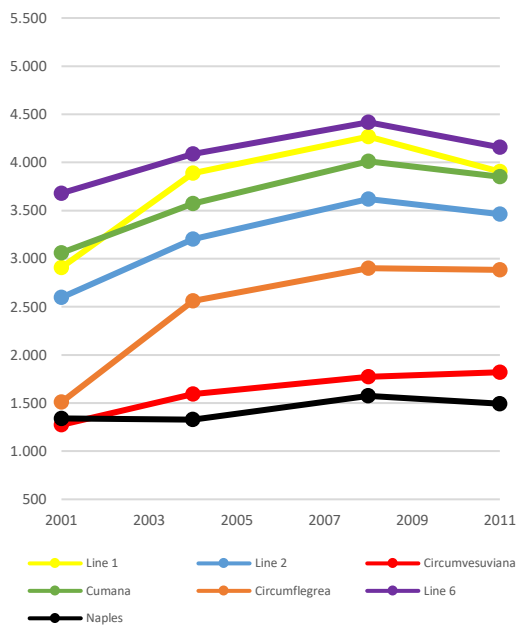


Fig. 5: Variation in Euro of residential average property values in the catchment areas for urban railway lines in the city of Naples.

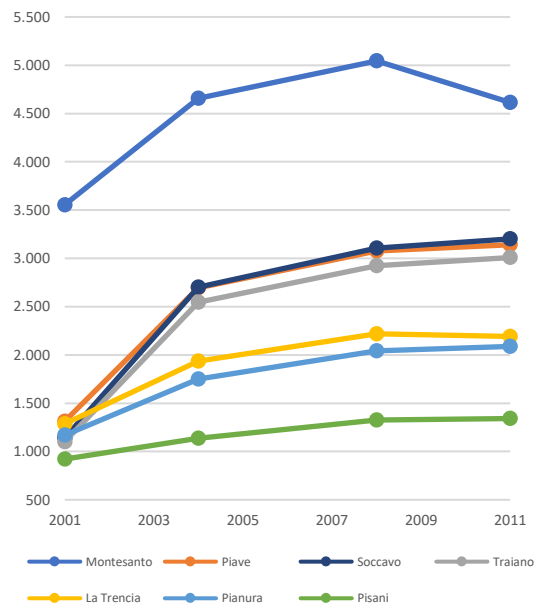


Fig. 6: Variation in Euro of residential average property values in the catchment areas for the Circumflegrea stations.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2005-2008	2008-2011	2001-2011
Line 1	2,908	3,888	4,268	3,904	25%	9%	-9%	26%
Line 2	2,597	3,204	3,619	3,461	19%	11%	-5%	25%
Circumvesuviana	1,274	1,595	1,772	1,820	20%	10%	3%	30%
Cumana	3,061	3,573	4,011	3,851	14%	11%	-4%	21%
Circumflegrea	1,509	2,562	2,901	2,883	41%	12%	-1%	48%
Line 6	3,680	4,086	4,417	4,158	10%	7%	-6%	11%
City of Naples	1,768	2,299	2,563	2,473	23%	10%	-4%	29%

Tab. 3 Comparison between real estate variations in prices for each railway line, within Naples Municipality

STATION	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Botteghelle	1,087	1,489	1,687	1,733	27%	12%	3%	37%
Madonnelle	987	1,352	1,532	1,574	27%	12%	3%	37%
Argine Palasport	750	1,025	1,160	1,193	27%	12%	3%	37%
Villa Visconti	927	1,179	1,343	1,447	21%	12%	7%	36%
Vesuvio De Meis	1,082	1,331	1,520	1,672	19%	12%	9%	35%
Bartolo Longo	1,043	1,313	1,497	1,623	21%	12%	8%	36%
Officine Ponticelli	1,118	1,508	1,710	1,775	26%	12%	4%	37%
Ponticelli	1,221	1,558	1,769	1,898	22%	12%	7%	36%
Ponticelli Neighbourhood	972	1,276	1,448	1,527	24%	12%	5%	36%
Suburban zone	949	1,201	1,376	1,436	21%	13%	4%	34%

Tab. 4 Comparison between real estate variations in price, for residential properties, for some Circumflegrea stations in Ponticelli neighbourhood

More, the best performances in terms of percentage change have been seen for railway stations located in the Ponticelli neighbourhood (Tab. 4): data show that some stations had nearly double increases of real estate

values compared to others in the same neighbourhood or urban zone, within their catchment areas. These results could be explained as a consequence of an increased number of heterogeneous activities within the neighbourhood (functional mix) and of workers. Based on ISTAT census data from 2001 and 2011, population and workers density were computed for each station catchment zone and both of them respectively average increase of almost 10% and 5%, during the analysis period (2001 – 2011). These positive variations of the real estate values depend to great extent of the investments to improve the urban accessibility and by localization of some new urban important services by public authorities (e.g. Del Mare Hospital, Sports and Instruction structures). Unresolved remains the effective participation of private investors should be encouraged in this neighbourhood.

4.2 COMMERCIAL PROPERTIES

This subparagraph refers to the changes in real estate values in prices, between 2001 and 2011, for commercial properties in Naples. As is shown by the graphs and tables, it is possible to note a common decreasing trend between 2004 and 2011, for each line and for the whole city. This trend is also found when analysing the three stations of line 1 presented in Fig. 8. The last period of analysis (2008 – 2011) presented a lower reduction in percentual variations of real estate values compared to the urban centre zone. Moreover, the same stations recorded for the whole period 2001 – 2011 a successful increase of real estate values, greater than other stations of Line 1.

Looking at Tab. 5 in more detail, a 21% decrease of commercial property values may be observed for line 2, while Circumvesuviana and Cumana lines recorded a minor reduction during the observation interval. The only railway line that shows a positive change in real estate values for this property category is line 6. This positive result is influenced exclusively to the catchment area of Mergellina station that in these years becomes a place very attractive for commercial activities.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Line 1	1,663	1,557	1,550	1,444	-7%	0%	-7%	-15%
Line 2	3,983	4,580	3,967	3,304	13%	-15%	-20%	-21%
Circumvesuviana	2,902	3,583	3,259	2,868	19%	-10%	-14%	-1%
Cumana	1,582	1,665	1,693	1,561	5%	2%	-8%	-1%
Circumflegrea	3,467	3,901	3,466	3,073	11%	-13%	-13%	-13%
Line 6	2,105	2,753	2,565	2,394	24%	-7%	-7%	12%
City of Naples	2,240	2,396	2,240	2,006	7%	-7%	-12%	-12%

Tab. 5 Comparison between commercial properties values within observation interval

The values reported in Tab. 6 shows that the commercial real estate values are negative within the line 2 station catchment areas, except for Gianturco, Piazza Amedeo and Mergellina. The results of Piazza Amedeo and Mergellina are significant since they are diametrically opposed to the performance of the urban zone where they are both located (Semi Central zone) but confirm (as the results of Line 6) that these two specific catchment areas are particularly targeted for the commercial sector.

They are characterized by a strong and high-level residential vocation and the reason for their performance in terms of commercial properties could be found in the increased number of local units, especially of luxury retail trade. For what concerns Gianturco, during the last decades, it attracted large investments to localization some large wholesale shops, since it is at the east edge of the city in the proximity of the port and highway exits. This may explain the increase of commercial properties' values around Gianturco railway station.

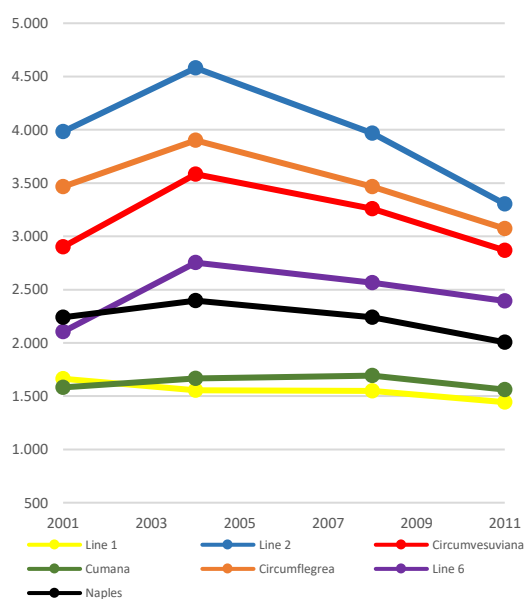


Fig. 7: Variation in Euro of commercial average property values in the catchment areas for urban railway lines in the city of Naples.

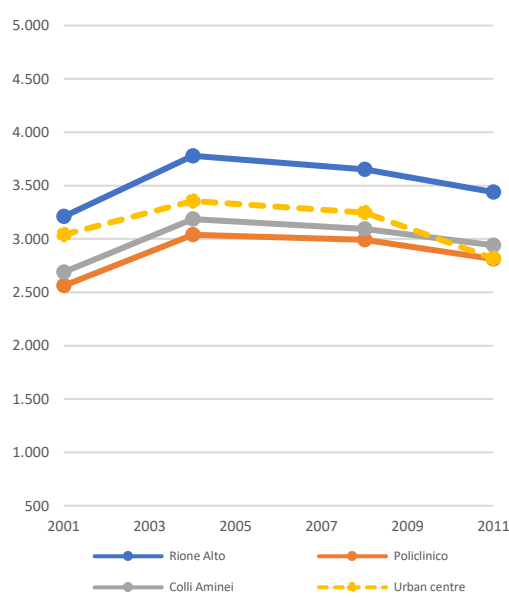


Fig. 8: Variation of commercial average property values in the catchment areas of Line 1 stations in Urban centre zone.

STATIONS	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Napoli San Giovanni Barra	1,551	1,734	1,697	1,564	11%	-2%	-9%	1%
Gianturco	1,408	1,452	1,738	1,708	3%	16%	-2%	18%
Piazza Garibaldi +	2,673	2,522	2,694	2,430	-6%	6%	-11%	-10%
Piazza Cavour +	2,898	3,298	3,123	2,569	12%	-6%	-22%	-13%
Central zone	3,040	3,356	3,247	2,816	9%	-3%	-15%	-8%
Montesanto FS +	4,185	5,190	4,538	3,856	19%	-14%	-18%	-9%
Piazza Amedeo +	2,959	6,987	5,556	4,618	58%	-26%	-20%	36%
Napoli Mergellina +	4,169	6,613	5,576	4,693	37%	-19%	-19%	11%
Semi Central zone	5,308	5,430	4,611	3,924	2%	-18%	-17%	-35%
Piazza Leopardi	3,234	3,710	3,319	3,037	13%	-12%	-9%	-6%
Napoli Campi Flegrei +	3,230	3,600	3,229	2,998	10%	-11%	-8%	-8%
Urban Center zone	3,040	3,356	3,247	2,816	9%	-3%	-15%	-8%
Cavalleggeri Aosta	2,609	3,100	2,762	2,463	16%	-12%	-12%	-6%
Bagnoli-Agnano Terme	3,728	2,817	2,699	2,483	-32%	-4%	-9%	-50%
Inner Urban Zone	1,726	1,838	1,806	1,708	6%	-2%	-6%	-1%

Note: + Interchange Stations.

Tab. 6 Comparison between commercial properties values for some line 2 stations

4.3 TERTIARY PROPERTIES

This subparagraph is dedicated to the changes in real estate values, between 2001 and 2011, for tertiary real estate in Naples, properties used to service activities for businesses and people, such as professional offices and to private facilities such as clinics, schools and training centres (D.Lgs. 1150/1942 – Legge Urbanistica). Tab. 7 shows the results of the methodology highlighting a significant increase in prices of tertiary properties between 2001 and 2011, but, focusing on 2008-2011 period, the economic crisis had impacts on this category for nearly every line and within the whole city with a significant decrease. However, Circumvesuviana and Circumflegrea recorded a better presentation than the other lines because these peripheral areas became

more attractive for the tertiary activities considering the low real estate value compared to the central areas and the improvement of urban accessibility.

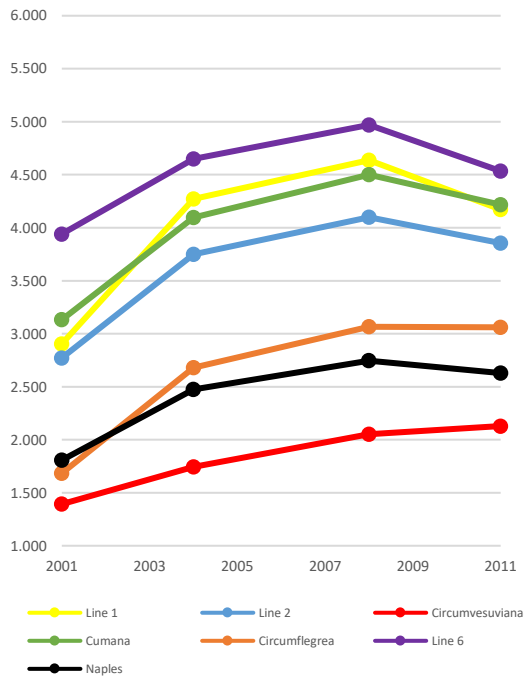


Fig. 9: Variation in Euro of tertiary average property values in the catchment areas for urban railway lines in the city of Naples.

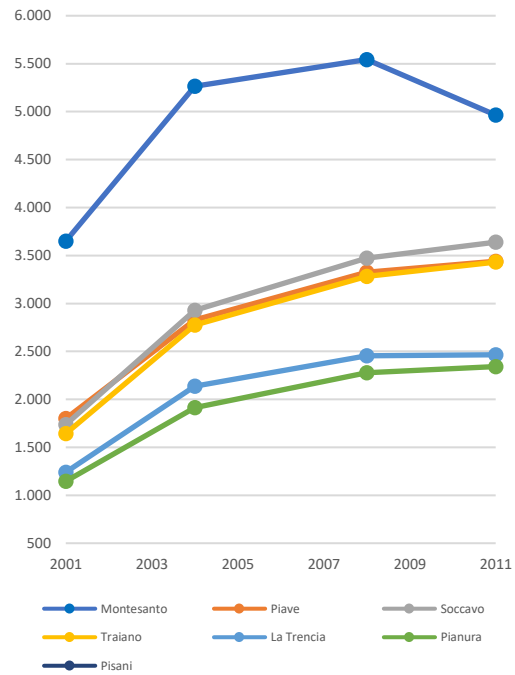


Fig. 10: Variation in Euro of tertiary average property values in the catchment areas of Circumflegrea line.

Tab. 7 shows in more detail the results of the methodology and it is worth noting that line 1 and line 6 recorded the greatest reduction in prices between 2008 and 2011. As stated above, Circumvesuviana is the only line whose stations catchment area have seen an increase between 2008 and 2011.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Line 1	2,905	4,272	4,637	4,171	32%	8%	-11%	30%
Line 2	2,772	3,749	4,099	3,856	26%	9%	-6%	28%
Circumvesuviana	1,393	1,745	2,051	2,129	20%	15%	4%	35%
Cumana	3,132	4,097	4,500	4,217	24%	9%	-7%	26%
Circumflegrea	1,684	2,682	3,066	3,062	37%	13%	0%	45%
Line 6	3,941	4,649	4,970	4,534	15%	6%	-10%	13%
City of Naples	1,807	2,474	2,745	2,628	27%	10%	-4%	31%

Tab. 7 Comparison between tertiary properties values within observation interval

Napoli Porta Nolana and Garibaldi EAV are the only Circumvesuviana stations that recorder a negative variation in tertiary properties' prices after the 2008 world economic crisis, and they are the only stations located in Semi-Central zone (Tab.8). This negative effect may be explained as a consequence of economic crisis and the consecutive bank close: the most widespread tertiary activities in Napoli Porta Nolana and Garibaldi EAV catchment areas are banking services. All the suburban stations, apart from Poggioreale, recorder higher values that the average for that urban section.

STATION	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Napoli Porta Nolana	2,823	3,309	3,694	3,404	15%	10%	-9%	17%
Garibaldi EAV +	2,178	2,499	2,888	2,825	13%	13%	-2%	23%
Semi Central Zone	2,922	3,597	3,949	3,610	19%	9%	-9%	19%
Via Gianturco	1,618	1,683	1,992	2,190	4%	16%	9%	26%
Centro Direzionale	2,172	2,735	3,209	3,280	21%	15%	2%	34%
Inner Urban Zone	1,412	1,918	2,248	2,309	26%	15%	3%	39%
San Giovanni a Teduccio	1,266	1,739	2,117	2,233	27%	18%	5%	43%
Barra	1,210	1,663	1,996	2,069	27%	17%	4%	42%
Santa Maria del Pozzo	1,151	1,581	1,915	1,990	27%	17%	4%	42%
Poggioreale	1,816	1,867	1,824	2,010	3%	-2%	9%	10%
Botteghele	1,127	1,547	1,888	1,966	27%	18%	4%	43%
Madonnelle	1,024	1,405	1,714	1,785	27%	18%	4%	43%
Argine Palasport	777	1,066	1,300	1,354	27%	18%	4%	43%
Villa Visconti	931	1,241	1,506	1,610	25%	18%	6%	42%
Vesuvio De Meis	1,072	1,409	1,706	1,845	24%	17%	8%	42%
Bartolo Longo	1,043	1,384	1,679	1,801	25%	18%	7%	42%
Officine Ponticelli	1,152	1,571	1,915	2,006	27%	18%	5%	43%
Ponticelli	1,227	1,638	1,987	2,117	25%	18%	6%	42%
Suburban Zone	924	1,215	1,434	1,500	24%	15%	4%	38%

Note: + Interchange stations.

Tab. 8 Comparison between tertiary properties values within observation interval, for Circumvesuviana stations

4.4 MANUFACTURING PROPERTIES

This paragraph analyses the main results of the methodology applied for manufacturing properties in Naples, within railway station catchment areas and their changes in prices between 2001 and 2011.

LINE	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Line 1	2,563	2,670	3,084	2,745	4%	13%	-12%	7%
Line 2	1,610	2,003	2,412	2,168	20%	17%	-11%	26%
Circumvesuviana	800	813	1,088	1,095	2%	25%	1%	27%
Cumana	1,589	2,085	2,311	2,167	24%	10%	-7%	27%
Circumflegrea	1,176	1,382	1,630	1,686	15%	15%	3%	30%
Line 6	1,970	2,139	2,361	2,292	8%	9%	-3%	14%
City of Naples	1,340	1,328	1,575	1,492	-1%	16%	-6%	10%

Tab. 9 Comparison between manufacturing properties values within observation interval

The average values of Tab. 9 and Fig. 11 show that stations of Line 2, Circumvesuviana, Cumana and Circumflegrea recorded a high increase when compared to other stations. Analysing the values for each station showed significantly increased for the stations localized in the periphery areas (Inner urban zone and Suburban zone) that are become more adequate for this category of activities (more accessibility and transformable areas). In the last temporal interval, 2008-2011, Circumvesuviana confirmed as the line that is the least affected by the impacts of the economic crisis as in the other categories of properties.

According to Fig. 12, line 1 stations in semi central urban sections, in the last observation period, are characterized by an even higher increase compared to other stations in the same urban section. Analysing data from Tab. 9, manufacturing properties recorded significant increases for all lines, with the exception of

line 1 that only increase of 7%. This result is mainly influenced by the conformation of urban structure around the station nodes is not adequate for this type of activity. Looking at Tab.10 it is worth noting that those Circumvesuviana stations located in peripheral sections, for this real estate category, had better performances rather than central stations. Moreover, for almost all stations, the values of manufacturing properties are higher than the average value of each urban section.

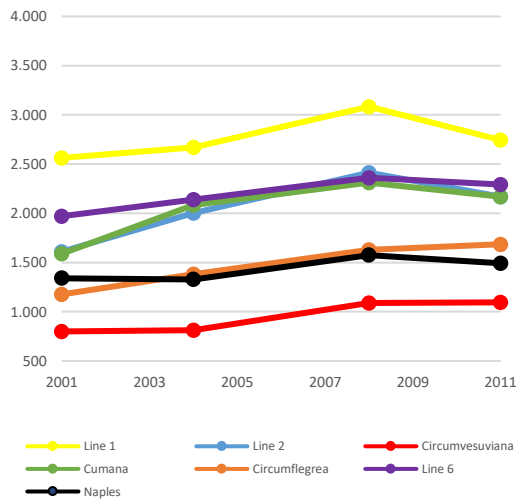


Fig. 11: Variation in Euro of manufacturing average property values in the catchment areas for urban railway lines in the city of Naples.

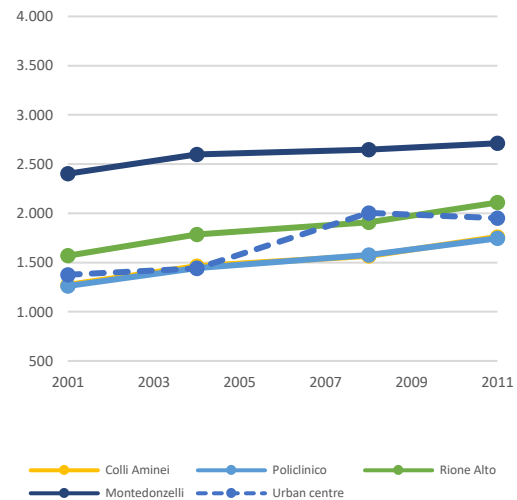


Fig. 12: Variation in Euro of manufacturing average property values in the catchment areas of Line 1 stations in Urban centre zone.

STATION	PROPERTIES VALUES [€/mq]				VARIATION [%]			
	2001	2004	2008	2011	2001-2004	2004-2008	2008-2011	2001-2011
Montesanto +	3,359	3,569	4,080	3,547	6%	13%	-15%	5%
Corso Vittorio Emanuele	3,289	5,755	6,151	4,819	43%	6%	-28%	32%
Central zone	4,399	3,888	4,175	3,514	-13%	7%	-19%	-25%
Fuorigrotta	1,683	1,723	1,919	2,052	2%	10%	6%	18%
Mostra +	1,522	1,526	1,672	1,844	0%	9%	9%	17%
Zoo-Edenlandia	986	1,376	1,518	1,552	28%	9%	2%	36%
Semi Central zone	1,376	1,441	2,004	1,952	5%	28%	-3%	30%
Agnano	582	1,163	1,300	1,302	50%	11%	0%	55%
Bagnoli	578	1,018	1,141	1,173	43%	11%	3%	51%
Dazio	641	1,193	1,403	1,432	46%	15%	2%	55%
Inner Urban zone	705	870	1,017	1,079	19%	14%	6%	35%

Note: + Interchange stations.

Tab. 10 Comparison between manufacturing properties values within observation interval, for Circumflegrea stations

5 CONCLUSIONS

This study concerns the development of an ex-post methodology useful to quantify the impacts of Transit-Oriented policies on the Land-Use System: the mutual interactions between the two systems make it difficult to quantify their social, economic and territorial effects in the government of territorial transformation process. The city of Naples represents an interesting case study considering the implementation of several tools developed by the local administrations (municipality, provincial and regional) in order to improve the quality of both the level of public transport service and the urban environment. The results presented in this paper further support the scientific assumption whereby the introduction of rail transit investment brings benefits to

the transportation system and to the accessibility of the population to employment, retail, and recreational activities (Pagliara & Papa, 2011). Similarly, the main results also confirm the policy strategy and objective: increase the accessibility to rail transit nodes, improving architectural and urbanistic quality of built environment within station buildings and their catchment areas. The municipal administration also aims at reducing the environmental damage of the rail infrastructure and its neighbourhoods (Napoli, 2003). This study is focused on the impacts on real estate values around transit nodes and within their catchment areas, but still points of reflection could be studied such as the impacts in social, generational and gender equity, safety and security perceptions. The results for the city of Naples showed that in some catchment areas and for some types of properties the effects of the world economic crisis of real estate had less effect in terms of reduction of the prices. Moreover, the results show that the methodology is useful to quantitatively assess ex-post the main impacts of actions aimed at the integration between the Transport and Land-Use Systems, but its application could be extended to support the implementation of these strategies in different territorial context, on the basis of well-known best practices and their economic impacts on urban environment. This study could be further developed by extending the analysis period and including more recent data, in order to quantify the impacts of 2008 global crisis on real estate values over the years. Moreover, different indicators may be selected to assess and quantify the main impacts of integrated transport and land-use policies on the urban environment: increased accessibility and employment, as two examples of improvement of quality of life within transport node catchment areas.

AUTHOR CONTRIBUTIONS

Paragraph 1, 3 and 4, Gerardo Carpentieri; Paragraph 2, 3 and 5 Carmen Guida; Paul Chorus has made substantial contributions to the essay's improvement, design, and conclusions.

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AUTHOR'S PROFILE

Gerardo Carpentieri is an Engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II and Research Fellow of Land Use Planning at the Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Carmen Guida is a Ph.D Student in Civil Systems Engineering Hydraulic and Transportation Systems Engineering at Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Paul Chorus is an urban planner with a PhD-degree in urban planning from the University of Amsterdam. Currently he is working for the province of Noord-Holland in the Netherlands as a policy advisor on transit-oriented development.